

Of Mice and Men: What Animal Research Can Tell Us About Context Effects on Automatic Responses in Humans

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Abstract

Automatic responses play a central role in many areas of psychology. Counter to views that such responses are relatively rigid and inflexible, a large body of research has shown that they are highly context-sensitive. Research on animal learning and animal behavior has a strong potential to provide a deeper understanding of such context effects by revealing remarkable parallels between the functional properties of automatic responses in human and nonhuman animals. These parallels involve the contextual modulation of attitude formation and change (automatic evaluation), and the role of contextual contingencies in shaping the particular action tendencies in response to a stimulus (automatic behavior). Theoretical concepts of animal research not only provide novel insights into the processes and representations underlying context effects on automatic responses in humans; they also offer new perspectives on the interface between affect, cognition, and motivation.

Keywords

automaticity, animal behavior, attitudes, context effects, situated cognition

The capacity to quickly respond to objects and events in the environment is essential for any living organism. Thus, it does not come as a surprise that many areas of psychology share a common interest in the causes and consequences of automatic responses (Bargh, & Chartrand, 1999; Ferguson & Zayas, 2009; Klauer, 2009). For example, various theories of prejudice attribute a central role to automatic responses in explaining ongoing conflicts between social groups despite the increased endorsement of egalitarian values (Gawronski, Brochu, Sritharan, & Strack, 2012). Similarly, research on interpersonal relations has identified automatic responses as a major factor in the initiation, maintenance, and dissolution of romantic relationships (Baldwin, Lydon, McClure, & Etchison, 2010). In applied areas, automatic responses have been shown to contribute to various psychopathologies (Roefs et al., 2011) and to influence a broad range of choices in the domains of health-related behavior (Hofmann, Friese, & Wiers, 2008), consumer behavior (Perkins & Forehand, 2010), and political decision making (Nosek, Graham, & Hawkins, 2010).

A common assumption in research on automatic responses is that they are relatively rigid and inflexible. Counter to this assumption, however, an accumulating body of research suggests that automatic responses can be highly context-sensitive, such that the same object may elicit different responses depending on the environment in which it is encountered (for reviews, see Blair, 2002; Gawronski & Sritharan, 2010).

Yet, the psychological underpinnings of such context effects are still not well understood. The main goal of the current article is to illustrate how animal research can provide a deeper understanding of the processes and representations underlying context effects on automatic responses in humans. Drawing on a review of various parallels between automatic responses in human and nonhuman animals, we argue that theories of animal behavior offer a useful framework for understanding (a) the contextual modulation of attitude formation and change in humans (automatic evaluation) and (b) the role of contextual contingencies in shaping the particular action tendencies in response to a stimulus (automatic behavior).

Toward this end, we first discuss the insights that can be gained from animal research to understand the contextual modulation of automatic evaluation in humans. Expanding on this discussion, we illustrate how animal research can inform us about how contextual contingencies shape the particular action tendencies (e.g., fight vs. flight) that reflect a positive or negative appraisal of a stimulus. The reviewed

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insights are then used to provide a conceptual integration of affective, cognitive, and motivational factors in the production of automatic responses. In the final section, we note potential limitations of animal research to understand automatic responses in humans, highlighting the significance of comparative approaches that consider both commonalities and differences between human and nonhuman animals.

Contextual Modulation of Automatic Evaluation

Although the notion of unreflected, impulsive responses has guided theorizing about the human mind for centuries (cf. Strack & Deutsch, 2004), the amount of empirical research in this area has increased exponentially with the development of measurement procedures that have been particularly designed to capture automatic evaluative responses (Gawronski & Payne, 2010). Examples include Fazio, Sanbonmatsu, Powell, and Kardes's (1986) evaluative priming task and Greenwald, McGhee, and Schwartz's (1998) implicit association test (IAT), which represent the most prominent exemplars in the toolbox of currently available instruments (for an overview, see Gawronski & De Houwer, in press). The procedural details of these measurement instruments, commonly described as *implicit measures*, are extensively reviewed elsewhere (e.g., Gawronski, Deutsch, & Banse, 2011; Teige-Mocigemba, Klauer, & Sherman, 2010; Wentura & Degner, 2010), and we, therefore, refrain from discussing method-related issues. For the purpose of the current article, it suffices to note that implicit measures of evaluation are characterized by the shared features that (a) participants are not required to evaluate the relevant target object, (b) participants are typically instructed to respond quickly, and (c) responses on implicit measures are less susceptible to strategic control than traditional self-report measures. In this sense, evaluative responses captured by implicit measures can be described as automatic in the sense that they are unintentional, fast, and difficult to control (cf. De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009).

A puzzling finding in early research using implicit measures was that automatic evaluations showed varying levels of resistance against experimental manipulations designed to change attitudes. Whereas some studies suggested that changes in automatic evaluations are more difficult to achieve than changes in self-reported, deliberate evaluations (e.g., Gawronski & Strack, 2004; Gregg, Seibt, & Banaji, 2006; Petty, Tormala, Briñol, & Jarvis, 2006; Rydell, McConnell, Strain, Claypool, & Hugenberg, 2007), other studies suggested the opposite conclusion (e.g., Gawronski & LeBel, 2008; Gibson, 2008; Karpinski & Hilton, 2001; Olson & Fazio, 2006). The conditions under which change occurs for (a) both automatic and deliberate evaluations, (b) automatic but not deliberate evaluations, or (c) deliberate but not automatic evaluations, are now much better understood and there are several theories that compete for the most

accurate predictions in this regard (e.g., Gawronski & Bodenhausen, 2006, 2011; Petty, Briñol, & DeMarree, 2007; Rydell & McConnell, 2006).

One issue that is less well understood, however, is when and why automatic evaluations are context-dependent or context-independent. Over the past decade, a large body of research has shown that automatic evaluations of the same object can differ depending on the environment in which it is encountered. For example, in one of the first demonstrations of such context effects, Wittenbrink, Judd, and Park (2001) found that a picture of an African American man elicited a less favorable response when this person was presented against a graffiti wall than when the same person was presented in the context of a family barbeque. Similarly, Roefs et al. (2006) found that automatic evaluations of high-fat foods were more favorable when these foods were presented in a context emphasizing palatability (i.e., restaurant) than when they were presented in a context emphasizing health (i.e., hospital). To date, research has identified a wide range of contextual factors that influence automatic evaluation (for a review, see Gawronski & Sritharan, 2010). In fact, the pervasive evidence for context effects on automatic evaluation has led some researchers to conclude that it seems more difficult to find evidence for context-independence than context-dependence (Schwarz, 2007).

Previous Accounts of Context Effects on Automatic Evaluation

Although current attitude theories focus primarily on the relation between automatic evaluation and behavior (e.g., Fazio, 2007; Strack & Deutsch, 2004) and the formation and change of the mental representations underlying automatic evaluation (e.g., Gawronski & Bodenhausen, 2006, 2011; Petty et al., 2007; Rydell & McConnell, 2006), there are at least three accounts that aim at explaining context effects on automatic evaluations. The first account, most prominently represented by Fazio (2007), argues that people have relatively stable evaluative representations stored in memory. These representations are conceptualized as mental associations between an object and its summary evaluation. To the extent that the associative link between the two is sufficiently strong, the evaluation that is associated with an object becomes activated automatically upon encountering the object. Context effects on automatic evaluations are attributed to the fact that virtually all objects can be categorized in multiple ways. For example, a young African American man may be categorized in terms of his age, race, or gender. Yet, categorization usually occurs in terms of a single dimension instead of all possible categories (Macrae, Bodenhausen, & Milne, 1995). Hence, contextual cues can modulate automatic evaluations when they influence how a given object is categorized (e.g., Mitchell, Nosek, & Banaji, 2003; Olson & Fazio, 2003; but see Gawronski, Cunningham, LeBel, & Deutsch, 2010). In the above example, the young

African American man may elicit a more favorable response when he is categorized in terms of his age (activating positive stereotypes of young people) than when he is categorized in terms of his race (activating negative stereotypes of African Americans). Thus, to the extent that contextual cues influence which feature is used to categorize a target person, it may modulate the automatic evaluative response that is elicited in response to that person. Such context effects are not limited to orthogonal categories but may involve the use of hierarchically structured subtypes (e.g., Barden, Maddux, Petty, & Brewer, 2004). For example, the same African American man may elicit a more favorable automatic evaluation when contextual cues promote a categorization of this person as a Black lawyer than when they promote a categorization in terms of the superordinate category African American. In sum, context effects on automatic evaluations are explained by the propositions that (a) people have relatively stable category representations, (b) any object can be categorized in multiple ways, and (c) contextual cues influence which of the applicable category representations is used to categorize the target object.

The second account, most prominently represented by Schwarz (2007), rejects the notion of enduring dispositional tendencies as it is reflected in many definitions of the attitude construct (e.g., Eagly & Chaiken, 2007; Fazio, 2007; for a review, see Gawronski, 2007). Instead, it is argued that all evaluations—including both automatic and deliberate evaluations—are constructed on the spot on the basis of momentarily accessible concepts (see also Schwarz & Bohner, 2001). Accessibility of mental concepts is further assumed to depend on specific features of the context. For example, environmental cues may influence the momentary accessibility of positive or negative exemplars of a given category (e.g., the context of a basketball court may activate different exemplars of the category African American than the context of a graffiti wall), which may moderate the evaluative quality of automatic responses to other members of the same category (Lord & Lepper, 1999). From a constructivist perspective, context effects on automatic evaluation do not represent exceptions to the presumed rule of context-independence. Instead, context-dependence is regarded as the default, with context-independence being the incidental outcome of highly similar contexts that activate the same concepts. Varying levels of context-similarity can also explain different levels of stability over time, in that automatic evaluations may show higher levels of temporal stability when they occur in the same context than when they occur in different contexts (e.g., Gschwendner, Hofmann, & Schmitt, 2008).

The third account adopts a view that is somewhere between representational and constructivist accounts. According to this account, automatic evaluations depend on the overall valence of associated concepts that are activated in response to a given object (e.g., Gawronski & Bodenhausen, 2006, 2011). Drawing on the notion of pattern matching in

connectionist models (E. R. Smith, 1996), it is further assumed that the particular concepts that are activated in response to an object are constrained by (a) the overall set of input stimuli and (b) the preexisting structure of associations in memory. Importantly, the overall set of input stimuli includes not only the relevant target object but also momentarily available contextual cues (see also Conrey & Smith, 2007; Ferguson & Bargh, 2007). Yet, whereas constructivist accounts imply a direct activation of mental concepts by contextual cues, the notion of pattern matching implies that context effects on the activation of associated concepts are constrained by the preexisting structure of associations in memory. For example, the representation of a given person may involve mental associations with both positive and negative experiences, and contextual cues may influence which of these experiences are automatically activated in response to that person. Thus, contextual cues should modulate automatic evaluations of a given object when they promote the activation of associated concepts of different valence. Conversely, automatic evaluations should be consistent across contexts when these contexts promote the activation of associated concepts of the same valence.

Although the three accounts are quite different, either one of them can explain the available evidence for context effects on automatic evaluations. However, their explanations may be criticized as vague, in that they can explain almost every possible finding in a post hoc fashion without allowing a derivation of testable predictions. For example, the pattern matching account would argue that consistent automatic evaluations across contexts are due to the fact that these contexts activated associated concepts of the same valence, whereas inconsistent automatic evaluations are due to the activation of associated concepts of different valence (Gawronski & Bodenhausen, 2006, 2011). However, the account does not include specific assumptions regarding the conditions under which contextual cues activate associated concepts of the same or different valence. Similarly, the constructivist account would argue that consistent automatic evaluations across contexts are due to the accessibility of mental concepts of the same valence, whereas inconsistent automatic evaluations across contexts reflect the accessibility of mental concepts of different valence (Schwarz, 2007). However, there are no assumptions regarding the conditions under which contextual cues increase the accessibility of mental concepts of the same or different valence. The only account that allows some tentative predictions is the representational account in terms of differential categorization (Fazio, 2007), given that there is a considerable body of evidence regarding the factors that determine the categorization of multiply categorizable objects (for a review, see Macrae & Bodenhausen, 2000). Applied to context effects on automatic evaluations, however, some of these assumptions might also be criticized as problematic. For example, it has been argued that category cues that elicit automatic evaluations (i.e., categories with strong category-evaluation associations) are more likely to

Table 1. Different Kinds of Renewal Effects and Their Definitions.

Effect	Description
ABA renewal	Learning of a particular response in Context A
	Learning of a new response in Context B
	Renewal of the initially learned response in the initial Context A
ABC renewal	Learning of a particular response in Context A
	Learning of a new response in Context B
	Renewal of the initially learned response in a novel Context C
AAB renewal	Learning of a particular response in Context A
	Learning of a new response in the same Context A
	Renewal of the initially learned response in a novel Context B

determine the categorization of multiply categorizable objects than category cues that do not elicit automatic evaluations (E. R. Smith, Fazio, & Cejka, 1996). However, categorization is also claimed to determine automatic evaluation, such that an object may elicit different automatic evaluations depending on how it is categorized (Fazio, 2007). In other words, categorization is claimed to moderate automatic evaluation and automatic evaluation is claimed to moderate categorization, which makes it difficult to derive testable predictions regarding context effects on automatic evaluation.

Contextual Modulation in Animal Learning

We argue that theories of animal learning have a strong potential in overcoming the problems of existing accounts, because they include precise assumptions about the conditions under which automatic evaluations should be consistent or inconsistent across contexts. In addition, these accounts provide novel insights into the contextual conditions under which automatic evaluations should show evidence for situationally induced change and when they should appear resistant to change. These predictions are closely related to the concepts of *occasion setting* and *renewal effects*.

The concept of *occasion setting* describes the modulation of the response that is elicited by a given stimulus due to the presence of another stimulus (Schmajuk & Holland, 1998). In the literature on animal learning, such contextual stimuli are commonly described as occasion setters. For example, a cage may function as an occasion setter, in that a stimulus (e.g., sound) may elicit a conditioned fear response only in this particular cage, but not in another cage. An important aspect of occasion setters is that they do not themselves elicit the relevant response. Instead, the presence versus absence of an occasion setter determines the response that is elicited by the relevant target object (Bouton, 2010). In this sense, the notion of occasion setting has a strong resemblance to context effects on automatic evaluation, in that contextual cues might modulate the automatic evaluation of a given target stimulus instead of eliciting the same evaluative response in the absence of the target stimulus (e.g., Barden et al.,

2004). For example, more favorable evaluations of a particular person in a work-related context compared with an exercise-related context would qualify as an instance of occasion setting only when the two contexts themselves are insufficient to elicit the same evaluative responses that are elicited by the person within these contexts.

The concept of *renewal effects* describes the recurrence of an old response after successful learning of a new response (Bouton, 2004). Although most animal studies focus on renewal effects after extinction, the term *new response* can refer either to the acquisition of an actual response that is different from the initially learned response (as is the case in studies on counterconditioning; for example, Peck & Bouton, 1990) or to the elimination of the initially learned response (as is the case in studies on extinction; for example, Bouton & Bolles, 1979). An important aspect of renewal effects is that they usually occur in contexts that differ from the one in which the new response has been learned. For example, a conditioned fear response to a particular sound may be successfully extinguished by repeatedly presenting the sound without the fear-eliciting stimulus (e.g., electric shock) that had initially been paired with the sound. A renewal effect would occur if the sound continues to elicit a fear response when it is presented in a context that differs from the context in which extinction occurred (e.g., a different cage). Although a large proportion of animal studies focused on the recurrence of conditioned fear responses, renewal effects are well established for both conditioned-aversive and conditioned-appetitive responses (e.g., Peck & Bouton, 1990).

Depending on the nature of contextual changes during (a) the acquisition of an initial response, (b) the acquisition of a new response, and (c) subsequent measurement, it is common to distinguish between three different kinds of renewal effects (see Table 1). *ABA renewal* refers to cases in which a particular response is learned in an initial Context A, a new response is acquired in a different Context B, and the initially learned response recurs when it is measured in the initial Context A (e.g., Bouton & Bolles, 1979; Bouton & Peck, 1989). For example, a rat may be conditioned to show an aversive or appetitive response to a sound in a particular cage (Context A), then undergo successful extinction or

counterconditioning in a different cage (Context B), but still show the previously acquired response to the sound when the rat is returned to the initial cage (Context A). Similarly, *ABC renewal* is said to occur when a particular response is learned in an initial Context A, a new response is acquired in a different Context B, and the initially learned response recurs when it is measured in a novel Context C (e.g., Bouton & Bolles, 1979; Bouton & Brooks, 1993). For example, a rat may be conditioned to show an aversive or appetitive response to a sound in a particular cage (Context A), then undergo successful extinction or counterconditioning in a different cage (Context B), but still show the previously acquired response to the sound when the rat is put into an entirely novel cage (Context C). Finally, *AAB renewal* refers to cases in which a particular response is learned in an initial Context A, a new response is acquired in the same Context A, and the initially learned response recurs when it is measured in a novel Context B (e.g., Bouton & Ricker, 1994; Tamai & Nakajima, 2000). For example, a rat may be conditioned to show an aversive or appetitive response to a sound in a particular cage (Context A), then undergo successful extinction or counterconditioning in the same cage (Context A), but still show the previously acquired response to the sound when the rat is put into an entirely novel cage (Context B).

Although renewal effects refer to the recurrence of an old response instead of context effects per se, they are closely linked to the notion of occasion setting. Specifically, the cases of ABA, ABC, and AAB renewal imply that renewal effects tend to emerge in measurement contexts that differ from the one in which an old response has been successfully replaced by a new response (depicted by the difference between the second and third letter). Thus, the context in which the new response had been learned (depicted by the second letter) can be said to function as an occasion setter, in that its presence versus absence modulates the type of response that is elicited by the object (Bouton, 2004). If the context is present, the newly acquired response will be activated. If, however, the context is absent, the initially acquired response will be activated. The notion of occasion setting also implies that the context itself is not directly associated with the newly acquired response. Instead, its presence versus absence simply modulates the response that is elicited by the relevant target object (Bouton, 2010).

Occasion Setting and Renewal Effects in Automatic Evaluation

A study by Rydell and Gawronski (2009) provided evidence that the principles of occasion setting, ABA renewal, and ABC renewal also guide the contextual modulation of automatic evaluations in humans. Using a simple impression formation task, participants were first presented with either positive or negative information about a target person against a meaningless, colored background (e.g., a blue screen). In a second block of the impression formation task,

participants were presented with information that was evaluatively opposite to the information provided in the first block, and this information was presented against a different colored background (e.g., a yellow screen). After the impression formation task, automatic evaluations of the target person were assessed with an affective priming task in which the target person was presented against (a) the background of the first block (Context A), (b) the background of the second block (Context B), or (c) a novel background that was not part of the impression formation task (Context C). Results showed that automatic evaluations reflected the valence of the initially acquired information when the target individual was presented against the initial Context A (*ABA renewal*). The same was true when the target individual was presented against the novel Context C, in that automatic evaluations in the novel context reflected the valence of the initially acquired information (*ABC renewal*). These responses were in contrast to the ones when the target person was presented in the second Context B. In this context, automatic evaluations reflected the valence of the information that was presented in the second block of the impression formation task (*occasion setting*). Importantly, these effects were limited to automatic evaluations of the target individual and did not generalize to automatic evaluations of other individuals who were displayed against the same backgrounds. Taken together, these results indicate that the presence versus absence of the background color during the second block modulated the response that was elicited by the target individual, but the background color itself was insufficient to evoke the same evaluative response. Similar findings have been reported by Hardwick and Lipp (2000) for the contextual modulation of affective conditioning effects using startle eye-blink responses as an indicator of automatic evaluation.¹

Evidence for AAB renewal comes from a study by Gawronski, Rydell, Vervliet, and De Houwer (2010, Experiment 4). Using Rydell and Gawronski's (2009) impression formation paradigm, participants were first presented with either positive or negative information about a target person against a meaningless, colored background. In a second block, participants were presented with information that was evaluatively opposite to the information provided in the first block. However, different from Rydell and Gawronski's (2009) procedure, this information was presented against the *same* colored background. Automatic evaluations of the target person were then assessed with an affective priming task in which the target person was presented against either the background of the two blocks of the impression formation task (Context A) or a novel background that was not shown during the impression formation task (Context B). Results showed that automatic evaluations reflected the valence of the second block when the target individual was presented against the background that was displayed during the two blocks of the impression formation task. However, automatic evaluations reflected the valence

Table 2. Patterns of Contexts During the Learning of Evaluative Information and the Measurement of Automatic Evaluations, and Their Implications for Empirical Outcomes Regarding Stability Versus Change in Automatic Evaluations in Studies on Attitude Change and Context-Dependence Versus Context-Independence of Automatic Evaluations in Studies on Context Effects.

Context pattern	Empirical outcome
Attitude change	
ABA	Stability
ABB	Change
ABC	Stability
AAA	Change
AAB	Stability
Context effects	
ABA/ABB	Context-dependence
ABB/ABC	Context-dependence
ABA/ABC	Context-independence
AAA/AAB	Context-dependence

Note: The first letter in three-letter acronyms depicts the context during the acquisition of initial information, the second letter depicts the context during the acquisition of subsequent counterattitudinal information, and the third letter depicts the context during the measurement of automatic evaluations.

of the first block when the target individual was presented against a novel background (*AAB renewal*). Again, these effects were limited to automatic evaluations of the target individual and did not generalize to automatic evaluations of other individuals who were displayed against the same backgrounds. These results suggest that the context during the impression formation task functioned as an occasion setter, in that its presence versus absence modulated the response that was subsequently elicited by the target individual.

Stability, Change, and Context-Dependence

An interesting aspect of occasion setting and renewal effects is that the two concepts imply very specific predictions regarding the contextual conditions under which automatic evaluations should appear unaffected by counterattitudinal information and under which conditions they should show evidence for change. In addition, the two concepts imply specific predictions regarding the conditions under which automatic evaluations should show evidence for context-dependence and under which conditions they should show evidence for context-independence (see Table 2).

First, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, measurement in the initial Context A should reveal automatic evaluations that are consistent with the valence of the initial attitudinal information. This finding would suggest that automatic evaluations are resistant to counterattitudinal information and relatively difficult to change. Second, if

initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, measurement in Context B should reveal automatic evaluations that are consistent with the valence of the counterattitudinal information. In contrast to the conclusion derived from the first case, this finding would suggest that automatic evaluations are sensitive to counterattitudinal information and relatively easy to change. Third, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, measurement in a novel Context C should reveal automatic evaluations that are consistent with the valence of the initial attitudinal information. As with the conclusion derived from the first case, this finding would suggest that automatic evaluations are resistant to counterattitudinal information and relatively difficult to change. Fourth, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in the same Context A, measurement in the initial Context A should reveal automatic evaluations that are consistent with the valence of the counterattitudinal information. In line with the conclusion derived from the second case, this finding would suggest that automatic evaluations are sensitive to counterattitudinal information and relatively easy to change. Finally, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in the same Context A, measurement in a novel Context B should reveal automatic evaluations that are consistent with the valence of the initial attitudinal information, again suggesting that automatic evaluations are resistant against counterattitudinal information and relatively difficult to change.

Similarly precise predictions can be derived for the context-dependence versus context-independence of automatic evaluations. First, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, comparing automatic evaluations across Contexts A and B should reveal inconsistent responses across the two contexts. This pattern would suggest that automatic evaluations are context-dependent. Second, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, comparing automatic evaluations in Context B to automatic evaluations in a novel Context C should also reveal inconsistent responses. In line with the conclusion derived from the preceding case, this pattern would suggest that automatic evaluations are context-dependent. Third, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in another Context B, comparing automatic evaluations in Context A to automatic evaluations in a novel Context C should reveal consistent responses across

the two contexts. Counter to the conclusion derived from the former two cases, this pattern would suggest that automatic evaluations are context-independent. Finally, if initial attitudinal information about a novel object is acquired in a particular Context A and then challenged by counterattitudinal information in the same Context A, comparing automatic evaluations in Context A to automatic evaluations in a novel Context B should reveal inconsistent responses across the two contexts. As with the first two cases, this pattern would suggest that automatic evaluations are context-dependent.

These patterns have important implications for the effectiveness of attitude change manipulations in social psychology. A common question in research on attitudes is whether experimentally induced changes in automatic evaluation can be assumed to reflect enduring long-term changes or contextually induced shifts that may dissipate over time (Gawronski & Bodenhausen, 2006). To address this question, participants are often brought back into the lab several days or weeks after the experimental manipulation. To the extent that the initially observed change remains stable over time, it is assumed that the employed manipulation was effective in producing enduring long-term change (e.g., Devine, Forscher, Austin, & Cox, 2012; Kawakami, Dovidio, Moll, Hermsen, & Russin, 2000; Olson & Fazio, 2006). However, the concepts of occasion setting and renewal suggest that, although the observed changes may be stable within the same context, they may not generalize to other contexts. After all, it is possible that effective change of automatic evaluations in the lab does not generalize to other contexts outside of the lab even when the observed change in the lab is shown to be stable over time. Thus, to establish the effectiveness of experimental manipulations to induce enduring changes that generalize across contexts, it is important to include not only delayed follow-up measurements of automatic evaluations but also measurements in contexts that are different from the one in which the manipulation took place (for a notable example, see Devine et al., 2012). At a broader level, this conclusion resonates with Mischel and Shoda's (1995) notion of "if-then" conditionals reflecting idiosyncratic situation-behavior profiles, which implies that individuals may show behavioral consistency over time *within* a particular context, even if behavioral consistency *across* contexts is low.

Contextualized Representation

To explain the diverse patterns of stability and context-dependence depicted in Table 2, Gawronski, Rydell, et al. (2010) proposed a representational account that specifies the processes and representations that are responsible for occasion setting and renewal effects in automatic evaluation. Similar to many other models of attitude formation and change, their representational account assumes that the encoding of evaluative information about an object produces

a memory trace that links the object to that information. Depending on the strength of this memory trace, encountering the object may automatically reactivate the associated information, thereby producing a corresponding evaluative response (Fazio, 2007; Gawronski & Bodenhausen, 2006). Yet, a central question is what happens when individuals are exposed to new information that is evaluatively incongruent with the initially acquired information. Drawing on previous research on expectancy violation (Roese & Sherman, 2007), Gawronski, Rydell, et al. (2010) argued that exposure to expectancy incongruent information triggers a search for contextual cues that may explain the inconsistency between the initial attitudinal expectancy and the newly acquired information (cf. Festinger, 1957). As a result of this process, attention is directed toward the momentary context, which becomes integrated in a contextualized representation of the newly acquired information (see also Bouton, 2010; Rosas & Callejas-Aguilera, 2007). This contextualized representation includes the target object, the newly acquired, counterattitudinal information, and the particular context in which this information was acquired, with the context serving as an occasion setter. Importantly, instead of erasing the initially formed context-free representation from memory, the newly formed contextualized representation is assumed to be added to the existing memory structures. Hence, the mental representation of the object can be said to acquire a "dual" nature, in that it comprises (a) a *context-free representation* that includes the object and the initially acquired attitudinal information and (b) a *contextualized representation* that includes the object, the subsequently acquired, counterattitudinal information, and the context in which this information was acquired as an occasion setter. For example, if a person forms a favorable first impression of a new colleague at work, and this impression is later challenged by negative behavior of that person at the gym, the initial positive information will be stored in a context-free representation whereas the subsequent negative information will be stored in a contextualized representation. As a result, automatic responses to the new colleague will be negative only in contexts that are similar to the gym, whereas the initial positive impression will dominate in any other context.

Although the proposed "duality" may suggest two fully independent representations of the same object in memory, it is worth noting that such an assumption is not necessary. Bouton (1994) proposed a formalized associative network model that integrates context-free and contextualized representations of the same object in a single memory structure (see Figure 1). For the extinction of an earlier acquired response, Bouton's model assumes that (a) the initially formed association remains intact during extinction, (b) extinction creates a new inhibitory link between the stimulus and the earlier acquired response, and (c) this inhibitory link is "gated" by the extinction context, in that the activation of the inhibitory link requires input from both the target stimulus and the context in which extinction occurred. The same

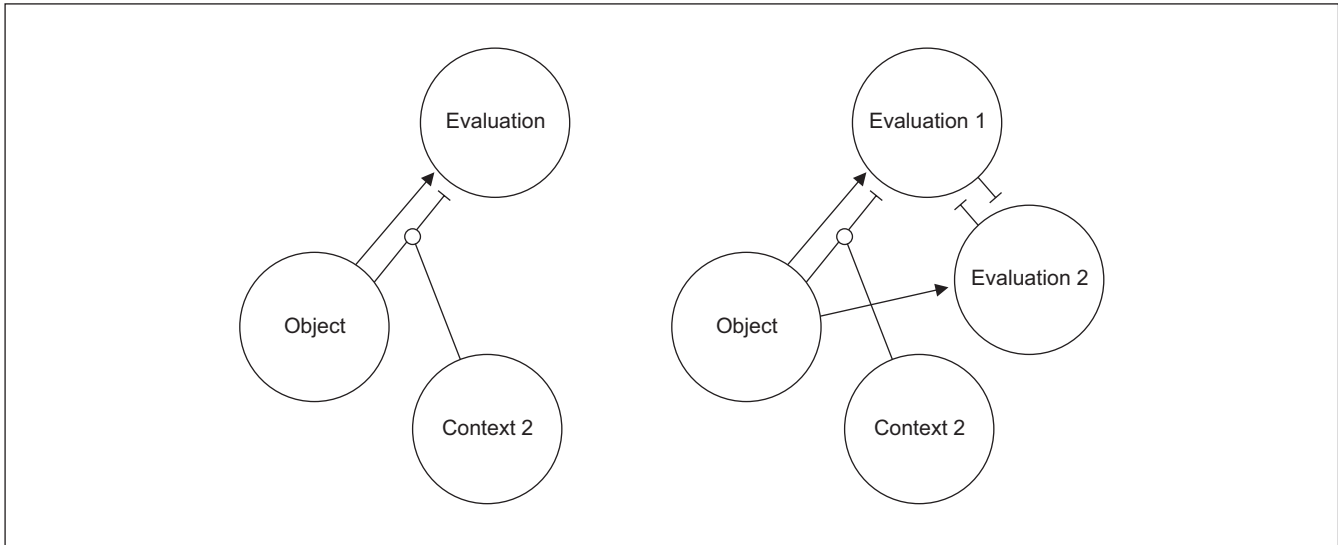


Figure 1. Associative memory model of occasion setting and renewal effects for extinction (left) and counterconditioning (right). Note: Arrows indicate excitatory associations; blocked lines indicate inhibitory associations; open circles indicate memory nodes or representations. Source: Adapted from Bouton (1994).

assumptions can be applied to cases of counterconditioning, the only difference being that exposure to counterattitudinal information is assumed to create (a) a new association between the stimulus and the newly acquired response and (b) mutually inhibitory links between the old and the new response. Applied to the above example, the mental representation of the new colleague may involve (a) an excitatory link between the colleague and the initial positive experience, (b) an excitatory link between the colleague and the subsequent negative experience, (c) an inhibitory link between the colleague and the initial positive experience that is “gated” by the gym context, and (d) mutually inhibitory links between the initial positive and the subsequent negative experience.

Attention to Contextual Cues

A common assumption in current accounts of occasion setting and renewal effects is that enhanced attention to contextual cues during counterconditioning or extinction functions as the central mediator for the formation of contextualized representations (e.g., Bouton, 2010; Pearce, George, & Redhead, 1998; Rosas & Callejas-Aguilera, 2007). This assumption is also shared by Gawronski, Rydell, et al.’s (2010) representational account, which argues that exposure to counterattitudinal information enhances attention to the momentary context to identify factors that may explain the discrepancy between the initial expectancy and the newly acquired information (e.g., enhanced attention to the momentary context when an initial positive impression of a new colleague is challenged by negative behavior). As a result, the momentary context becomes integrated into the representation of the counterattitudinal information. Thus,

whereas initial attitudinal information is assumed to be stored in context-free representations, counterattitudinal information is stored in contextualized representations.

Evidence for enhanced attention to contextual cues during exposure to counterattitudinal information comes from a memory study by Gawronski, Rydell, Ye, and De Houwer (2012). Participants were presented with either positive or negative behavioral descriptions about an unknown target person. The statements were presented one-by-one against different background colors, and participants were asked to form an impression of the target. After 20 statements that were consistently positive or negative, participants were presented with a target statement that was either consistent or inconsistent with the induced favorable or unfavorable impression of the target person. The impression formation task was followed by a surprise recognition test in which participants had to identify against which of 10 background colors a given statement had been presented during the impression formation task. Results showed that recognition memory for the background color of the target statement was at chance level (approximately 10%) when the target statement was consistent with the induced impression of the target. However, recognition memory was substantially higher, and significantly different from chance level, when the target statement was inconsistent with the induced impression (approximately 35%). These results support the hypothesis that exposure to counterattitudinal information enhances attention to momentarily available contextual cues, which in turn leads to an integration of these cues into the representation of the counterattitudinal information.

Further evidence on the role of attentional processes comes from a series of studies by Gawronski, Rydell, et al.

(2010) that manipulated participants' attention to contextual cues during the acquisition of either (a) initial attitudinal information or (b) subsequent counterattitudinal information. A central prediction of Gawronski, Rydell, et al.'s representational account is that ABC renewal should disappear if attention to contextual cues is already enhanced during the encoding of initial attitudinal information about a novel object. In the presumed default scenario outlined above, attention to contextual cues is assumed to be low during the acquisition of initial attitudinal information and enhanced by exposure to subsequent counterattitudinal information. As a result, contextual information is included in the representation of the counterattitudinal information but not the initial attitudinal information. Yet, when attention to contextual cues is high during both encoding of initial attitudinal information and exposure to subsequent counterattitudinal information, the two pieces of information should be stored in two contextualized representations—one including the attitudinal information and the initial Context A, and the other including the counterattitudinal information and the subsequent Context B. In such cases, encountering the object in a novel Context C should activate the two representations to the same extent, thereby producing an averaging effect of the two kinds of information rather than a renewal effect. In other words, automatic evaluations in a novel Context C should reflect a neutral (or ambivalent) evaluation rather than an evaluation that reflects the valence of the initially acquired attitudinal information. Importantly, enhanced attention to the context during the acquisition of initial attitudinal information should attenuate only ABC renewal but not ABA renewal. In fact, ABA renewal should remain perfectly intact because automatic evaluations in Context A should be driven by the contextualized representation of the initial attitudinal information. The same is true for automatic evaluations in Context B. Because automatic evaluations in Context B are driven by the contextualized representation of the subsequent counterattitudinal information, enhanced attention to the context during the encoding of initial attitudinal information should leave automatic evaluations in Context B unaffected. These predictions were confirmed in a study by Gawronski, Rydell, et al. (Experiment 1) that combined Rydell and Gawronski's (2009) paradigm with a priming manipulation designed to increase versus decrease attention to the background color during the first block of the impression formation task. Considering that incidental factors may sometimes increase attention to contextual cues during the encoding of initial attitudinal information, these results also explain why ABC renewal tends to be less pronounced and less robust across studies than ABA renewal.²

Another implication of Gawronski, Rydell, et al.'s (2010) representational account is that both ABA and ABC renewal should disappear when attention to contextual cues is reduced during the encoding of counterattitudinal information. In such cases, the counterattitudinal information should be integrated into the initial, context-free representation, which

should eliminate context effects altogether. Hence, automatic evaluations should reflect all of the available information about the target regardless of whether the target is encountered in the initial Context A, the subsequent Context B, or a novel Context C. In other words, reduced attention to the context during the encoding of counterattitudinal information should eliminate ABA renewal, ABC renewal, as well as the occasion setting function of the Context B.

Gawronski, Rydell, et al. (2010, Experiment 3) confirmed these predictions in a study that manipulated attention to contextual cues during the encoding of counterattitudinal information by presenting this information against either a single background or multiple different backgrounds. The rationale underlying this manipulation was that counterattitudinal information in multiple different contexts signals that the newly acquired information generalizes across contexts, which should reduce participants' attention to the relevant contextual cues.³ Consistent with these assumptions, Gawronski, Rydell, et al. found evidence for ABA renewal, ABC renewal, and the occasion function of the second Context B when counterattitudinal information was presented against a single background. In contrast, when counterattitudinal information was presented against multiple different backgrounds, participants showed neutral evaluations regardless of whether the target was presented in the initial Context A, the subsequent Context B, or a novel Context C.

These findings not only support the proposed contribution of attentional processes to occasion setting and renewal effects; they also have important implications for the effective change of automatic evaluations without recurrence of the initially acquired response in contexts that differ from the one in which counterattitudinal information had been acquired. Specifically, Gawronski, Rydell, et al.'s (2010) results suggest that exposure to the same amount of counterattitudinal information should be more effective in changing automatic evaluations when this information is dispersed over multiple different contexts than when it is consistently presented within the same context. This finding is particularly relevant for the treatment of dysfunctional or undesired automatic evaluations (e.g., Gunter, Denniston, & Miller, 1998; Vansteenwegen et al., 2007; but see Bouton, García-Gutiérrez, Zilsik, & Moody, 2006). For example, experimental procedures designed to reduce automatic prejudice may be more effective in producing stable changes that generalize across contexts when they are administered in multiple different contexts rather than a single context.

Mere Attention Versus Causal Attribution

Although current accounts of occasion setting and renewal effects share the assumption that exposure to counterattitudinal information enhances attention to momentarily available contextual cues (Bouton, 2010; Gawronski, Rydell, et al., 2010; Pearce et al., 1998; Rosas & Callejas-Aguilera,

2007), there are at least two possible ways in which attentional processes may promote the formation of contextualized representations. First, one could argue that contextual cues are integrated into the representation of counterattitudinal information to the extent that these cues “explain” the discrepancy between the initial attitudinal and the subsequent counterattitudinal experience. This hypothesis resonates with classic theories of causal attribution, according to which unexpected events are attributed to situational factors (Heider, 1958; Jones & Davis, 1965; Kelley, 1973), and these factors may be integrated into a contextualized representation of the expectancy-violating information. Second, it is possible that enhanced attention to contextual cues is sufficient for an integration of these cues in a contextualized representation regardless whether they do or do not “explain” the deviation from the expected valence. This scenario resembles attentional interpretations of illusory correlation effects (e.g., Hamilton & Gifford, 1976; Sherman et al., 2009), according to which enhanced attention to two co-occurring stimuli can create a link between these stimuli in memory even if they lack any objective contingency.

An important difference between the two accounts is that in the former case, the context should be integrated into the representation of subsequent counterattitudinal information only when it differs from the context that was present during the encoding of the initial attitudinal information (i.e., when context “explains” the difference in valence). In the latter case, however, expectancy-violating counterattitudinal information may become contextualized even when there is no objective contingency between context and the valence of an object (i.e., even when context does not “explain” the difference in valence). Although the former hypothesis can account for the emergence of ABA and ABC renewal, it is unable to explain cases of AAB renewal, which does not involve any meaningful relation between valence and context (e.g., Bouton & Ricker, 1994; Gawronski, Rydell, et al., 2010; Tamai & Nakajima, 2000). In AAB renewal, both initial attitudinal and subsequent counterattitudinal information is encountered in the same context, which implies that the context during the encoding of counterattitudinal information does not “explain” the observed expectancy violation. Thus, although causal attributions might contribute to renewal effects when the contexts of initial attitudinal and subsequent counterattitudinal information differ, such attributions do not seem necessary. Instead, renewal effects can occur as a result of mere attentional processes, such that enhanced attention to contextual cues may produce contextualized representations regardless of whether these cues do or do not explain the deviation from the expected valence.⁴

Moderating Versus Direct Effects of Contextual Cues

The concept of occasion setting implies that a given contextual cue does not itself elicit the relevant response (Bouton,

2010). Instead, its presence versus absence modulates the response that is elicited by the relevant target object. Thus, two important questions follow: (a) Are there conditions under which contextual cues themselves acquire an evaluative connotation during the encoding of counterattitudinal information? (b) What happens when contextual cues that function as occasion setters acquire a positive or negative valence?

As for the first question, research by Urcelay and Miller (2010) suggests that contextual cues can themselves acquire a positive or negative valence during the encoding of counterattitudinal information under particular conditions. A moderating factor in this regard seems to be the timing in which a contextual cue is encountered during the encoding of counterattitudinal information (see also Bouton & Nelson, 1998). To the extent that the presence of the contextual cue has perfect overlap with the occurrence of the attitudinal event (e.g., a person who is known as friendly behaves unfriendly whenever this person is wearing a particular shirt), the contextual cue tends to become directly associated with the valence of the attitudinal event (e.g., the shirt being sufficient to elicit a negative response). However, if the presence of the contextual cue does not have perfect overlap with the occurrence of the attitudinal event (e.g., a person who is known as friendly behaves unfriendly whenever this person is encountered at the gym), the contextual cue is more likely to acquire the characteristics of an occasion setter, such that it does not itself elicit a corresponding evaluative response (e.g., the gym itself being insufficient to elicit a negative response). Instead, its presence versus absence simply modulates the response that is elicited by the target object.

As for the second question, there is evidence that contextual cues tend to retain their occasion setting function even when they become directly associated with a particular valence (e.g., De Houwer, Crombez, & Baeyens, 2005; Holland, 1991). For example, if a person who is known as unfriendly is learned to be quite friendly at the gym, the gym context may produce a positive automatic evaluation of that person even when the gym itself acquires a negative valence (e.g., as a result of repeated negative experiences at the gym). Consistent with this assumption, Gawronski, Rydell, et al. (2012) found that the context during the encoding of counterattitudinal information retained its occasion setting function when the context was subsequently associated with an automatic response of the opposite valence in an evaluative conditioning paradigm. In fact, their results showed that subsequently conditioned context cues influenced automatic evaluations via two functionally independent mechanisms: (a) by modulating the evaluative response that was elicited by the target stimulus and (b) by directly eliciting the conditioned response that was subsequently associated with the context.

What Is a Contextual Cue?

Although the concepts of occasion setting and renewal provide valuable insights into context effects on automatic

evaluation, we have not yet addressed the critical question of what constitutes a contextual cue. In most animal studies, context is operationalized by means of perceptual features of the lab setting, such as perceptually different cages or different light conditions. Similar perceptual manipulations (e.g., illuminated vs. dark lab room) have been used in several clinical studies with human participants that investigated the context-dependent recurrence of appetitive (e.g., chocolate craving; Van Gucht, Vansteenwegen, Beckers, & Van den Bergh, 2008) and aversive responses (e.g., conditioned fear; Vansteenwegen et al., 2005) after successful extinction. In Rydell and Gawronski's (2009) paradigm to study occasion setting and renewal effects in automatic evaluation, context was similarly manipulated by means of simple perceptual features (i.e., background colors of the computer screen). However, to better understand context effects in real life, it is important to know which characteristics of contexts are responsible for the contextual modulation of automatic evaluations. For example, if counterattitudinal experiences are made in a gym context, will only the same gym activate the contextualized representation of the counterattitudinal experience (*conceptual identity*)? Will other gyms do the same (*conceptual equivalence*)? Or can any context that is perceptually similar to the gym function as an occasion setter for the activation of the contextualized representation, even if it is not a gym (*perceptual similarity*)?

A study by Gawronski, Rydell, et al. (2012) provides preliminary evidence that occasion setting and renewal effects in automatic evaluation depend on the perceptual similarity of contextual cues, rather than their conceptual identity or conceptual equivalence. In their study, participants were first presented with either positive or negative information about two target individuals against a neutral real-life background (i.e., sky with clouds). In a second block, participants were presented with evaluative information of the opposite valence against a different real-life background (e.g., a row of trees). Afterward, participants completed an affective priming task in which the two targets were presented against the background during the encoding of the initial attitudinal information and the background during the encoding of the subsequent counterattitudinal information. In addition, the priming task included trials in which the two targets were presented against (a) a background that was conceptually equivalent, but perceptually dissimilar, to the background in which the counterattitudinal information had been presented, (b) a background that was perceptually similar, but conceptually distinct, to the background in which the counterattitudinal information had been presented, and (c) a background that was both conceptually and perceptually dissimilar to the background in which the counterattitudinal information had been presented. Results showed that contexts that were perceptually similar to the context in which counterattitudinal information had been acquired led to automatic evaluations that were consistent with the valence of the counterattitudinal information. Contexts that were conceptually equivalent

to the context in which counterattitudinal information had been acquired failed to produce automatic evaluations reflecting the counterattitudinal information. Although more research is needed to determine potential effects of perceptual versus conceptual processes during the encoding of counterattitudinal information, these results provide preliminary evidence that occasion setting is driven by the perceptual similarity of contextual cues rather than by their conceptual identity or conceptual equivalence.

Automatic Versus Deliberate Evaluation

Numerous studies have demonstrated a wide range of context effects on self-reported, deliberate evaluations (Schwarz & Strack, 1991). Because many of these effects are mediated by participants' subjective interpretation of ambiguous questions and the available response options in traditional self-report measures (for a review, see Schwarz, 1999), they seem less suitable to understand context effects on automatic evaluations. Yet, an important question is whether the concepts of occasion setting and renewal can conversely advance our understanding of context effects on deliberate evaluations. Are there reasons to believe that context effects on automatic evaluations generalize to self-reported, deliberate evaluations? Or is it likely that higher-order processes completely override the contextual influences obtained for automatic evaluations?

An interesting possibility is that occasion setters function like retrieval cues in memory, in that they influence which information comes to mind most rapidly upon encountering a target object. With increasing delays, however, controlled processing may involve the retrieval of other target-related information, including information that has been learned in other contexts (cf. Cunningham, Zelazo, Packer, & Van Bavel, 2007; Wojnowicz, Ferguson, Dale, & Spivey, 2009). In this case, perceivers would have to resolve the resulting inconsistency between conflicting pieces of information (Gawronski & Bodenhausen, 2006, 2011). To the extent that people use their contextual knowledge to resolve this inconsistency, it seems likely that controlled evaluations in Context B are guided by subsequent counterattitudinal information. However, it seems less clear how perceivers would resolve the resulting conflict for deliberate evaluations in Contexts A and C for which there is no contextual information stored in memory.

Drawing on research on ease-of-retrieval effects (Schwarz et al., 1991), one could argue that perceivers typically attribute higher validity to information that comes to mind easily and discount the validity of information that requires cognitive effort to be retrieved from memory (Tormala, Petty, & Briñol, 2002). In this case, deliberate evaluations in Contexts A and C may show the same patterns of ABA and ABC renewal that has been demonstrated for automatic evaluations (see Gawronski, Rydell, et al., 2010; Rydell & Gawronski, 2009). Alternatively, it is possible that less

accessible information is given equal weight in an integrated judgment that combines all available information regardless of how rapidly it comes to mind. In this case, the patterns of ABA and ABC renewal obtained for automatic evaluations may not necessarily generalize to deliberate evaluations, which may instead reflect a state of ambivalence (Van Harreveld, Van der Pligt, & De Liver, 2009). Although the correspondence between automatic and deliberate evaluations can be moderated by a variety of other factors (for a review, see Hofmann, Gschwendner, Nosek, & Schmitt, 2005), future research may help to clarify the commonalities and differences between automatic and deliberate evaluations in their susceptibility to occasion setting and renewal effects.

Contextual Modulation of Action Tendencies

So far, we primarily focused on the usefulness of animal research for understanding the contextual modulation of automatic evaluation. However, a positive or negative evaluation does not necessarily suggest a specific behavioral response. For example, an automatic negative evaluation may be associated with a tendency to either fight or flee. Thus, over and above the contextual modulation of automatic evaluation, it is important to understand the contextual modulation of the action tendencies that reflect a positive or negative appraisal. As we will show in the following sections, animal research provides interesting insights in this regard.

Previous Accounts of Context Effects on Automatic Behavior

Early approaches to studying automatic behavior overwhelmingly focused on a person's stable mental representations and the way in which the behavioral information associated with this representation becomes automatically and inflexibly executed. For example, to account for the effects of social category priming, early models proposed that perception of a category cue activates the associated category information, which is then directly translated into behavior. This translation was assumed to occur irrespective of any contingencies in the environment (e.g., Dijksterhuis & Bargh, 2001). The most well-known account of this kind is the *perception-behavior link hypothesis* (Bargh, Chen, & Burrows, 1996), which states that mere increases in the accessibility of a behavioral representation make that behavior more likely to be executed.

As an example of a now-classic study inspired by this account, Bargh et al. (1996) primed White participants with pictures of young Black males (the mental representation of which contains the concept *aggressive*) and later provoked participants by making them repeat a boring computer task. Participants' aggressiveness in response to this provocation

was measured by having the experimenter and blind coders rate participants' behavior. Relative to a no-prime control condition, those participants primed with pictures of young Black males were more likely to respond with increased hostility. According to the perception-behavior link hypothesis, exposure to social category members (e.g., pictures of young Black males) activates associated behavioral representations (e.g., *aggressive*), and the increased accessibility of these representations makes them more likely to be executed.

Although the importance of context for automatic processes has been acknowledged from the start (e.g., Bargh, 1989), its presumed role was highly constrained in early accounts of automatic behavior. Specifically, it was proposed that context was able to moderate prime-to-behavior effects by allowing versus preventing the expression of an activated behavioral representation (e.g., people do not aggress in the absence of the opportunity to do so). However, these early accounts do not allow for context to play a fundamental role in defining *which* actions are prepared and executed. The same is true for more recent accounts that propose a mediating role of active self-concepts (Wheeler, DeMarree, & Petty, 2007) and misattribution processes (Loersch & Payne, 2011). Although these accounts include several novel predictions regarding the conditions under which prime-to-behavior effects should or should not occur, they also do not consider context as a central factor in determining *which* actions are prepared and executed.⁵ Such a role of context was explicitly proposed by Cesario, Plaks, and Higgins's (2006) motivated preparation to interact account. Their model proposes that automatic behavior can be understood as the output of self-regulatory processes designed to prepare the person to effectively interact with a target other. Effective behavior requires incorporating information about one's evaluation of the target (e.g., Do I like this person? Is this person threatening?), as well as information about the contingencies in the environment that allow a person to execute his or her goals with respect to the target (Can I flee? Can I hide?).

Initial studies on automatic behavior frequently drew connections to nonhuman animals as an attempt to build support for the proposal that there were direct, context-free effects of stimulus perception on behavior (e.g., Chartrand & Bargh, 1999; Dijksterhuis & Bargh, 2001; Dijksterhuis, Bargh, & Miedema, 2000). Nonhuman animals, it was claimed, are insensitive to context and respond directly to stimuli, and, because we share subcortical neural structures and common evolutionary ancestors with these animals, the same should be true for humans. However, such reasoning presupposes that evolution by natural selection results in perception-behavior links that are controlled solely by stimulus cues. Counter to this view, the literature on nonhuman animal behavior (a) demonstrates the essential role of contextual influences and (b) specifies the particular aspects of the context that determine behavioral responses.

In the following sections, we focus on context sensitivity in defensive threat behavior and mating behavior, given that these behaviors reflect necessary functions of the brain. At minimum, human and nonhuman brains alike have evolved as organs whose function is to successfully navigate the body through space and time—that is, to survive and reproduce. Of course, the exact mechanisms underlying survival and reproduction differ across species and even types of behaviors within a species. However, it seems reasonable to assume that for nearly all reproduction and survival behaviors, contextual cues beyond the target stimulus (e.g., a predator or mate) play a central role in the regulation of these functions. Indeed, one useful way of characterizing the brain's role in behavioral regulation is that natural selection has resulted in brains that implement decision-making rules. These rules take as input information from the current context and flexibly execute behavior depending on this input.⁶ According to this view, context has to be considered because successful action is defined differently depending on the present contextual contingencies (i.e., what an organism can and cannot do in a given situation).

Defensive Threat Behavior

Defensive threat behavior has been thoroughly researched in rodents and the well-specified models from that literature allow for interesting insights into human defensive behavior. Such models characterize threat responding in terms of the relationships between “the type of defensive behavior . . . and particular features of the eliciting (threat) stimulus and the situation in which it is encountered” (D. C. Blanchard, Hynd, Minke, Minemoto, & Blanchard, 2001, p. 761, italics added). Both intraspecies and interspecies threats result in defensive behavior that can be classified as flight, freezing, defensive threat (e.g., vocalizations), defensive attack, or risk assessment (D. C. Blanchard, 1997; R. J. Blanchard, Flannelly, & Blanchard, 1986). One useful way of characterizing defensive behavior is to understand it as the output of a computational process that assesses what an animal can and cannot do in relation to a threat. This includes an assessment of contextual factors such as structural contingencies (e.g., the presence of escape or hiding spots) and coalitional contingencies (e.g., the presence of ingroup conspecifics), as well as noncontext factors such as one's physical size.⁷

What precisely are the factors that influence which of the five defensive responses are executed upon encountering a threat? Although features of the stimulus itself, such as the magnitude and ambiguity of the threat, are important, the context of the encounter is essential. Indeed, the presence of escape options and the distance between the rodent and the threat are two key variables in defensive responding. At far distances, a high magnitude threat elicits flight behavior if escape is available. As distance between the threat and the rodent decreases, defensive threat responses become more likely. At very close distances, defensive attack is most likely.

Furthermore, if escape is not available but becomes available during an approaching threat, the rodent may choose to flee, illustrating that a continual assessment of contextual opportunities takes place (e.g., D. C. Blanchard & Blanchard, 1984; R. J. Blanchard et al., 1986; D. C. Blanchard et al., 2001; McNaughton & Corr, 2004; Stankowich & Blumstein, 2005). Thus, what is clear from the literature on rodent action tendencies in response to threats is that “decisions” about which actions to execute are dependent on features of the context beyond just features of the threat stimulus itself.

How closely do human behavioral responses to threat follow rodent models? To answer this question, Cesario, Plaks, Hagiwara, Navarrete, and Higgins (2010) investigated automatic cognitive and behavioral responses to outgroup threats in humans (for evidence that deliberate responses in humans closely parallel nonhuman animal responses, see D. C. Blanchard et al., 2001). In a first study, the researchers tested the role of escape availability in influencing the accessibility of fight-related versus flight-related action tendencies (i.e., words related to fighting or fleeing). White participants were primed with pictures of either young Black males or young White males, and their reaction times to respond to fight-related and flight-related words were assessed. Of key importance, participants completed the experiment either in a closed sound-resistant booth or in an open field. The results showed that, the more participants represented Black males as threatening, the greater their fight-related action tendencies when in the booth. Conversely, the more participants represented Black males as threatening, the greater their flight-related action tendencies when in the field. A second study conceptually replicated this effect with a behavioral measure by showing that when participants remained trapped in the booth following priming of Black males, they responded with aggressiveness to a provocation. However, when given the opportunity to distance themselves by increasing their seating distance from a target, they did so instead. Again, this was contingent on the degree to which participants associated Black males with threat.

Another aspect of context important for defensive behavior, particularly for highly social species, is the presence of ingroup conspecifics—or more specifically, the computation of numerical advantage (i.e., number of ingroup animals relative to number of outgroup animals; see J. E. Smith et al., 2010). Whether or not an animal is surrounded by its coalitional (ingroup) members influences action in response to threats. Benson-Amram, Heinen, Dryer, and Holekamp (2011) provide a prototypical example with wild hyenas. In this work, researchers played sounds of stranger hyenas (i.e., outgroup members) through a concealed speaker and recorded whether a target hyena exhibited flight behavior or risk-assessment behavior (approaching the sound to investigate). The results provided evidence that hyenas can compute numerical advantage and use this computation to determine action: The ratio of the number of ingroup hyenas present to the number of intruder hyena voices predicted

whether a hyena decided to flee from the sound or approach it. When this ratio exceeded one, hyenas approached the intruder voices more than twice as often. Consistent with a game theoretic perspective (Maynard-Smith, 1979; Maynard-Smith & Parker, 1976; Maynard-Smith & Price, 1973), it appears that hyenas were computing the relative strengths of the ingroup and outgroup coalitions in determining their behavioral responses. Similar evidence for numerical assessment effects has been found with other social species, including wild chimpanzees (Wilson, Britton, & Frank, 2002; Wilson, Hauser, & Wrangham, 2001) and male and female lions (Grinnell, Packer, & Pusey, 1995; McComb, Packer, & Pusey, 1994).

Does this same contextual influence of the presence of ingroup members also affect automatic action tendencies in humans? In recent years, there have been several demonstrations that the presence of others influences a range of automatic responses (e.g., Castelli & Tomelleri, 2008; Sechrist & Stangor, 2001; Sinclair, Lowery, Hardin, & Colangelo, 2005). More directly relevant to the question of automatic defensive threat behavior, there is some evidence with humans that provides direct analogs to the nonhuman animal literature. Cesario and Jonas (2012) investigated whether the presence of reliable ingroups would change participants' reactions to physically formidable outgroup males. The researchers had White participants complete a Black–White Stereotyping IAT (which measures associations between Blacks/Whites and physical/mental trait words) and a Black–White Evaluative IAT (which measures associations between Blacks/Whites and positive/negative adjectives). Participants completed these measures either alone or in the presence of five other participants. Crucially, a shared, important ingroup identity had been made salient for participants in the ingroup condition prior to beginning the tasks, to encourage them to believe they were surrounded by a reliable ingroup. The results showed that, when participants completed the two measures alone, there was a moderate, positive correlation between responses on the two IATs. The more participants stereotyped Black males as physical (relative to White males as intellectual), the more negative their evaluations of Black males (relative to White males). In other words, a physically formidable outgroup male was judged as negative. In contrast, when participants completed the measures surrounded by a reliable ingroup, there was no correlation between responses on the two measures. A physically formidable outgroup male no longer implied something negative when a person had coalitional support. Importantly, the mere presence of others did not produce the same effects as the presence of ingroup members.

Cesario and Navarrete (2012) recently provided direct evidence that coalitions change defensive threat responding by measuring the effect of ingroups on the perception of defensive distance. Defensive distance is the perceived distance to a threat, and depending on various features of the situation, this perceived distance may not be equivalent to

the actual distance to a threat. For less formidable animals, threats will be perceived as closer than they actually are, whereas for more formidable animals, this bias will be attenuated. This hypothesis is consistent with the finding that more formidable animals allow threats to approach more closely before initiating a defensive response (McNaughton & Corr, 2004).

Cesario and Navarrete (2012) tested the possibility that the presence of one's ingroup would serve the same function as "ingroup" members in nonhuman animals by demonstrating that defensive distance judgments change in the presence of others. Across two studies, the researchers found that the distance estimated to a threat (Detroit, seen as a dangerous city by the subject population) was dependent on whether White participants were completing the task alone or with a reliable ingroup (with the salient ingroup category being gender in one study and students of the same undergraduate institution in the second study). When participants were alone, the more they evaluated Black males as dangerous, the closer they judged Detroit. When participants were with a reliable ingroup, this effect was attenuated. Thus, similar to the changes in defensive responding shown by the presence of Hyena ingroups in Benson-Amram et al. (2011), the presence of a human coalition also regulated defensive threat responding. Although self-reported judgments of distance clearly reflect a more deliberate (rather than automatic) type of response, the reported findings are consistent with related evidence for contextually induced changes in automatic responses.

Evidence of the influence of the ingroup on automatically activated action semantics was provided by Cesario and Jonas (2012). Their research also demonstrated that multiple sources of information are simultaneously incorporated as inputs into an assessment of which actions are to be prepared (e.g., Parker, 1974). Specifically, this research investigated how assessments of one's own formidability would interact with the presence of one's coalition when responding to outgroup threats. Given that aggression is a potentially costly act (e.g., Navarrete, McDonald, Molina, & Sidanius, 2010), those inclined to physical aggression in response to outgroup threats should be most willing to use aggression when the costs of doing so are distributed—in other words, when one has a coalition present. To test this hypothesis, White participants were primed with pictures of young Black males or young White males and completed a reaction time measure assessing the accessibility of fight-related and flight-related action semantics. This priming took place either while participants were alone or surrounded by a salient ingroup of other students from the same university (an important identity for these students). Participants also completed a measure of trait physical aggressiveness (A. H. Buss & Perry, 1992).

Results showed that different action semantics were automatically activated in response to the Black male primes depending on whether participants completed the task alone

or were surrounded by the ingroup. This outcome was contingent, however, on participants' levels of trait aggressiveness. Participants in the ingroup condition showed greater accessibility to fight-related words (relative to flight-related words) in response to Black primes as their trait-level physical aggressiveness increased. This effect was not observed when participants completed the task alone, indicating that participants high in trait aggressiveness are not only inclined to respond to others but also know the importance of one's coalition for doing so. Such a pattern of results indicates that people may be incorporating multiple sources of action-relevant information (the support of ingroup members, one's own physical formidability) in preparing responses at the cognitive level.

One additional piece of evidence that people incorporate multiple variables into threat responding can be found in Study 2 of Cesario et al. (2010). This study tested how people incorporate information about the physical structure of the context (escape availability) with information about personal physical formidability in automatic behavioral responses to outgroup threats. Participants were subliminally primed with pictures of young Black males or young White males. Half the participants, while seated in a booth, were then provoked through the use of a fake computer crash paradigm (see Bargh et al., 1996). To the degree that participants associated Blacks with danger, they responded to the provocation with increased hostility. This effect did not depend on whether participants believed themselves to be highly physically formidable. In other words, trapped in a location where escape was not available, participants responded to a threat with increased aggression regardless of whether they were high or low in self-perceived strength.

For the other half of the participants, however, something different happened. For these participants, the priming task ended without incident, and they were led to an open room in which they were free to respond to threats with a behavior other than aggression. Specifically, a chair was placed in the room and participants were told that another participant, with whom they would interact, had already arrived but had left the room for a moment. Participants were instructed to take a chair from a stack and place it wherever they would like for an interaction with this participant. Results indicated that participants' approach/avoidance responses, like the wild hyenas of Benson-Amram et al. (2011), were influenced by whether they believed they had the physical formidability required to challenge physical threats. To the degree that participants associated Blacks with danger, they sat closer to the target other if they rated themselves high in physical formidability but sat farther away if they rated themselves low in physical formidability. In sum, when escape was not an option, participants responded with aggression regardless of their physical formidability. When other behavioral options were possible, however, participants' physical formidability influenced whether they chose to approach or avoid the target. Thus, humans, similar to

nonhuman animals, appear to incorporate multiple sources of information into the computation of action, demonstrating that the automatic evaluation of a stimulus as positive or negative is not sufficient for understanding *which* behavior will be prepared and executed in response to that stimulus.

Mating/Affiliation Behavior

Defensive regulation is clearly a necessary function for both human and nonhuman animals. Yet, evolutionary success also requires regulation of positive or affiliative behaviors. The most obvious example is mating behavior, one of the most well researched areas of study. Although the nature of nonhuman minds is a source of continuing debate, one could argue that most mating behaviors in animals are the result of what would reasonably be called "automatic" processes, and similar automatic processes may be operating in humans. Thus, our discussion primarily focuses on those behaviors for which it seems reasonable to assume that there might be similar automatic effects in humans. Although there is a considerable body of evidence regarding the role of automatic processes in human mating behavior (for a review, see Baldwin et al., 2010), we want to emphasize the lack of evidence regarding context effects on automatic (as opposed to deliberate) responses, which we consider as an interesting avenue for future investigations.

As with our analysis of defensive threat behavior, our starting point is the notion that the brain implements flexible decision-making strategies. These strategies may also help understand mating behavior, with context serving as one input into such computations. Context includes both environmental-level input and individual-level input (e.g., availability of resources and one's own value as a mate, respectively). Such input serves to shift behavioral preferences to maximize reproductive success (see Goetz & Shackelford, 2006a, 2009; Gorelik & Shackelford, 2011). As with defensive behavior, a simple positive or negative evaluation of a target is not enough for predicting mating behavior. Animals and humans do not simply attempt to mate with the most positively evaluated targets, and they do not attempt to do so regardless of contextual factors that determine whether such an attempt is even feasible.

In humans, the way in which assessments of environmental factors influence mating behavior can be seen in the life-history approach (Kaplan & Gangestad, 2005). This approach emphasizes the role of environmental cues in the selection of different life strategies related to mating behavior, including biological maturation. Specifically, cues related to the stability of resources are assumed to serve as primary input into the activation of fast versus slow life strategies. A general hypothesis of the life-history approach is that harsh, stressful environments favor risky life strategies, such as early sexual maturation, early reproduction, and multiple offspring with low investment in each. Conversely, safe environments are assumed to favor slow life strategies, which include later

sexual maturation, delayed reproduction, and fewer offspring with high parental investment in each (Oli, 2004). Thus, the activation of one strategy or the other is sensitive to cues in the environment, because fast life strategies are more adaptive for harsh and unstable environments and slow life strategies are more adaptive for stable environments with predictable access to resources. Consistent with these assumptions, it has been found that factors such as availability and predictability of resources, trustworthiness of others, and enduringness of interpersonal relationships are important cues to environmental stability in the early rearing context, which then direct expression of a slow or fast life strategy (Belsky, Steinberg, & Draper, 1991).

Although evidence has accumulated in support of the life-history approach, there is little in this research that might reasonably be considered automatic responses. Indeed, the research on biological maturation appears to be the only example of context effects on automatic responses in this literature. Again with respect to specific empirical findings, degree of family conflict, parental divorce and separation, and absence of a father in childhood predict early menarche (Graber, Brooks-Gunn, & Warren, 1995; Moffitt, Caspi, Belsky, & Silva, 1992; Quinlan, 2003). Beyond this, the responses of interest to life-history researchers fall decidedly on the more deliberate side (early sexual activity, age at first pregnancy, number of sexual partners, and shorter duration of first marriage; see Ellis et al., 2003; Quinlan, 2003). Thus, in terms of mating behavior, there is evidence consistent with the idea that contextual contingencies are assessed and different behavioral strategies are flexibly executed, but at the same time, there are many opportunities to push this research further into the realm of automatic responses.

With respect to human mate preferences, the situation is quite similar, in that there is strong evidence for context sensitivity (mimicking the evidence in the animal literature) with interesting opportunities to extend these findings by studying automatic responses. Indeed, the idea that mate preferences shift across contexts is now well established. D. M. Buss and Shackelford (2008) note that mate preferences shift "as a function of personal and ecological contexts" (p. 135), which matches the distinction between personal and ecological variables as described in our analysis of defensive threat behavior. For females making mate decisions, the degree of importance placed on features indicating physical attractiveness (e.g., sex appeal, muscularity, symmetry) versus resource potential (e.g., having a promising career, good financial prospects) changes depending on whether a woman is pursuing short-term or long-term mating strategies (D. M. Buss & Schmitt, 1993; Frederick & Haselton, 2007; Gangestad, Garver-Apgar, & Simpson, 2007; Gangestad & Simpson, 2000; Haselton & Gangestad, 2006; Haselton & Miller, 2006; Little, Cohen, Jones, & Belsky, 2007; Pawlowski & Jasienska, 2005). Pursuing one strategy or other is remarkably sensitive to context. For example, the last decade has seen a growing body of evidence showing

that female mate preferences shift across the menstrual cycle, such that hormones present during the high fertility phase of the menstrual cycle shift females' preferences toward those indicating "good genes" (which would be a male mate's primary contribution to the offspring at that phase), such as masculinity, symmetry, and dominance (e.g., Gangestad et al., 2007; Little, Jones, & Burriss, 2007; Pillsworth, Haselton, & Buss, 2004; Puts, 2005).⁸ Again, however, there seems to be wide opportunity for researchers to extend this work into automatic preferences. To the best of our knowledge, all the research on mate preference has used measures of deliberate preferences.

Interestingly, mate preference decisions are also sensitive to females' own mate value, indicating that the assessment of one's own value by members of a mating pool can serve as an additional source of contextual input into reproductive decisions. D. M. Buss and Shackelford (2008) have found that "attractive women want it all" (p. 134). Women who were rated as physically attractive by observers had higher expected standards in a mate across all mate characteristics (good-gene indicators, good investment indicators, good parenting indicators, and good partner indicators). Hence, one additional source of input into mating decisions concerns how members of a mating pool evaluate themselves. To the extent that the characteristics valued in the environment change, such inputs should impact decisions.

Further evidence of context sensitivity in mating behavior can be found in the literature on female extra-pair copulation (EPC) and male strategies to avoid cuckoldry (the unwitting investment of resources by a male in offspring with whom he does not share genetic similarity). Given that cuckoldry is a recurrent problem for males (who have paternal uncertainty), and being subject to cuckoldry decreases males' reproductive success, it has been argued that males should have evolved adaptations designed to prevent cuckoldry. In nonhuman males a variety of anticuckoldry behaviors are evident, all of which, one would assume, reflect the product of relatively automatic rather than deliberate processes. Of interest here are sexual coercion behaviors following EPC, a variety of which serve to reduce the likelihood of cuckoldry. For example, across a number of avian species, males use forced in-pair copulations to prevent cuckoldry, but the use of this strategy is dependent on the female being absent from the male's view. Thus, this mating strategy is not inflexibly executed in the presence of a stimulus cue (a female partner) but instead is the output of a process that incorporates relevant environmental cues conveying information about the likelihood that a female has paired with another male (e.g., Barash, 1977; Birkhead, Hunter, & Pellatt, 1989; Valera, Hoi, & Kristin, 2003).

Are similar behaviors evident in human males? Shackelford and colleagues have amassed evidence supporting the prediction that the time spent apart since a couple's last copulation is correlated with a range of mate retention behaviors in males, including both positive behaviors (e.g., buying flowers for a female partner) and negative behaviors

Table 3. Examples of Context-Sensitive Action Tendencies in Nonhuman Animals and Corresponding Evidence for Context-Sensitive Action Tendencies in Humans.

	Context-sensitive action tendencies in nonhuman animals	Corresponding evidence for context-sensitive action tendencies in humans
Defensive behavior	Escape availability: Presence of escape moderates fight versus flight behavior Presence of conspecifics: Presence of coalitional members moderates tendency to approach versus flee threats posed by other animals	Automatic activation of fight versus flight action semantics depends on escape availability Automatic activation of fight versus flight action semantics in response to outgroup males is influenced by the presence of ingroup members
Mating/affiliation behavior	Resource availability: Availability of resources influences operation of sexual selection principles Cues to EPC: Cues signaling the possibility that a female has mated with other males influences anticuckoldry behaviors	Life history perspective: Stability of resources influences biological maturation (early menarche), early sexual activity, age at first pregnancy, number of sexual partners, and shorter duration of first marriage Amount of time spent apart since last copulation influences both positive (e.g., buying flowers) and negative (e.g., sexual coercion, violence) mate retention behaviors

Note: EPC = extra-pair copulation.

(e.g., sexual coercion, violence; see Goetz & Shackelford, 2006b; Goetz, Shackelford, Platak, Starratt, & McKibbin, 2007; Shackelford et al., 2002; Shackelford, Goetz, McKibbin, & Starratt, 2007; Starratt, Shackelford, Goetz, & McKibbin, 2007; see also Shackelford & Goetz, 2006, 2007; Starratt, Goetz, Shackelford, McKibbin, & Stewart-Williams, 2008; Thornhill & Thornhill, 1992).⁹ Although such strategies might as well be considered as the product of deliberate rather automatic processes, they can be interpreted as the output of the same type of computational process described in the section on defensive threat behavior. For example, the use of sexually coercive strategies is particularly likely for males who perceive themselves at risk for EPC by their female partners (Kaighobadi & Shackelford, 2009; McKibbin, Starratt, Shackelford, & Goetz, 2011) and is stronger for males who are paired with more attractive females (who would be more likely to be pursued for EPC; Kaighobadi & Shackelford, 2008). Even more specifically, these strategies are sensitive to a male's mate value *relative to* the female partner's mate value (Starratt, Popp, & Shackelford, 2008), mimicking the relative computation of resource-holding power found in decisions of defensive threat behavior.

Sacco, Brown, Young, Bernstein, and Hugenberg (2011) recently provided direct support for the role of ingroup support in aggressive mating strategies, which is consistent with the coalitional research by Cesario and colleagues described earlier (Cesario & Jonas, 2012; Cesario & Navarrete, 2012). These researchers found that when male participants had experienced social inclusion, they endorsed riskier and more aggressive mating strategies (e.g., mate-poaching behaviors). Such effects were not observed in female participants. The researchers explained these effects in terms of the up-regulation of mating goals under social inclusion, given that such inclusion indicates that survival needs are being met.

“That is, feelings of belongingness might indicate that one has the resources (tangible and social) necessary to pursue these potentially costly mating strategies that are usually more judiciously enacted” (Sacco et al., 2011, p. 987). This finding is consistent with the idea that behavior is an output of a computational process that assesses what a person can and cannot accomplish in a particular situation—in this case, that the presence of a reliable ingroup increases an individual's computed resource-holding power (see Parker, 1974) in making decisions about which strategies to enact.

Implications for Theories of Automatic Behavior

If theory is to advance beyond the vague claim of saying “context should matter” for the selection of particular actions, it is necessary to predict exactly *which* aspects of context should be important (cf. Reis, 2008; E. R. Smith & Semin, 2004). Animal research can provide important insights in this regard by identifying which context variables are important, and in doing so, revealing key insights into the nature of how the mind prepares and executes action (see Table 3).

One widely accepted way of understanding the brain is as an organ that has evolved via natural selection to solve recurrent problems in the environment with computational processes. The brain follows adaptive decision rules that take as input relevant sources of information, and does so in the service of producing adaptive behavior. Accordingly, the key features of context should be, at minimum, those features that change or influence the likelihood that an animal can successfully execute a given action in the service of survival and reproduction. One can also understand these contextual features as *resources* that feed into a process of resource assessment, which influence how an animal “decides” on a

particular action. Consistent with this approach, the reviewed research by Cesario and colleagues (Cesario et al., 2010; Cesario & Jonas, 2012; Cesario & Navarrete, 2012) has focused predominantly on the influence of structural resources (e.g., escape availability) and coalitional resources (e.g., presence of reliable ingroup members).

We previously noted that early approaches in social cognition ignored context in favor of a singular focus on stimulus features. This trend continues today across various subdisciplines in psychology. Perhaps the most obvious example is the literature on mirror neurons and their relation to behavioral mimicry. Initial demonstrations of behavioral mimicry relied on the perception–behavior link hypothesis to explain why people often imitated the behavioral expressions of interaction partners (e.g., shaking one’s foot when an interaction partner shakes his or her foot; Chartrand & Bargh, 1999). As research on the mirror neuron system (MNS; Fadiga, Fogassi, Pavesi, & Rizzolatti, 1995) has become widely known, this cluster of cells has frequently been cited as the underlying neurological basis for behavioral mimicry (e.g., Dijksterhuis & Bargh, 2001). Other researchers, however, have been very cautious about this claim (Chartrand & Van Baaren, 2009; Newman-Norlund, Van Schie, Van Zuijlen, & Bekkering, 2007). Indeed, Chartrand and colleagues have provided a large body of evidence demonstrating the importance of affiliation motivation for behavioral mimicry (Cheng & Chartrand, 2003; Lakin & Chartrand, 2003; Lakin, Chartrand, & Arkin, 2008; see also Stel et al., 2010; Stel, Rispens, Leliveld, & Lokhorst, 2011), which seems inconsistent with the possibility of a direct perception–behavior link underlying mimicry effects.

As Heyes (2011) has illustrated, making precise distinctions among different kinds of “imitation” that share surface similarity is both important and fruitful. Indeed, the types of human behaviors for which a direct, strict congruency mechanism makes the most sense (finger tapping, pressing right-facing vs. left-facing arrows) are of a very different kind than the more interactive behaviors found in the behavioral mimicry literature. The ability for the MNS to shed light on significant, naturally occurring interactive behavior is potentially quite limited, particularly with respect to the “strictly congruent” neurons of the MNS (which comprise approximately one third of the MNS and respond to identical observed and executed actions; see Newman-Norlund et al., 2007). This limitation is evident when considering normal human life, for which strict imitation would be of very little help when interacting with others (e.g., being aggressive when an enemy is aggressive, trying to take a beer mug from a friend’s hand using the same grip as he is using, and speaking when a lecturer speaks).

One might be tempted to point to the “broadly congruent” neurons of the MNS (which respond to complementary rather than imitative action; Newman-Norlund et al., 2007) as a means of making the MNS more useful for understanding dynamic, context-bound behaviors. However, it is not

clear that these neurons offer much more in the way of flexibility and context sensitivity, at least not to any more substantive degree. Even complementary behaviors are studied in a context devoid of any of the important features one might expect in daily life. It is true that seeing the mug being grabbed may activate the strictly congruent neurons of the MNS (Fadiga et al., 1995), and performing the complementary action that allows one to take hold of the passing mug may activate the broadly congruent neurons to an even greater degree (Newman-Norlund et al., 2007). But in actual interactions, there are context cues that make neither imitative nor complementary action the preferred behavior. Imagine seeing a person throw a punch. Would the appropriate action be to punch as well (imitation)? Or would it be to duck or take cover (complementation)? It is simply impossible to say without knowing the kinds of important contextual cues discussed in this review. To allow the MNS a central role in behavioral preparation is to presuppose that only two responses to any stimulus are useful or possible: imitation or complementation. This is not even to begin to speak of motivation, which could substantially change which actions are effective. For example, the desire not to spill any beer from a full mug may result in a grip on the mug that is neither complementary nor imitative to the grip of the person passing it to you. Thus, whether the MNS has any relevance for the context-rich and motivationally relevant interactions found in every day life is unclear.

Yet, a focus on context in the production of automatic behavior is perfectly consistent with evolutionary principles and the flexible behavioral strategies found in nonhuman animals. Proposing mechanisms of action preparation and execution that explicitly disavow context sensitivity, such as the perception–behavior link (Bargh et al., 1996), reflects a view of evolutionary pressures on the development of the brain that ignores the vast literature showing the essential role of context in animal behavior. Indeed, any species that uses a heuristic such as “always be aggressive when you see others act aggressive” would quickly head down an evolutionary dead end. There is the real possibility that in all but the most meaningless situations, strict imitation is likely to play little to no role in adaptive behavior.

In contrast to direct expression accounts, a game theoretic framework has been very useful in understanding interactive behaviors, particularly those relevant to competition fighting behavior (see Maynard-Smith, 1979; Maynard-Smith & Parker, 1976; Maynard-Smith & Price, 1973; Parker, 1974). Although a thorough discussion of game theory and its implications is well beyond the scope of the current review, it is worth noting that assessment of each animal’s resource-holding potential (see Parker, 1974) plays a key role in decisions to escalate versus withdraw a fight. Part of this assessment includes assessing cues to formidability (e.g., physical size). From the current perspective, the presence of coalition members could feed into this assessment as well (see Cesario & Jonas, 2012). In any event, it is clear from

these literatures that any type of strict imitation or direct expression account is rather limited in explaining behavior, and this conclusion applies to both human and nonhuman animals.

Automatic Versus Deliberate Behavior

As with automatic evaluation, an interesting question is whether the role of contextual contingencies in shaping automatic behavior generalizes to deliberate behavior. Deliberate action planning in humans often goes beyond the computation of immediately available resources by including subjectively valued outcomes that may not be easily realized given current contextual contingencies. These assessments may sometimes suggest that an automatically elicited action tendency, although viable in the current situation, should be inhibited because it conflicts with some other subjectively valued goal. For example, defensive threat behavior in response to an outgroup member may be inhibited because of its conflict with higher-order goals (e.g., egalitarianism) that go beyond automatic appraisals of the immediate situation (Gawronski, Brochu, et al., 2012). Thus, deliberate action planning may override the execution of contextually feasible responses if they conflict with higher-order goals, and such deliberate assessments may include potential long-term outcomes as well as general beliefs about the normative appropriateness of a given action.

These considerations have two important implications for context effects on automatic versus deliberate behavior. First, context effects on automatic behavior may not generalize to deliberate behavior when the deliberate assessment of response options is based on information other than the contextual contingencies that shape automatic action tendencies. In this case, a particular contextual factor may influence automatic, but not deliberate, behavior. Second, deliberate action planning may itself be influenced by contextual factors that go beyond the ones that influence the resource-based computations underlying automatic action tendencies. Different from the first case, such contextual factors may influence deliberate, but not automatic, behavior. Although the primary question of the current article concerns context effects on automatic action tendencies, examples of the second case are contextual factors that influence the momentary accessibility of information that is relevant for the assessment of potential long-term consequences and the normative appropriateness of available response options.

Integrating Affect, Cognition, and Motivation

Behavior is the output of coordinated systems that prepare the organism for effective action (e.g., Panksepp, 1998). In social cognition research, human behavior has at times been described in purely cognitive terms, as resulting from the activation of stored (stereotype or evaluative) information

that is then directly translated into behavior. Animal research suggests that such accounts are at odds with what is known about the affective, cognitive, and motivational underpinnings of behavior. Of course, the integration of affect, cognition, and motivation has been a focus of many prominent theories within social psychology (e.g., Festinger, 1957; Higgins, 1997; Strack & Deutsch, 2004). Yet, we would argue that findings from animal research can make a unique contribution to this enterprise that cannot be gained from traditional accounts.

As described in the first part of this review, research on animal learning can inform us about the ways in which context influences automatic evaluation. The concepts of renewal and occasion setting suggest that contextual information is sometimes integrated into the mental representation of an object (*cognition*). Thus, to the extent that the evaluative quality of an automatic response is defined by its underlying affective state (Russell, 2003), one could argue that such contextualized representations shape the affective response that is elicited by an object within a given context (*affect*). Theories of animal learning provide important insights in this regard by specifying the conditions under which contextual information is integrated into the mental representation of newly acquired evaluative information. As described in the second part of this review, however, a positive or negative affective response alone does not provide enough information to yield effective action. Specific action tendencies are shaped by motivational concerns, such as defense and affiliation (*motivation*). Information about contextual contingencies influences the resulting action tendencies through the selection of behavioral options that are most conducive for successful goal pursuit within that context (*cognition*). Again, animal research provides important insights in this regard by specifying how context influences the particular action tendencies that are resulting from a positive or negative affective response. Yet, an important difference between the two stages is that context seems to influence affective reactions through perceptual processes (Gawronski, Rydell, et al., 2012), whereas the modulation of action tendencies involves conceptual processing of available response options within a given context. Thus, theories of animal behavior offer a useful framework that integrates affective, cognitive, and motivational processes in a manner that goes beyond previous accounts by relating these processes to the environmental context in which they naturally occur.

This integration does not have to be limited to the psychological level of analysis; it may also include the neurobiological level (Marr, 1982). An illustrative example in this regard is Porges's polyvagal theory (Porges, 1995a, 1995b, 2001, 2007), which describes the neurobiological underpinnings of the autonomic nervous system (ANS) as it pertains to the vagus nerve regulation of the ANS in response to threats. The theory outlines three phylogenetically ordered neural circuits that regulate the heart and support distinct adaptive behavioral strategies: (a) the unmyelinated vagus,

the most primitive component that supports immobilization responses (e.g., freezing); (b) the sympathetic–adrenal system, which supports mobilization for fight/flight responses; and (c) the mammalian myelinated vagus, which supports the social engagement system.

Importantly, polyvagal theory describes a neural process (neuroception) that evaluates risk and controls vagal output in response to environmental challenges. When the environment is evaluated as safe, the myelinated vagal pathway actively inhibits heart rate, thereby dampening fight/flight responses and allowing for social engagement behaviors to be expressed. These include exploration of the social environment, acknowledging social contact, and, through neural connections that influence the stapedius muscle of the middle ear, extracting the frequencies of the human voice out of background noise (by preventing low frequency background noise from being transduced to the cochlea; see Denver, 2004; Porges & Lewis, 2010; Schaaf, Miller, Seawell, & O’Keefe, 2003; Van Hecke et al., 2009). The social engagement system has clear connections with the mating/affiliative behaviors described earlier. Indeed, Porges (1998) has argued that the mammalian vagus nerve provides the neurobiological underpinning for understanding adult intimacy behavior such as mating and long-term social bonds. Furthermore, for early infants, the assessment of safety is driven by the presence of the primary caregiver, which is analogous to our understanding of the role of ingroup members in adults.

When the environment is perceived as dangerous, however, the *vagal brake* is inhibited and the phylogenetically older systems are recruited for action execution. That is, the expression of the myelinated vagus nerve, which inhibits the sympathetic nervous system at the sinoatrial node of the heart, is inhibited. With this removal of the vagal break, rapid increases in metabolic output result, allowing for defensive fight/flight behavioral responses to be executed (e.g., Doussard-Roosevelt, Montgomery, & Porges, 2003; Heilman et al., 2008; Porges, 2003; see also Porges, 1995b, 2001, 2007).

What can polyvagal theory contribute to our understanding of context effects on automatic responses? We illustrate two potential contributions of this theory. First, a theory such as polyvagal theory can provide key evidence concerning the underlying mechanisms related to changes in context. For example, assessing vagal regulation in participants encountering outgroup males while alone or in the presence of coalition members can provide critical evidence that changes in this context feature influence a person’s assessment of the situation as dangerous or safe. If context influences the assessment of what a person can and cannot do in response to a target other, and concomitant with this change is a change in the degree to which the target is threatening, then changes in vagal inhibition should be observed.

More important, however, is that the polyvagal theory (and other integrative theories) has strong implications for

how we develop theories designed to explain the preparation and execution of automatic behavioral responses. Social-cognitive accounts that focus solely on cognitive processes and representations will need to be reconciled with what is known about the development of motivational systems that regulate interpersonal behavior. As the polyvagal theory makes clear, such behavior is not somehow localized at the cognitive level. As such, the theory questions the idea that automatic behavior can be described in purely perceptual–cognitive terms, and that relevant findings in the nonhuman animal literature could be safely ignored. For example, when explaining why priming White participants with images of Black males (who are represented as a threatening outgroup) causes increased aggressiveness, the vast literature on defensive responding in nonhuman animals might be considered important. The same conclusion holds for priming any other social category. Thus, research and theory involving nonhuman animals can help inform us whether our theories of human behavior are adequate, much in the same way that findings from patients with neurological damage constrain theories of cognitive neuroscience.

Limitations of Animal Research for Understanding Human Behavior

Human and nonhuman animals both are concerned in a fundamental way about context. We have argued that theories of nonhuman animal behavior can provide important insights for understanding the essential roles of context in shaping human automatic responses. However, it is also important to ask about the limits of animal research for this enterprise. To be sure, we are not proposing that the *only* aspects of context that should matter are those derived from theories of nonhuman animal behavior. After all, humans have motivations that, to the best of our knowledge, nonhuman animals do not have—for example, the need for shared reality (Hardin & Higgins, 1996). The influence of such motivations have been nicely demonstrated by Sinclair et al. (2005) who found that participants’ desires for shared reality influenced automatic racial evaluations.

More generally, concerns with shared reality are an illustration of the human capacity for language use and abstract thought, and in particular, the ability to see oneself from the perspective of another (Mead, 1934). To the extent that motivations related to these capacities are accessible and directing thought and behavior, theories of nonhuman animal behavior seem rather limited in their ability to inform us about automatic responses in humans. Note, however, that this caveat is not inconsistent with theories of animal behavior or with natural selection more generally. Neural changes in the evolution of the human species would, of course, be concomitant with changes in cognitive capabilities (e.g., Semendeferi, Lu, Schenker, & Damasio, 2002), and thus, theories of animal behavior may simply become silent in their ability to explain automatic behavior related to those

human cognitive functions (but see Navarrete & Fessler, 2005, for counterexamples).

Another important limitation concerns the (potentially) uniquely human ability for context to change the meaning of action tendencies. Although this limitation seems less relevant for the role of *perceptual* context features in influencing automatic evaluation, it is of utmost importance for the contribution of *conceptual* context features to the preparation and execution of automatic action tendencies. An illustrative example in this regard concerns the influence of body postures on subjective power. Recently, several researchers have explored the link between physical positioning of one's body and resultant expressions of power. For instance, Carney, Cuddy, and Yap (2010) demonstrated that holding expansive (vs. constrictive) physical positions increases feelings of power and risk-taking behavior, lowers cortisol, and increases testosterone (see also Bohns & Wiltermuth, 2012; Huang, Galinsky, Gruenfeld, & Guillory, 2011). Some researchers have explained such findings in terms of an evolved connection between physical size and dominance. According to this reasoning, because physically larger animals were more successful at obtaining and exercising power, there exists an innate connection between size and power, such that mere expressions of physical size can change experience of power. Consistent with this interpretation, Huang et al. (2011) argued that "the causal link between body expansiveness and power-related behavior may be so close that it is not mediated by and may precede perception" (p. 96). Even more forcefully, Adam and Galinsky (2012) proposed that "the link between a physical experience and its symbolic meaning is direct, as it is the physical experience itself that carries the symbolic meaning. In other words, the symbolic meaning is always automatically embodied because it directly stems from the physical experience" (p. 919). Thus, to the extent that there is a close connection between physical expansiveness and power in nonhuman animals, we might reasonably expect such findings to inform human behavior.

Cesario and McDonald (in press) have recently suggested that the ability for context to change the meaning of humans' behavior provides an important qualification to this interpretation. In a first study, participants held either expansive or constrictive positions, as in prior research. However, participants held these positions either while looking at faces of other humans presented on a computer screen or without such faces presented. Only when there was the virtual presence of another person did physical expansiveness and constriction have any effect on power (as measured with a risk-taking task). When the faces were present, the meaning of the physical position was one of dominance versus submissiveness, and attendant changes in power were observed. Absent this interpersonal context, however, physical pose had no effect on power. That is, the physical positioning itself had no influence on power absent an interpersonal context in which such positions could be given the meaning of dominance versus submissiveness.

In a second study, participants again held either expansive or constrictive positions, but this time did so while imagining themselves in either dominant or submissive roles. For example, participants held an expansive position in which they stood with their hands on top of a table, leaning over it. In the dominant condition, they were instructed to imagine themselves at work, standing at their executive desk and looking out over a worksite. In the submissive condition, in contrast, they were instructed to imagine themselves being frisked by the police with their hands on the hood of a police car. Results showed a complete determination of power (measured through risk-taking behavior) by role and no influence of physical pose. Counter to Huang et al.'s (2011) assumption that the "link between posture expansiveness and power may be so deeply wired into people that it 'mutes' the effect of role when postures are sufficiently salient" (p. 100), the researchers found that context was key in providing for participants the meaning of their physical posture. Similar context effects have been obtained for the meaning of automatic action tendencies to approach versus avoid objects (e.g., Krieglmeier & Deutsch, in press; Markman & Brendl, 2005; Seibt, Neumann, Nussinson, & Strack, 2008), which have also been claimed to reflect innate links between basic motivational orientations and particular motor responses (cf. Neumann, Förster, & Strack, 2003).

Taken together, these findings illustrate that parallels between human and nonhuman behavior should be treated with some caution. This concern is particularly relevant for the understanding of context effects that involve a change in the meaning of a particular behavior. Nevertheless, evidence for such contextual changes of meaning could point to interesting lines of research with nonhuman animals—that is, applying our understanding of context effects on human behavior to nonhuman animals. For example, does the meaning of physical size differ for nonhuman animals across contexts? Would being placed in an expansive position, absent a conspecific, have any detectable changes for a nonhuman animal? These questions could serve as interesting starting points for future comparative studies that consider both commonalities and differences between human and nonhuman animals.

A final limitation is the restricted range of behaviors that is captured by the analogy between human and nonhuman animals. With respect to our review of automatic action tendencies, we focused primarily on defensive threat and mating/affiliation behavior, given that these behaviors reflect necessary functions of the brain. Yet, it seems fair to ask whether animal research can be utilized to understand a wider range of human behavior. Would we expect animal research to inform us about context effects related to, for example, people walking more slowly after priming of *elderly* (Bargh et al., 1996) or people performing better on trivia tasks after priming of *professor* (Dijksterhuis & Van Knippenberg, 1998)? Although animal research may seem less suitable to capture such effects, we would argue that one

of the central predictions derived from the animal analogy should hold across behaviors: that those context features important for effective action influence any kind of automatic behavior.

Indeed, there is preliminary evidence that is consistent with this assumption. For example, Casper, Rothermund, and Wentura (2011) demonstrated that relevant contexts activated specific stereotype content after priming of *elderly* or *youth*. When the context surrounding the activation of the category *elderly* was relevant to the stereotype of slowness (e.g., walking across the street), evidence for the activation of that stereotype trait was obtained. However, such activation was not evident when the context was irrelevant (e.g., watering flowers). The account offered by Casper et al., that context-dependent activation of specific stereotype content is functional, is consistent with the current approach insofar as relevant (but not irrelevant) contexts inform a person of how to most effectively interact with a target other ("Do I need to consider this person's speed at the task?"). More directly related to automatic behavior rather than stereotype activation, Cesario et al. (2006) found that the speed at which participants walked after priming of *elderly* or *youth* was influenced by their automatic evaluations of these categories. Participants walked more slowly following *elderly* priming to the degree that they had automatic positive evaluations of the elderly, but walked more quickly following priming to the degree that they had automatic negative evaluations. The reverse was true following priming of *youth*. Consistent with the current perspective, such an effect may be predicted on the basis of the assumption that one's evaluation of a target should serve as input into the calculation of which behavior should be executed. Thus, although theories of animal behavior may seem limited in their applicability to certain kinds of behaviors, their proposition that automatic behavior should depend on those context features that are important for effective action should be valid regardless of the particular behavior.

Conclusion

The main goal of the current review was to illustrate the value of animal research for understanding context effects on automatic responses in humans. Drawing on various parallels between the functional properties of automatic responses in human and nonhuman animals, we argued that theories of animal behavior offer novel insights into the contextual modulation of attitude formation and change (automatic evaluation), and the role of contextual contingencies in shaping the particular action tendencies in response to a stimulus (automatic behavior). Although theories of animal behavior certainly do not provide a comprehensive understanding of human behavior, they suggest a novel perspective on the interplay between affective, cognitive, and motivational processes, thereby providing an interesting framework for the study of automatic responses in humans.

Authors' Note

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Notes

1. Two unsuccessful attempts to demonstrate contextual modulation of evaluative flavor conditioning have been reported by Baeyens and colleagues (Baeyens, Crombez, De Houwer, & Eelen, 1996; Baeyens, Hendrickx, Crombez, & Hermans, 1998). However, deviating from the current focus on automatic evaluation, Baeyens and colleagues investigated context effects on self-reported, deliberate evaluations. We discuss potential differences between automatic and deliberate evaluations at the end of the section on contextual modulation of automatic evaluation.
2. The same conclusion applies to the emergence of AAB renewal, which is attenuated by enhanced attention to contextual cues during the acquisition of initial attitudinal information (Gawronski, Rydell, Vervliet, & De Houwer, 2010, Experiment 4).
3. In the literature on animal learning, counterconditioning or extinction in multiple contexts is assumed to enhance generalization of the newly acquired information to novel contexts (e.g., Bouton, García-Gutiérrez, Zilzik, & Moody, 2006). According to this account, the newly acquired information becomes connected to a wider range of contextual cues.
4. The differential contribution of attentional and attributional processes to AAB versus ABC renewal may also explain why AAB renewal tends to be weaker and less robust than ABC renewal. Whereas ABC renewal can be due to either attentional or attributional processes (or both), AAB renewal seems to be exclusively due to attentional processes.
5. It is worth noting that the basic principles of occasion setting and renewal have also been applied to investigate the extinction of instrumental behavior in operant conditioning (for a review, see Bouton, Winterbauer, & Todd, 2012), which may be regarded as similar to the action tendencies reviewed in the current section.
6. Such input can play multiple roles, and input into decision making represents only one of these roles. Context cues can be represented symbolically and serve as input into a computational process that operates on amodal representations. Alternatively, context cues can directly regulate physiology, as when low temperature and scarce food availability block ovulation or when

day length (photoperiod) regulates reproductive cycles (e.g., Berry & Bronson, 1992; Bronson, 1995).

7. This conceptualization is consistent with theorizing by Tolman (1932) and D. C. Blanchard and Blanchard (1984). While not denying the importance of context, other theorists have offered alternative accounts of defensive threat responses in terms of inhibitory interactions between distinct behavioral systems (e.g., Fanselow, 1994).
8. Such menstrual cycle changes apply to intergroup evaluations as well, a topic we do not cover here (see McDonald, Asher, Kerr, & Navarrete, 2011; Navarrete, Fessler, Fleischman, & Geyer, 2009). It is worth noting that the research on intergroup bias is unique in having included measures of automatic responses.
9. Indeed, the context sensitivity of mating behavior extends to the biological level. The number of sperm in a human male's ejaculate varies depending on the proportion of time a couple has spent together since their most recent intercourse, such that the longer proportion spent apart the greater number of sperm produced. Importantly, this is true only for the number of sperm ejaculated during copulation and not during masturbation (e.g., Baker & Bellis, 1993).

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