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Implicit Attitudes Reflect Associative, Non-associative, and Non-attitudinal Processes

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Abstract

It is a common assumption that responses on implicit measures are proxies for automatically activated associations stored in memory. Consequently, explanations for implicit attitude malleability, variability, and prediction have assumed differences in underlying associations. However, a growing body of evidence challenges the assumption that implicit attitude change is driven only by associative processes. This paper reviews evidence from research with the Quadruple Process model on the influence of associative and non-associative processes on implicit task performance. We also describe recent research on non-attitudinal processes that do not pertain directly to the attitude object of interest but that, nevertheless, influence implicit task performance. Implications for the interpretation of implicit measures and implicit attitude change are discussed.

Introduction

Implicit attitude measures were created to overcome problems associated with self-report (or explicit) attitude measures that had troubled researchers for decades. Explicit measures, which directly ask respondents to report their attitudes, are susceptible to deliberate response strategies that may arise from social desirability or self-presentational concerns. Explicit measures also are unable to capture mental content that is inaccessible through introspection (Gawronski, 2009). Implicit measures, in contrast, were designed to minimize these "unwilling and unable" problems by assessing attitudes and beliefs without directly requesting that respondents report those attitudes and beliefs. Implicit measures indirectly assess attitudes in a variety of ways, such as structuring the task in a manner that conceals what is being measured (e.g., evaluative priming, Fazio, Jackson, Dunton, & Williams, 1995; semantic priming, Wittenbrink, Judd, & Park, 1997) or by making responses difficult to control (e.g., IAT, Greenwald, McGhee, & Schwartz, 1998; GNAT, Nosek & Banaji, 2001).[1]

These features of implicit measures have led to the widely held belief that responses on these measures reflect only the respondent's underlying and automatically activated mental associations with the attitude object (e.g., Fazio & Towles-Schwen, 1999; Greenwald et al., 1998). One important consequence of this belief is that any malleability in measured implicit attitudes, variability in implicit attitudes among respondents, or prediction of behavior by implicit attitudes must, by definition, result from differences in the activation of associations. That is, given that the measures reflect only associations in memory, any change, variability, or predictiveness of the measures must also be due only to associations in memory (e.g., the same stimuli activate different associations, the same associations are activated to a different extent, or the associations themselves are altered; Blair, 2002; Gawronski & Sritharan, 2010).

However, the fact that implicit measures minimize strategic responding and the requirement of accurate introspection does not necessarily imply that performance reflects only respondents' underlying associations. Indeed, it has become quite clear that implicit task

performance is affected by a variety of *non-associative* processes. For example, task switching ability (e.g., Mierke & Klauer, 2003), stimulus recoding into figure-ground discriminations (e.g., Rothermund, Wentura, & De Houwer, 2005), and response criterion setting processes (e.g., Klauer, Voss, Schmitz, & Teige-Mocigemba, 2007; for a review, see Teige-Mocigemba, Klauer, & Sherman, 2010) have all been proposed to contribute to IAT performance. Several formal models incorporate non-associative processing components to explain performance on other implicit measures, including application of Jacoby's (1991) process dissociation procedure to a variety of measures (for a review, see Payne & Bishara, 2009), the ABC model (Stahl & Degner, 2007) of performance on the EAST (De Houwer, 2003), Nadarevic and Erdfelder's (2011) Trip model of performance on the GNAT (Nosek & Banaji, 2001), Payne and colleagues' (Payne, Hall, Cameron, & Bishara, 2010) account of performance on the AMP (Payne, Cheng, Govorun, & Stewart, 2005), and Krieglmeyer and Sherman's (2012) multi-process account of stereotype activation and application on the SMT. Each of these models provides evidence that both associations and non-associative processes contribute to responses on implicit attitude measures.

The Quadruple Process Model

The purpose of this article is to describe in detail the Quadruple Process model (Quad model) that Sherman and colleagues have applied to understanding implicit attitudes and implicit task performance on a wide variety of measures (Sherman et al., 2008) and how the model has been used to identify processes associated with implicit attitude malleability, variability, and behavior prediction. The model is a multinomial model (Batchelder & Riefer, 1999; Riefer & Batchelder, 1988) that was developed to provide an account of how multiple, qualitatively distinct processes interact to direct behavior, particularly on implicit measures. The model proposes that implicit task performance depends jointly on the activation of associations in memory (Activation [AC]), the ability to detect correct responses on the task (Detection [D]), the success at overcoming biased associations when they would produce an incorrect response (Overcoming Bias [OB]), and the influence of general guessing or response biases that may influence behavior in the absence of other available guides to response (Guessing [G]).

The Quad model is depicted as a processing tree in Figure 1. Each path represents a likelihood, and processing parameters with lines leading to them are conditional upon all preceding parameters. For instance, OB is conditional upon both AC and D. Similarly, G is conditional upon the lack of AC (1 − AC) and the lack of D (1 − D). Note that these conditional relationships do not imply a serial or temporal order in the onset and conclusion of the different processes. Rather, these relationships are mathematical descriptions of the manner in which the parameters interact to produce behavior. Thus, the activation of associations (AC), attempts to detect a correct response (D), and attempts to overcome associations (OB) may occur simultaneously. However, in determining a response on an incompatible trial, the status of OB determines whether AC or D drives responses when they are in conflict.

The conditional relationships described by the model form a system of equations that predicts the numbers of correct and incorrect responses in the compatible (e.g., pairing black faces with unpleasant words) and incompatible (e.g., pairing black faces with pleasant words) trials of an implicit measure. The model's predictions are then compared with the actual data to determine the model's ability to account for the data. A chi-square estimate is computed for the difference between the predicted and observed errors. To best approximate the model to the data, the four parameter values are changed through maximum likelihood estimation until they produce a minimum possible value of the chi-square. The final parameter values
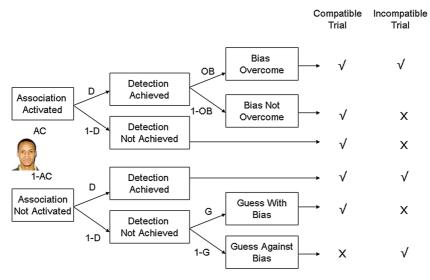
Figure 1. The Quadruple Process model (Quad model). Each path represents a likelihood. Parameters with lines leading to them are conditional upon all preceding parameters. The table on the right side of the figure depicts correct (√) and incorrect (X) responses as a function of process pattern.

that result from this process are interpreted as relative levels of the four processes. The Quad model and the nature of its proposed processes have been extensively validated (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Sherman et al., 2008).

Associative and Non–associative Processes

An important feature of the Quad model is that it specifies the influence of both associative and non–associative processes in implicit task performance. In terms of implicit measures, an associative process is one in which the activation of associations between two concepts in memory (e.g., "flowers" and "pleasant") produces a corresponding behavioral predisposition (e.g., to press a particular button). The activation (AC) parameter is conceptualized as such a process because it reflects the associations activated by the task stimuli. However, detecting correct responses (D) represents an accuracy–oriented process that cannot be achieved solely through the passive activation of associations in memory. Overcoming bias (OB) represents a self-regulatory process that overcomes the activated associations when necessary. As such, D and OB (and sometimes G) are non–associative processes.

Associative and Non–associative Contributions to Implicit Attitude Malleability, Variability, and Prediction

As described above, the standard view of implicit measures as reflecting only the activation of associations constrains interpretations of implicit attitude malleability, variability, and behavioral prediction. If the measures only reflect underlying associations, then any observed differences among respondents can only be interpreted as reflecting differences in associations. However, the Quad model provides a means of directly assessing the influence of associative and non–associative processes on implicit attitude malleability, variability, and behavior prediction. We have now accumulated a substantial body of evidence that both types of process contribute to these effects.

Associative influences on implicit attitude malleability

In some cases, changes in associations alone can account for implicit attitude malleability. For example, Quad model analysis revealed that increased intergroup bias resulting from ego threat (e.g., Fein & Spencer, 1997; Sinclair & Kunda, 1999) was associated only with increased AC estimates of activation of negative associations about outgroups (Allen & Sherman, 2011). In another example, Gonsalkorale and Sherman (2007) showed that altering impressions of novel targets (e.g., Rydell & McConnell, 2006) only changes the AC parameter. A third example is that malleability of implicit intergroup attitudes due to the presentation of different group exemplars (e.g., Martin Luther King; Charles Manson; see Blair, Ma, & Lenton, 2001; Dasgupta & Greenwald, 2001; Govan & Williams, 2004) is related only to changes in the AC parameter (Gonsalkorale et al., 2010). None of these studies found evidence for any role for Detection (D), Overcoming Bias (OB), or Guessing (G). Thus, associative influences alone can account for the implicit attitude malleability observed in these studies.

Associative and non-associative influences on implicit attitude malleability

In other cases, malleability is related to both associative and non–associative processes. For example, the finding that implicit bias can be reduced through counter–prejudicial training (e.g., Kawakami, Dovidio, Moll, Hermsen, & Russin, 2000; Gawronski, Deutsch, Mbirkou, Seibt, & Strack, 2008) is associated with both reductions in activation of biased associations and enhanced detection of correct responses (Calanchini, Gonsalkorale, Sherman, & Klauer, 2013).

Non-associative influences on implicit attitude malleability

Evidence that associative influences alone can account for malleability in implicit attitudes is congruent with previous models of implicit attitude change. Evidence that associative and non–associative processes can work together to account for malleability in implicit attitudes expands our understanding of these effects and demonstrates the role of non–associative processes. However, in some cases, associations appear to have nothing to do with malleability in implicit attitudes, suggesting that these effects are due entirely to non–associative processes. For example, the finding that placing outgroup members in positive social contexts reduces implicit bias (e.g., Wittenbrink, Judd, & Park, 2001; Barden, Maddux, Petty, & Brewer, 2004) appears to be related only to enhanced overcoming bias (OB) instigated by the context (Allen, Sherman, & Klauer, 2010). No other parameters were affected by context, indicating that the effect could be explained by non–associative processes alone.

Associative influences on implicit attitude variability

As with malleability, sometimes associations alone are related to implicit attitude variability among participants. For example, the common finding that Black respondents show less anti–Black implicit bias than White respondents (e.g., Fazio et al., 1995; Greenwald et al., 1998; Olson, Crawford, & Devlin, 2009; Rudman, Greenwald, Mellott, & Schwartz, 1999) is associated only with group differences in AC, the associations activated among Black and White respondents (Gonsalkorale et al., 2010). None of the other parameters differed between groups.

Associative and non-associative influences on implicit attitude variability

Associative and non–associative processes not only can work together to account for implicit attitude malleability but they also can account for implicit attitude variability. For example, the well-established finding that people who are internally but not externally motivated to control prejudice (high IMS/low EMS) show less implicit bias than other people (e.g., Amodio, Devine, & Harmon-Jones, 2008; Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002) is related to both lower AC and higher D among high IMS/low EMS people (Gonsalkorale, Sherman, Allen, Klauer, & Amodio, 2011).

Non-associative influences on implicit attitude variability

Non–associative processes alone not only can account for implicit attitude malleability but they also can account for implicit attitude variability. For example, previous research has found a positive correlation between age and implicit race bias (Nosek, Banaji, & Greenwald, 2002): older people are more biased than younger people. Gonsalkorale and colleagues (Gonsalkorale, Sherman, & Klauer, 2009) found that this relationship was associated with reduced overcoming bias (OB) among older respondents. However, the older respondents did not have stronger pro–White or anti-Black associations than younger respondents. As such, the non-associative process OB alone was able to account for age-related variability in implicit race bias.

Non-associative processes can conceal underlying differences in associations

Age-related biases are not limited to the racial domain. Previous research has demonstrated equally strong implicit pro-young bias among younger and older adults (e.g., Hummert, Garstka, O'Brien, Greenwald, & Mellott, 2002; Jost, Banaji, & Nosek, 2004; Nosek et al., 2007), or even slightly greater pro-young bias among older adults (Nosek et al., 2002). Application of the Quad model to this domain (Gonsalkorale, Sherman, & Klauer, 2012) showed that older respondents, in fact, had lower AC estimates of young–pleasant and old–unpleasant associations. At the same time, older participants also had lower OB estimates of overcoming biased associations in performing the task than younger participants. Thus, in this case, age differences in underlying associations were concealed by countervailing age differences in overcoming those associations. Older participants have more favorable (though still biased) associations with aging than do younger participants, but they are less able to overcome those associations when completing implicit measures of bias.

Associative and non-associative contributions to behavior prediction

Just as associative and non–associative components of implicit attitudes may both contribute to malleability and variability effects, so, too, may they both contribute to the ability of implicit attitudes to predict behavior. Gonsalkorale, von Hippel, Sherman, and Klauer (2009) had White non-Muslims interact with a Muslim confederate and then complete a GNAT measuring anti-Muslim bias. The confederate's ratings of how much he liked inter-action partners were predicted by an interaction between estimates of activated associations (AC) and overcoming bias (OB). Specifically, when participants had low AC estimates of negative associations with Muslims, their level of OB was unrelated to how much they were liked by the confederate. In contrast, participants with high AC estimates of negative associ-ations with Muslims were liked to the extent that they had high OB estimates. Thus, the ability to overcome negative associations on the GNAT predicted the quality of the social interaction when those associations were strong.

Summary

The evidence presented in this section demonstrates that both associative and non–associative processes can play roles in implicit attitude malleability, variability, and prediction. In some cases (e.g., Gonsalkorale et al., 2010), these effects can be explained by associative influences alone, whereas in other cases (e.g., Calanchini et al., 2013), they can be explained by both associative and non-associative influences. In yet other cases (e.g., Gonsalkorale et al., 2009), non-associative processes alone can explain implicit attitude malleability and variability. These results highlight the utility of applying the Quad model to measure the distinct contributions of associative and non-associative processes to implicit task performance. An important conclusion is that failing to take into account the role of non-associative processes may provide an incomplete and inaccurate account of implicit task performance.

Implications for Additional Processing Distinctions

The automatic versus controlled nature of implicit task performance

The distinction between associative and non-associative processes is related to other important processing distinctions in the attitudes literature. The evidence presented thus far makes clear that implicit task performance can be influenced by activated associations and non-associative processes. This has important implications for understanding the extent to which implicit task performance reflects relatively automatic versus controlled processes. Just as implicit measures have been assumed to reflect underlying associations, so too have they been assumed to reflect processes that are automatic.

Automatic and controlled processes have traditionally been defined in contrast to one another. A process is considered to be automatic if it is initiated unintentionally, operates efficiently, cannot be terminated once started, and operates outside of conscious awareness. Conversely, a process is generally considered to be controlled if it is initiated intentionally, dependent on cognitive resources, can be stopped voluntarily, and operates within conscious awareness (e.g., Bargh, 1994; Moors & De Houwer, 2006; Gawronski & Creighton, 2013). Implicit measures are designed to reduce the extent to which respondents can intentionally manipulate their responses, reveal responses that are robust to reductions in processing capacity, reduce the imposition of control, and diminish subjective awareness concerning the nature of the task. As a consequence, implicit measures are usually regarded as reflecting solely automatic processes (e.g., Fazio et al., 1995; Greenwald et al., 1998). However, research with the Quad model indicates that claims on the automatic nature of implicit task performance have been overstated.

The development of the Quad model was heavily influenced by dual–process models of cognition and social cognition (Chaiken & Trope, 1999; Sherman, Gawronski, & Trope, forthcoming). Though there are many different dual-process models, they are almost unanimous (but see Gawronski & Bodenhausen, 2006) in dividing psychological processes into two distinct categories: those that reflect automatic processes and those that reflect controlled processes (e.g., Fazio et al., 1995; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000; Greenwald et al., 1998; Kahneman, 2003; Lieberman, 2003; Rydell & McConnell, 2006). The parameters specified in the Quad model reflect processes that are found commonly among these dual-process models. Association Activation (AC) is related to the types of simple associations or habitual responses in dual-process models that are triggered automatically by environmental stimuli without the perceiver's awareness or intent, capturing attention and drawing it away from more deliberate processes (e.g., Schneider & Shiffrin, 1977).

Detection (D) is conceptually similar to the type of accuracy-oriented controlled process found in dual–process models of recollection memory (e.g., Jacoby, 1991; Roediger, 1990), judgment and decision making (e.g., Epstein, 1994; Sloman, 1996), or persuasion (e.g., Chen & Chaiken, 1999; Petty & Wegener, 1999). Overcoming Bias (OB) resembles the type of controlled self-regulatory process found in Wegner's (1994) dual–process model of thought suppression or Devine's (1989) model of stereotype control. Guessing (G) can encompass a variety of secondary influences on responding, ranging from the familiarity component of Jacoby's (1991) process dissociation model, the tendency to prefer objects on the right side of a display (Nisbett & Wilson, 1977), or to intentional self–presentational response biases.

The extents of automaticity and control are empirical questions

It is important to note that, although the Quad model parameters were identified based on their prevalence in dual-process models, the Quad model makes no *a priori* assumptions about the extent to which the processes are relatively automatic versus controlled. The model specifies the qualitative natures of the processes (e.g., this is the process that detects the correct response), but does not specify whether the process occurs automatically or requires/permits control. Rather, questions pertaining to the automaticity versus control of the processes are considered to be empirical questions that must be investigated through careful experimentation. Indeed, research on the Quad model from the time of its initial publication has been directed at just these sorts of questions. This research shows that, just as implicit task performance reflects a combination of associative and non–associative processes, so, too, does it reflect a combination of automatic and controlled processes.

Consistent with how related processes are portrayed in dual-process models, AC and G appear to be relatively automatic in that they are not sensitive to time constraint (Conrey et al., 2005). Conversely, time constraint reduces D (Conrey et al., 2005), suggesting that this process entails the imposition of control, as in dual–process models that include an accuracy detection process. Neuroimaging also has linked D with activation in both the dorsal anterior cingulate cortex and the dorsolateral prefrontal cortex, areas of the brain associated with implementing control (Beer et al., 2008). OB is also diminished by time constraint (Conrey et al., 2005), which is consistent with controlled processing and is, again, consistent with the portrayal of similar self–regulatory processes in dual-process models. OB also is impaired by alcohol consumption (Sherman et al., 2008) and decreases with age (Gonsalkorale et al., 2009; 2012), further attesting to its status as a controlled, inhibitory process.

Undoubtedly, implicit measures constrain controlled processing to a greater extent than do explicit measures. Moreover, our research indicates that implicit measures indeed reflect, in part, the relatively automatic activation of underlying associations. But it also is evident that both Detection and Overcoming Bias possess features associated with controlled processes and that they are important components of implicit task performance. Though respondents may not intend or be aware of the operation of D and OB, they, nevertheless, appear to require sufficient time and resources to operate effectively. These findings indicate that implicit measures should no longer be interpreted as reflecting solely automatic processes. Note that this conclusion holds even when respondents are not aware that they are engaging in such control (e.g., on priming tasks). All that is required for the initiation and operation of these processes is a need to respond correctly to a task despite the influence of underlying associations toward an incorrect behavioral tendency.

Automatic control

The operation of controlled processes in the context of implicit task performance raises important questions about the nature of automaticity and control. After all, implicit measures are explicitly designed to prevent the imposition of control. One possible conclusion is that the measures have simply failed and that better measures may more successfully constrain the operation of control. However, just as we doubt that measures can be free of non-associative processes, we also doubt that they can be entirely free of control. Any task that requires an intentional response (e.g., a button press) must involve some degree of control. Instead, we argue that the operation of Detection and Overcoming Bias demands a more nuanced portrayal of automaticity and control because D and OB possess features of both. For example, though it is clear that their operation can be disrupted, it also is clear that they are sufficiently efficient to influence responses during the performance of implicit tasks. This suggests two important points. First, researchers should resist the temptation to describe processes as either automatic or controlled. Rather, as many others have noted, we should more readily describe the ways in which a process may be both automatic and controlled (e.g., Bargh, 1994; Moors & De Houwer, 2006). Second, we need to broaden the range of processes that may be characterized as automatic. In many dual-process models, the activation of associations represents the automatic process, whereas other processes, including accuracy-oriented and inhibitory processes, are assumed to require control. However, there is growing evidence from our research and many others' (e.g., Glaser & Knowles, 2008; Monteith, Lybarger, & Woodcock, 2009; Moskowitz & Ignarri, 2009) that a variety of processes that counter the influence of activated associations may be automatized to the extent that they influence performance on implicit tasks.

Attitudinal and Non–attitudinal Components of Implicit Task Performance

The distinction between associative and non–associative processes also has implications for the distinction between attitudinal and non–attitudinal processes that influence implicit task performance. Since the development of Fazio's MODE model of attitude–behavior processes (Fazio, 1990), attitudes have increasingly come to be defined in associative terms. That is, according to MODE and related models, an attitude is defined as an evaluative association activated by an attitude object. This conceptualization of attitudes is at the heart of attempts to measure attitudes with implicit measures. Because implicit measures have been assumed to reflect only underlying associations, they have been viewed as more "pure" measures of attitudes, unadulterated by the intervention of non–associative processes that may contaminate explicit measures of attitudes.

However, a non–associative process is not necessarily a non–attitudinal process. That is to say, a process can be non–associative yet still pertain specifically to a given attitude object. We refer to such processes as *non–associative attitudinal processes*. A non–associative attitudinal process can be thought of as domain–specific, in that it is related to the content of a given attitude measure. At the same time, associative and non–associative processes that influence task performance may also be unrelated to the specific attitude object in question. For example, IAT scores sometimes correlate on tests from different attitude domains (e.g., Cai, Sriram, Greenwald, & McFarland, 2004; McFarland & Crouch, 2002), an outcome suggesting the influence of domain-general processes unrelated to specific attitude content. Theoretically, the processes that contribute to this domain generality may be either associative or non–associative in nature. We refer to such processes as *non–attitudinal processes*. Of course, processes may reflect varying degrees of both attitudinal specificity and non–attitudinal domain generality.

Recent evidence suggests that implicit task performance is in some cases driven by non–attitudinal processes. Calanchini, Sherman, and Klauer (2013) had participants complete pairs of IATs that varied in conceptual overlap. Some tests shared a high degree of overlap (i.e., Black/White evaluative IAT; Asian/White evaluative IAT), while other tests shared either moderate overlap (i.e., Black/White evaluative IAT; flower/insect evaluative IAT) or low overlap (i.e., Black/White stereotype IAT; flower/insect evaluative IAT). Quad model parameters were estimated for each test, and the domain generality or specificity of each was explored. Domain-general non-attitudinal processes would be expected to correlate across tests, regardless of degree of conceptual overlap. Conversely, domain-specific attitudinal processes would be expected to correlate across tests to the degree that they shared conceptual overlap. That is, attitudinal processes should correlate to a greater extent across tests with high conceptual overlap than tests with moderate or low conceptual overlap, and this should be true regardless of whether they are associative or non-associative processes.

Two AC parameters were estimated for each test, one representing the association between an attribute and a concept stimulus and another representing the association between the other attribute and the other concept stimulus. For example, when a Black/White evaluative IAT was paired with a flower/insect evaluative IAT, four AC parameters were estimated, representing White–pleasant associations, Black–unpleasant associations, flower–pleasant associations, and insect–unpleasant associations. As such, there were four cross-test AC comparisons possible for each pair of IATs. When the pair of IATs shared a high degree of conceptual overlap, AC parameters correlated significantly in all four cross-test comparisons. However, when the pair of IATs shared either moderate or low conceptual overlap, AC parameters correlated in only one of four cross-test comparisons. That AC parameters correlated to a greater extent across tests with high overlap than tests with moderate or low overlap suggests that AC is a relatively domain-specific, attitudinal process. This is consistent with how AC has traditionally been conceptualized as attitude-specific associations in the Quad model.

One D, G, and OB parameter was estimated for each test and, thus, one cross-test comparison was possible for each parameter in each pair of tests. Neither OB nor G correlated across any tests. This suggests that both are highly domain-specific attitudinal processes. However, in all three studies, D parameters correlated strongly across tests, regardless of conceptual overlap. This suggests that D is, in part, a domain-general, non-attitudinal process because D from one test predicts D from another test independent of the content of either test.

That implicit task performance is, in part, driven by non-attitudinal processes has a number of important implications. First, responses on implicit tasks should no longer be assumed *a priori* to solely reflect attitudinal processes. Second, the role of non-attitudinal processes implies very different conclusions about individual differences in implicit bias, the susceptibility of implicit bias to intervention (i.e., implicit attitude malleability), and the ability of implicit bias scores to predict important behaviors than the standard conceptualization of implicit measures as proxies for attitudinal associations. To the extent that non-attitudinal processes influence implicit task performance, many of these effects may have nothing to do with attitudes, *per se*. Moreover, it is possible that interventions targeting non-attitudinal processes will generalize beyond task and context. For example, D is associated with correct identification of weapons and tools in the Weapons Identification Task (Gonsalkorale, et al., 2011; Payne, 2001) and is responsive to domain-specific training (Calanchini et al., 2013). Thus, training police officers to improve their general object identification skills may also influence their ability to accurately identify the presence of a weapon in the field. Further research should explore this possibility.

Conclusion

Though implicit measures were developed to assess automatically activated attitudinal associations stored in memory, it has become clear that the measures reflect much more than that. The research summarized here provides substantial evidence of the influence of non–associative processes, non–attitudinal processes, and processes that possess features associated with control on a variety of implicit measures. As such, implicit measures cannot be interpreted as proxies for the measurement of activated associations in memory. Similarly, implicit attitude malleability and variability cannot be interpreted as reflecting only differences among activated associations. To be sure, there are cases in which implicit attitude malleability, variability, and behavior prediction can be explained in terms of associative processes alone. However, there are other cases in which these effects are related to a combination of associative and non–associative processes (e.g., Gonsalkorale et al., 2011) or even entirely by non–associative processes (e.g., Allen et al., 2010). Likewise, the variability and malleability of implicit attitudes, as well as the influence of implicit attitudes on behavior, may be due to both attitudinal and non–attitudinal processes (e.g., Calanchini et al., 2013). Moreover, the extent to which any of these processes are automatic, controlled, or some combination of the two is an empirical question, rather than one to be assumed *a priori*. In other words, when it comes to interpreting implicit attitude effects, automatic attitudinal associations are not the whole story, and sometimes they are not the story at all.

This, in turn, has implications for interventions associated with implicit attitude change. Based on the types of research summarized in this paper, researchers can design interventions with a process-level understanding of implicit bias and its relationship to behavior. For example, an intervention that targets associations would be ineffective at altering behavior driven primarily by non–associative processes. At the same time, association-based interventions may be improved upon by also targeting non–associative processes that may constrain or influence the impact of activated associations.

The use of implicit measures has expanded far beyond social psychology to such diverse applications as brand evaluation (e.g., Forehand & Perkins, 2005), phobia treatment (e.g., Teachman, Gregg, & Woody, 2001), medical treatment (Green et al., 2007), and alcohol (Wiers, Van Woerden, Smulders, & De Jong, 2002) and drug therapy (Wiers, Houben, & de Kraker, 2007), to name just a few. The increasing popularity of implicit measures and their application to practical problems magnifies the consequences of misunderstanding what the measures are, how they operate, and how to change the underlying processes that contribute to implicit attitudes and their behavioral consequences. In this paper, we have tried to address some important misconceptions and describe the uses of the Quad model in refining our understanding of implicit attitudes.

Short Biographies

Jimmy Calanchini studies the cognitive, affective, and evaluative components of inter- and intra-group attitudes. One of his specific areas of interest focuses on the role of efficient control in implicit task performance. Jimmy takes a multi-modal approach to research that includes mathematical modeling, multi-agent modeling, and laboratory experiments. His work has been published in the *European Journal of Social Psychology*, and in 2013, he received both the Diversity Fund Travel Award and the Graduate Student Travel Award from the Society for Personality and Social Psychology. He earned his bachelor's degree in psychology from the University of California, Davis, where he is presently a doctoral candidate in social psychology.

Jeffrey Sherman is a Professor in the Department of Psychology at the University of California, Davis. Dr. Sherman's research investigates the cognitive processes underlying social psychology

and behavior. In particular, he is interested in person perception, stereotyping and prejudice, and attitude formation and change. He has authored more than 75 scientific publications on these topics. He is currently Editor of the journal *Social Cognition*. He is the past President of the International Social Cognition Network and is a Fellow of the Association for Psychological Science, the Society of Personality and Social Psychology, and the Society for Experimental Social Psychology. Dr. Sherman was the winner of the 2006 Theoretical Innovation Prize presented by the Society for Personality and Social Psychology, and the 2009 Best Paper Award from the International Social Cognition Network. In 2013, he received the Anneliese Maier Research Award from the Alexander von Humboldt Foundation and the German Federal Ministry of Education. His research has also been funded by the National Institutes of Health and the National Science Foundation. He holds a BA from the University of California, Berkeley, and a PhD from the University of California, Santa Barbara.

Endnotes

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[1] We use the term "implicit measure" to refer to measures that assess attitudes and knowledge indirectly (i.e., without explicitly asking people to report their attitudes and knowledge). The term "indirect measure" may be technically more accurate for our intended meaning, but we will nevertheless use the common terminology of "implicit". We use the term "implicit attitude" to refer simply to an attitude that is measured with an implicit measure.

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