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Mechanisms for the Regulation of Intergroup Responses

INSIGHTS FROM A SOCIAL NEUROSCIENCE APPROACH

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Issues of prejudice and stereotyping have been at the forefront of social-psychological inquiry for much of the field's history. The psychological phenomenon of racial bias embodies the confluence of social psychology's major themes: how elements of the situation interact with attitudes, emotions, motivations, and beliefs to influence behavior, and, more recently, how these influences may operate in automatic or more controlled fashions. For this reason, the area of prejudice and stereotyping has provided a rich context for studying the interplay of social-psychological variables, in addition to addressing important sociopolitical issues. The basic psychological variables underlying prejudice and stereotyping were first formally articulated by Allport in his classic treatise *The Nature of Prejudice* in 1954, and since that time, volumes of research on the topic have been published (Dovidio, Glick, & Rudman, 2005). However, although much has been accomplished in the understanding of intergroup bias, some major questions remain, such as, How is the process of prejudice control initiated in the first place? For such questions that probe the interface of basic cognitive mechanisms and social attitudes, traditional social-psychological theory and methods have limited explanatory power. These limitations have led many social psychologists to expand their approach to include theory and methods from the related areas of cognitive neuroscience and psychophysiology. In this chapter, we review how research from the social neuroscience perspective has contributed to the literature on prejudice and stereotyping. We begin with a brief history of social neuroscience research in the area of prejudice and stereotyping and then describe in more detail how we have used the social neuroscience approach to address important theoretical questions in our own research. Finally, we discuss what we think are some important guidelines for ensuring the successful development of the field of social neuroscience.

A BRIEF HISTORY OF SOCIAL NEUROSCIENCE INVESTIGATIONS OF PREJUDICE AND STEREOTYPING

American history is rife with racial conflict, most notably between the white majority and the black minority. When psychologists first began to study the nature of prejudice and stereotyping in the 1920s and 1930s, discrimination against black people was the norm. In their seminal surveys of racial beliefs, Katz and Braly (1933) found widespread, candid endorsement of African American stereotypes at the time, suggesting that in the 1930s, there were few, if any, normative pressures to appear nonprejudiced (see also LaPiere, 1934). However, as social norms began to shift toward favoring civil rights in the post–World War II era (Schuman, Steeh, Bobo, & Krysan, 1997), respondents grew increasingly reluctant to express prejudice overtly (Crosby, Bromley, & Saxe, 1980). The earliest use of physiological measures in research on racial attitudes was to circumvent deliberate efforts to conceal racial biases. Rankin and Campbell (1955; see also Vidulich & Krevanick, 1966) measured white participants' galvanic skin response, an index of sympathetic nervous system arousal, as they interacted with either a white or a black experimenter. They found larger galvanic skin responses toward black experimenters than white experimenters, suggesting an underlying bias against black people. More recently, facial electromyography (EMG) has been used to measure facial muscle activity associated with affective reactions, such as frowns (corrugator supercillii) and smiles (zygomaticus), during interracial interactions (Vanman, Paul, Ito, & Miller, 1997; Vrana & Rollock, 1998). EMG provides a continuous and unobtrusive measure of emotional responses that is sensitive enough to detect facial expressions unobservable by the naked eye. Participants in these studies showed facial muscle responses toward black individuals that indicated negative affect despite reporting high levels of liking (Vanman et al., 1997; Vrana & Rollock, 1998). Thus, up through the 1990s, physiological measures were used primarily as unobtrusive markers for racial bias (Guglielmi, 1999). In addition, some social psychologists began to incorporate theories from cognitive and behavioral neuroscience without necessarily using physiological measures. For example, Monteith (1993) integrated Gray's (1982; see also Fowles, 1980) neurophysiological model of the behavioral activation and behavioral inhibition systems with social-

psychological theories of self-regulation (e.g., Carver & Scheier, 1990; Rokeach, 1973; Pyszczynski & Greenberg, 1987) to break new ground in understanding the mechanisms of prejudice control.

Since the publication of Guglielmi's (1999) review, social neuroscience research on prejudice and stereotyping has increasingly focused on applying neuroscientific models to probe the sociocognitive mechanisms that underlie different aspects of race bias. For example, research using startle-eyeblink methodology and functional magnetic resonance imaging (fMRI) studies have indicated that the amygdala, a neural structure associated with the detection of threat and fear learning, was more strongly activated when participants viewed out-group (vs. in-group) faces (Amodio, Harmon-Jones, & Devine, 2003; Hart et al., 2000; Phelps et al., 2000). By considering the function of amygdala-based learning and memory, theorists can infer that basic emotional forms of race bias (e.g., implicit prejudice) follow the dynamics of classical conditioning in that they are learned quickly with little cognitive mediation and may be difficult to extinguish. In other research, event-related potential (ERP) studies of expectancy violation and multiple categorization have revealed forms of implicit stereotyping (Bartholow, Fabiana, Gratton, & Bettencourt, 2001) and evaluation (Ito, Thompson, & Cacioppo, 2004) in rapidly activated patterns of neural activity. By using ERPs to track changes in brain activity on the order of milliseconds, these researchers have gained new insights into the time course of implicit and explicit forms of race bias activation and have already shown that stereotype-based processing is evident within 100 milliseconds of encountering a stigmatized group member (e.g., Ito et al., 2004). More recently, researchers using ERP and fMRI measures have linked frontal cortical mechanisms to the regulation of a prejudiced response (Amodio et al., 2004; Cunningham et al., 2004; Richeson et al., 2003). This research has begun to unpack the subprocesses involved in response control, suggesting increasingly refined models of how different personal and situational factors may affect different aspects of control. Taken as a whole, the social neuroscience approach has begun to make important strides in shedding new light on the sociocognitive mechanisms of prejudice and stereotyping. In the following section, we describe our own research on the neurocognitive substrates of prejudice control and discuss its theoretical implications in some detail.

A SOCIAL NEUROSCIENCE APPROACH TO MECHANISMS OF RACE-BIAS CONTROL

For many white Americans, an interracial interaction constitutes a significant self-regulatory challenge. Research has shown that the vast majority of Americans are familiar with the societal stereotypes of African Americans, regardless of whether they believe them to be true (Devine & Elliot, 1995).

Because familiarity with stereotypes leads to their automatic activation, all Americans are susceptible to the influence of stereotypes on their behavior (Devine, 1989). For this reason, people with egalitarian beliefs must effortfully override the influence of automatic stereotypes in order to respond consistently with their beliefs. Furthermore, the initiation of regulatory processes must occur rapidly and with little deliberation in order to facilitate a smooth social interaction.

Several social-psychological models have been proposed to account for the regulation of automatically activated race-biased tendencies (e.g., Bodenhausen & Macrae, 1998; Devine, 1989; Devine & Monteith, 1993; Monteith, 1993). These models posit detailed accounts of stereotype inhibition and response control, yet they have been limited in that they assume that regulatory processes are initiated only after conscious reflection on one's biased course of action. Thus they have limited applicability to the rapid flow of a real-life interaction. Monteith's (1993) model is notable for acknowledging that regulation may be deployed rapidly in the course of an unfolding response to preempt a race-biased behavior, although its focus is on the process of self-regulation that arises from a prejudiced response to prevent future transgressions. Hence previous social-psychological models have not yet addressed the critical step in the regulatory process by which race bias is detected and overridden in a single, rapidly unfolding response. One reason that this step has received little attention may be that the traditional tools of the social psychologist—self-reports, behavioral observation, computerized reaction-time tasks—are poorly equipped for measuring rapid changes in underlying cognitive processes that may be observable only through measures of neural activity. These factors led us to incorporate recent theoretical and methodological advances from the cognitive neuroscience and psychophysiological literatures that were capable of addressing this gap in the prejudice control literature.

Neurocognitive Model of Control

Botvinick, Braver, Barch, Carter, and Cohen's (2001) influential model of cognitive control proposed that two distinct neurocognitive systems work in concert to successfully regulate responses. The first is *conflict-monitoring system* (sometimes referred to as conflict detection), which monitors ongoing responses for conflicts between alternative response tendencies. Research suggests that this system is constantly active, requires few cognitive resources, and operates below conscious awareness (Berns, Cohen, & Mintun, 1997; Nieuwenhuis, Ridderinkhof, Blom, Band, & Kok, 2001). When conflict is detected, a second, resource-dependent *regulatory system* is signaled. The regulatory system draws on more deliberative processing to ensure that one's intended response prevails over the conflicting alternative tendency.

The conflict-monitoring and regulatory systems have been linked to distinct neural substrates. Conflict monitoring has been associated with activity in the anterior cingulate cortex (ACC) in fMRI and ERP investigations, and fMRI data link the regulatory system with activity in the prefrontal cortex (Botvinick, Nystrom, Fissel, Carter, & Cohen, 1999, Carter et al., 1998, Dehaene, Posner, & Tucker, 1994; Kerns et al., 2004; van Veen & Carter, 2002a). This research has shown that ACC activity is heightened when prepotent responses are at odds with one's consciously intended response, such as in the color-naming Stroop task and the Eriksen flankers task (in which a participant must identify a target stimulus [e.g., *S*] amid inconsistent flankers [*HHSHH*] versus consistent flankers [*SSSSS*]).

When applied to the context of race bias, the neurocognitive model of control suggests two ways that automatic stereotypes can make their way into the behavior of a person with low prejudice. The first possibility is that a discrepancy between one's automatic stereotyping tendency and one's egalitarian intentions does not activate the conflict-monitoring system, and therefore the regulatory system is never signaled. The second possibility is that the regulatory system is signaled but is unable to orchestrate the intended egalitarian response needed to override the unwanted stereotyping tendency. Although the theorized role of the *regulatory system* in prejudice control has been addressed in social-psychological research examining the effects of cognitive load (e.g., Gilbert & Hixon, 1991; Spencer, Fein, Wolfe, Fong, & Dunn, 1998), the role of *conflict monitoring* in prejudice control has not been investigated. Thus we were particularly interested in whether conflict monitoring might provide a theoretical account of how regulatory processes aimed at responding without prejudice are initiated in rapidly unfolding behaviors that involve little conscious deliberation. Having identified a useful theoretical framework, our next step was to identify a measure capable of assessing rapid changes in conflict-related ACC activity that could be used in conjunction with a task that reliably elicited response conflicts between automatic stereotypes and the desire to respond in an unbiased manner.

Measuring Conflict Monitoring with ERPs

ERP methods provide the highest resolution of localizable neural activity available among noninvasive neuroimaging techniques. Whereas fMRI and PET typically measure changes in neural activity on the order of seconds, ERPs, derived from either EEG or magnetoencephalography, measure changes on the order of milliseconds. ERPs refer to patterns of neuronal activity that are detectable using electrodes placed on the scalp (see Luck, 2005, for an excellent and highly accessible ERP sourcebook; Fabiani, Gratton, & Coles, 2000, for a review chapter). To observe ERPs, very subtle electrical changes on the scalp are recorded using EEG while a participant responds to events in an experimental task. By recording changes in scalp voltage using EEG at a high sampling rate (e.g., 2000 Hz), ERPs can provide an extremely high-resolution measure of brain activity. Because EEG picks up neural signals from a wide range of neural processes, only a subset of which are related to task events, EEG must be collected from many trials and averaged, such that extraneous EEG signals are "canceled out" and only the signals associated with the experimental event are preserved. When averaging, it is critical that epochs of EEG are aligned with respect to the event of interest (e.g., at the onset of a stimulus or behavioral response) to ensure optimal signal-to-noise ratio of the desired ERP component. This process of averaging is illustrated in Figure 16.1.

Several different ERP components have been identified in the experimental literature, each corresponding to a specific pattern of voltage change detected on the scalp, which in turn reflects a particular underlying pattern of neural activity that is evoked by a specific psychological, perceptual, or behavioral event (for a review, see Coles, Gratton, & Fabiani, 1990). An ERP component that has been shown previously to reflect conflict-related activity in the ACC is the *error-related negativity* (ERN; Gehring & Fencsik, 2001; Falkenstein, Hohnsbein, Hoorman, & Blanke, 1991). The ERN is a response-locked wave, meaning that epochs of EEG for each trial are aligned to the moment a response is made for the averag-

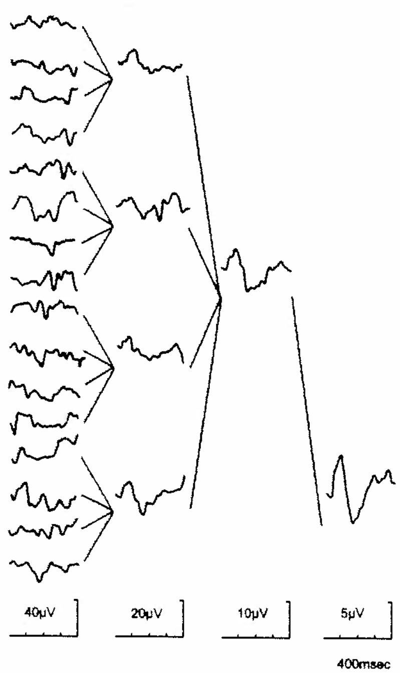

FIGURE 16.1. An illustration of the averaging process used to extract ERPs from epochs of scalp-recorded voltage measured using EEG, adapted from Picton (1980). Several epochs of raw EEG signals are illustrated on the left side of the diagram. As more epochs of raw signal are included in the average, the overall amplitude of the signal diminishes, while a clear event-related "signal" begins to emerge from the background "noise."

ing process. The ERN is characterized by its negative-polarity voltage deflection that peaks approximately at the time a response is made (Gehring, Goss, Coles, Meyer, & Donchin, 1993). It is most strongly pronounced at frontocentral midline scalp sites and originates from the ACC (Dehaene et al., 1994; van Veen & Carter, 2002a). ERNs are specifically sensitive to conflicts that lead to response errors (i.e., failed control; Yeung, Holroyd, & Cohen, 2004), making them particularly useful for examining failures in response regulation. However, conflict monitoring associated with response errors has been shown to arise from the same ACC neural generator as conflict monitoring that leads to successful regulation (Yeung et al., 2004), and therefore an individual's average ERN response provides an index of the general sensitivity of the conflict-monitoring system, which may then be used to predict patterns of successful control (e.g., Gehring et al., 1993; Pailing, Segalowitz, Dywan, & Davies, 2002).

Behavioral Task

A good behavioral task serves two purposes in a neuroscience experiment: (1) it elicits the neural response of interest and (2) it provides behavioral data that can corroborate one's interpretation of the elicited neural response. Furthermore, because a particular neural structure is often involved in multiple psychological processes (Cacioppo, Tassinary, & Berntson, 2000), it is advisable to choose behavioral tasks that offer several measures of related processes to permit an assessment of convergent and discriminant validity. With these considerations in mind, we needed a task that could (1) provide separate, theoretically independent indices of automatic stereotyping and controlled response patterns, (2) elicit a sufficient number of errors across trial conditions to permit reliable analyses of accuracy and ERP averages, (3) elicit ERN waves concurrently with behavioral responses, and (4) be completed with minimal head movement, thereby enabling artifact-free EEG recording. After considering several different tasks, we chose to use Payne's (2001) weapons identification task because it best suited these requirements.

The weapons identification task is a sequential priming task designed to elicit high- versus low-conflict stereotype-related responses in a way that is conceptually similar to the Stroop or flankers tasks. On each trial of the weapons identification task, a black or a white face is presented for 200 milliseconds, followed by a picture of either a handgun or a hand tool, presented for 200 milliseconds and then masked (Figure 16.2). Participants must quickly categorize each target as a gun or a tool via button press. Because white Americans tend to associate black faces with danger and hostility (Devine & Elliot, 1995), black face primes tend to facilitate correct categorization of guns. By the same token, because a black face primes a gun response, it interferes with the correct categorization of tools, thereby eliciting high levels of response conflict. By this logic, black–gun trials may be thought of as low-conflict trials, whereas black–tool trials may be

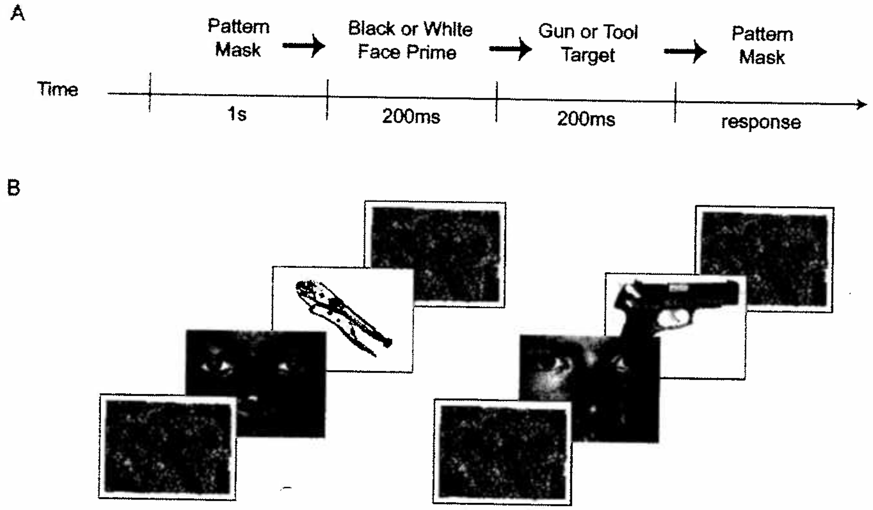

FIGURE 16.2. Schematic of weapons identification task, adapted from Payne (2001), illustrating the time course of events (A) and stimuli (B).

thought of as high-conflict trials. Because white faces are not typically associated with either guns or tools, they should not differentially affect responses to targets.

Conventional response facilitation indices of automaticity (e.g., degree of response facilitation) may be derived from responses on the weapons identification task (Fazio, 1990), and levels of response control may be inferred from measures of post-error slowing and accuracy (Rabbit, 1966). However, response facilitation scores are limited in their ability to index purely automatic or controlled processes because any deliberative response (such as a key press) involves some degree of control, and therefore response-latency measures provide somewhat ambiguous indicators of automatic versus controlled processing (Jacoby, 1991). With this limitation in mind, the weapons identification task was designed to provide theoretically independent measures of automatic processing (e.g., stereotype-based responding) versus controlled processing (e.g., accuracy-based responding), as inferred from patterns of error rates according to the processes dissociation (PD) procedure (Payne, 2001). According to the PD framework, the independent effects of automatic and controlled processes can be dissociated using tasks that place these processes in opposition to one another. For example, when a correct response is congruent with automatic tendencies (e.g., choosing "gun" following a black face), automatic and controlled processes act in concert. When a correct response is incongruent with automatic tendencies (e.g., choosing "tool" following a black face), automatic and controlled processes act in opposition. By assessing accuracy performance across congruent (black–gun) and incongruent (black–tool) trial

types, independent estimates of automatic and controlled processes may be obtained (see Payne, 2001, for PD formulas), which permits us to assess the convergent and discriminant validity of the ERN as a measure of conflict monitoring.

A Neural Mechanism for Recruiting Prejudice Control

The preceding paradigm was initially used by Amodio et al. (2004) to demonstrate the role of conflict monitoring in the process of prejudice control. Although participants reported low-prejudice attitudes on average, they exhibited a pattern of automatic race bias on the weapons identification task such that black faces facilitated responses to guns and interfered with responses to tools relative to white faces. These results suggested that enhanced control was needed to override the prepotent tendency to erroneously choose "gun" on black–tool trials. Next, we examined participants' ERN amplitudes to test whether levels of behavioral control could be explained by individual differences in conflict monitoring. As illustrated in Figure 16.3, error responses to all trial types elicited the typical ERN wave relative to correct responses, consistent with the idea that a response error generally conflicts with one's intention to respond accurately. However, the ERN was significantly larger on black–tool trials, on which automatic stereotypes created high response conflict, compared with the other trial types, supporting the hypothesis that the need to control stereotypes elicits activity of the neural system for conflict monitoring. To further validate the meaning of the ERN effect, we examined correlations between ERN ampli-

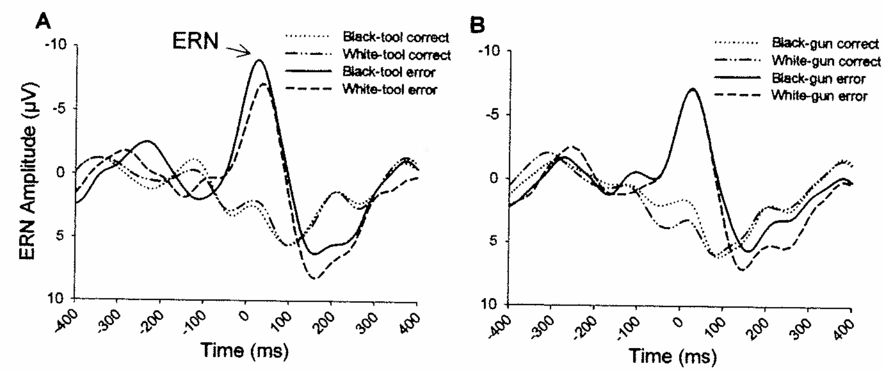

FIGURE 16.3. Response-locked event-related potential waveforms for correct and incorrect tool (A) and gun (B) trials as a function of race of face. The larger error-related negativity (ERN) elicited on black–tool trials reflects the heightened activity of the conflict-monitoring system when an automatic stereotyping tendency conflicts with participants' intention to correctly categorize the target as "tool." (Zero indicates the time of the key press.)

tudes and PD estimates of automatic and controlled responding. Consistent with predictions, larger ERN amplitudes were associated with higher levels of PD control, as well as longer posterror response latency and accuracy. On the other hand, ERNs were uncorrelated with the PD estimate of automatic processing, consistent with the idea that all participants would show similar levels of automatic bias, independent of whether they engaged controlled processing.

Taken together, these findings demonstrated that conflict-monitoring processes are activated in response to automatic race-biased tendencies at very early stages of response execution. In a broader sense, the findings identified an important component of prejudice control that had not been addressed in previous social-psychological models. Hence, this work suggested a new theoretical framework and methodology for addressing some enduring questions regarding the regulation of behavior in response to race bias.

APPLYING A NEW MECHANISM TO OLD QUESTIONS

The next step in our program of research was to apply the findings of Amodio et al. (2004) to a question that has captured the attention of prejudice researchers for years: Why do racial biases sometimes appear in the behavior of well-intentioned egalitarians? And why do some low-prejudice people have more trouble responding without prejudice than others with similarly low-prejudice beliefs? Amodio et al.'s (2004) findings raised the possibility that individual differences in the ability to control bias may be rooted in the conflict-monitoring process. In the next section, we describe how we applied the conflict-monitoring model of prejudice control to address this question.

Individual Differences in the Ability to Respond without Prejudice

All people who are truly low in prejudice desire to respond without prejudice, yet some tend to be more effective than others (e.g., Devine, Monteith, Zuwerink, & Elliot, 1991; Dovidio, Kawakami, & Gaertner, 2002; Gaertner & Dovidio, 1986; Moskowitz, Gollwitzer, Wasel, & Schaal, 1999). Research has shown that this variability is related to the motivations behind people's efforts to respond without prejudice (Amodio et al., 2003; Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002). For example, some people are internally motivated to respond without prejudice—they inhibit race biases primarily for personal reasons. Others are externally motivated—they inhibit bias primarily to avoid social disapproval (Plant & Devine, 1998). Some people may be motivated for both reasons, whereas still others are simply not motivated for either reason. Research examining

the effects of these motivations on people's ability to control bias has characterized good regulators as people low in prejudice who respond without prejudice primarily because it is personally important to them (i.e., high internal, low external motivation). Poor regulators are people low in prejudice who respond without prejudice for personal reasons but also because they are worried about social disapproval (i.e., high internal, high external motivation). Finally, one may think of nonregulators as people high in prejudice who are simply uninterested in responding without prejudice for internal reasons (although some nonregulators might feel the need to conceal their prejudice in social situations to avoid disapproval; see Devine, Brodish, & Vance, 2005; Plant, Vance, & Devine, 2006).

Amodio, Devine, and Harmon-Jones (2006) proposed that individual differences in the conflict-monitoring process might account for differences between good and poor regulators. They hypothesized that the neural systems of poor regulators may be less sensitive to conflict between an automatic race-biased tendency and an egalitarian response intention compared with good regulators. To test this hypothesis, they recruited participants who fit the profiles of good, poor, and nonregulators based on their scores on the Internal and External Motivation to Respond Without Prejudice scales, as in past research (Plant & Devine, 1998), and then tested for differences in these groups' average ERN responses as they completed the weapons identification task. As in past work, the researchers found that all participants showed evidence of automatic stereotyping (i.e., elevated PD-automatic scores for black vs. white faces), yet good and poor regulators reported equally positive attitudes toward black people. Thus good and poor regulators needed to regulate their responses, whereas nonregulators did not. However, an examination of response control (PD-control estimate) showed that good regulators were significantly better at responding without bias than poor regulators. As hypothesized, the difference between good and poor regulators in behavioral control corresponded to their differences in conflict monitoring on trials in which control was needed to overcome bias. That is, good regulators exhibited an enhancement in ERN amplitudes when responses required the control of automatic stereotypes (i.e., on black–tool trials; see Figure 16.4), but poor regulators did not. Indeed, the difference in behavioral control between good and poor regulators was found to be fully mediated by their ERN amplitudes, suggesting that poor regulators are less effective in regulating their intergroup responses because their conflict-monitoring systems were relatively insensitive to discrepancies between a tendency to use stereotypes and their intention to respond without bias. By considering the neurocognitive mechanisms involved in the control of race bias, these results were able to address what has been an enduring and often puzzling question in the prejudice literature.

Our findings (Amodio et al., 2005) indicated that poor regulators may respond with prejudice for different reasons than nonregulators and that,

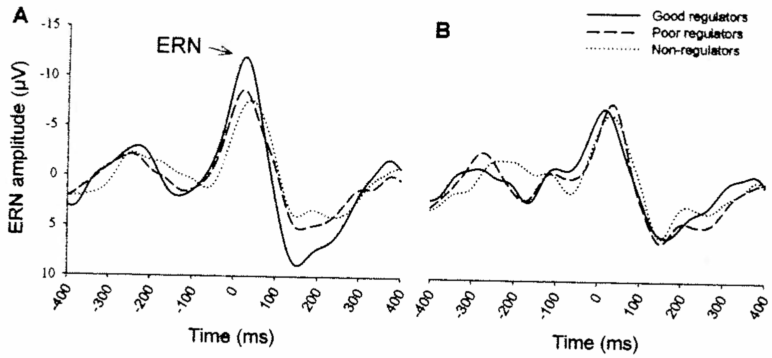

FIGURE 16.4. Error-related negativity (ERN) amplitudes associated with black–tool (A) and black–gun trials (B) as a function of regulation group. Good regulators showed larger ERNs only on trials requiring the inhibition of a stereotype-based response. ERNs did not vary by group when responses did not require stereotype inhibition. (Zero represents the time of key press.)

therefore, different prejudice-reduction strategies could be targeted for these two groups. Whereas past efforts at prejudice reduction have focused on influencing people's consciously held attitudes and beliefs, our findings suggest that for people who fit the "poor regulator" profile, efforts should focus on enhancing the strength of the conflict-monitoring signal in situations in which control is needed. One must ask, Why were conflict processes lower among the poor regulators? One possibility is that poor regulators' brains are simply less sensitive to response conflicts; however, this explanation is not supported by the data. For example, the ERNs of poor regulators did not differ from those of other groups when response conflict was unrelated to race-bias control (e.g., on black–gun trials). A more plausible possibility is that situations requiring control do not strongly activate belief-based response tendencies at automatic levels of processing among poor regulators compared with good regulators and therefore prejudice-reduction strategies should focus on automatizing responses to cues that control is needed. At the theoretical level, Monteith (1993) emphasized the importance of learning to recognize such "regulatory cues" (see also Devine & Monteith, 1993), although this work focused on more deliberative forms of cue processing. Our findings highlight the important role of the more automatic processing of regulatory cues (e.g., Kawakami, Dovidio, Moll, Hermsen, & Russin, 2000; Monteith, Ashburn-Nardo, Voils, & Czopp, 2002; Moskowitz et al., 1999). One way to accomplish automatic cue sensitivity is through repetition training, in which a person practices identifying stimuli that might normally elicit unwanted stereotypic associations. Kawakami et al. (2000) showed that this type of training is effective in enhancing behavioral control. A next step in this line of research would be to test whether this type of training affects the conflict-monitoring system.

Using Social Neuroscience to Uncover New Neural Mechanisms of Control

Our previous work has focused on how people regulate their race-biased behavior in private, when concerns about social disapproval are not an issue. Yet much research has shown that normative pressures can have a profound influence on people's behavior as well (Cialdini & Trost, 1998). For example, some people high in prejudice have been shown to change their behavior in order to appear nonprejudiced when giving responses in public (Plant & Devine, 1998; Plant, Devine, & Brazy, 2003). However, the mechanism by which highly externally motivated individuals control prejudice in public situations is unknown. Does enhanced control occur via a preconscious mechanism, such as conflict monitoring? Or does it reflect a conscious, deliberative effort to modify one's behavior?

To investigate how mechanisms of prejudice control might operate differently when motivated by internal versus external concerns, we conducted a study in which participants completed the weapons identification task either privately or while being observed by an ostensibly nonprejudiced experimenter (i.e., in public; Amodio, Kubota, Harmon-Jones, & Devine, 2006). Because people vary in their sensitivity to external pressures (e.g., Plant & Devine, 1998), we recruited participants who reported either very high or very low levels of external motivation to respond without prejudice. By considering this combination of situational and dispositional factors, we could make the focused prediction that neural mechanisms of control that operate specifically in response to normative pressures should emerge most strongly in the public condition and only among participants high in sensitivity to external social pressures.

As described earlier, cognitive neuroscience research has identified the conflict-monitoring process, measured via the ERN, as a preconscious mechanism for eliciting control. In contrast, social-psychological theory has emphasized a postconscious mechanism of control that is recruited when an individual becomes consciously aware of an initial response error and that leads to a more careful style of responding (Devine, 1989; Monteith, 1993; Monteith et al., 2002; Bodenhausen & Macrae, 1998). Recent work has shown that the postconscious awareness of a response error on a cognitive conflict task, referred to as *error perception*, is associated with the error-positivity (P_e) ERP wave (see Figure 16.5a; Nieuwenhuis et al., 2001). Thus, the ERP literature has identified two separate neural processes linked to different aspects of control. The P_e is a positive-polarity wave that immediately follows the ERN. Whereas the ERN is generated by the dorsal ACC, the P_e has been linked to activity of the rostral ACC (Kiehl, Liddle, & Hopfinger, 2001; van Veen & Carter, 2002), an area associated with affect and awareness in response to error commission (Bush, Luu, & Posner, 2000). However, few studies have found an association between P_e amplitude and changes in behavioral measures of control, and therefore the functional significance of the error-perception process is not well understood.

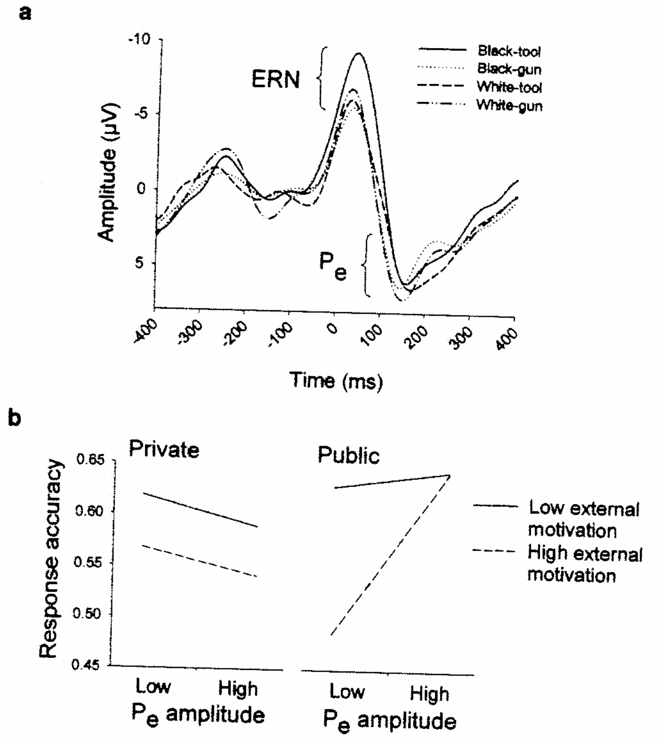

FIGURE 16.5. Error-related negativity (ERN) and error-positivity (P_e) waveforms (see labels) elicited during weapons identification task (Panel A; zero indicates the time of the key press). Panel B illustrates predicted values for behavioral control as predicted by error-positivity (P_e) amplitudes as a function of private versus public response condition for participants reporting high vs. low external motivation to respond without prejudice. Behavioral control represents a probability estimate of control derived using the process-dissociation (PD) procedure. Predicted values of PD control show that P_e amplitudes predicted control only among externally sensitive participants who responded in the public condition.

We proposed that prejudice control motivated by external concerns would involve the error-perception process because the error-perception process could theoretically support more conscious forms of conflict appraisal associated with complex social contingencies (Amodio & Frith, 2006). We therefore predicted that whereas the ERN reflects a basic mechanism for recruiting control across situations, the P_e reflects an additional process that emerges only when external cues, such as the presence of normative social pressures to respond without prejudice, are used to evaluative one's performance and regulate behavior.

Our primary interest in this research was in the association between alternative neural processes and behavioral control. Specifically, we examined the effect of the ERN and P_e waves on behavioral control on the weapons identification task. As in past work, we found that ERN amplitudes predicted behavioral control across conditions, corroborating the important role of conflict monitoring in eliciting control regardless of the social situation. However, the association between P_e amplitude and behavioral control followed a different pattern: The P_e wave predicted control only among highly externally motivated participants who responded in the public condition (Fig. 16.5b). This pattern of effects was replicated when the dependent measure was response accuracy (see Amodio et al., 2006). These findings suggest that the error-perception process elicits control specifically when behavior must be modulated according to external social cues, beyond the effects of conflict monitoring found in previous work.

The results of this research suggest that two processes, pre- and postconscious, are at work when behavior is controlled in response to normative pressures. Based on these findings, prejudice researchers may develop new hypotheses regarding how situational factors affect people's ability to control prejudice. For example, past work suggests that the conflict-monitoring process does not rely on cognitive resources. On the other hand, error-perception processes may rely heavily on cognitive resources. Therefore, cognitive load may have a deleterious effect on the ability to control prejudice in public for people high in external motivation but not for those low in external motivation, as reported by Lambert et al. (2003). At a broader level, this research is noteworthy because it suggests a function for a pattern of neural activity that emerges only in certain social situations. That is, although past work had identified the P_e wave as a potential elicitor of control, a consideration of situational factors and individual differences helped to elucidate the parameters of its function.

As a whole, our program of research on prejudice control has combined many important elements of the social neuroscience approach. Our initial questions arose from theoretical issues in the prejudice and stereotyping literature. To address these questions, we incorporated neurocognitive theory on the conflict-monitoring component of control and adopted psychophysiological methods of measurement that were most appropriate for assessing our theoretical construct. After establishing a paradigm for examining the role of conflict monitoring in prejudice control (Amodio et al., 2004), we used the paradigm to address questions about individual differences in the ability to control prejudice. Here, we demonstrated that error-detection processes accounted for individual differences in the ability of people with low prejudice to override the influence of automatic stereotypes on their behavior. These findings then raised new questions of how mechanisms of control are affected by external social pressures to respond in a nonprejudiced way. Our research on the effects of external pressures identified a new mechanism of behavioral control, the error-perception process, as having a targeted effect on control that emerges only among people who are sensitive to normative pressures when those pressures are salient. Finally, these findings have generated new hypotheses regarding methods of prejudice reduction tailored to individuals with a particular motivational profile (e.g., poor regulators). We believe that the findings from this program of research could only have resulted from a social neuroscience approach.

IMPORTANT ISSUES FOR THE DEVELOPMENT OF SOCIAL NEUROSCIENCE

In this section, we describe what we think are some of the important issues that social neuroscientists will need to address in order for the field to develop successfully. We begin with a few suggested guidelines for conducting social neuroscience research.

1. *Social neuroscience research should be theory driven.* Science is a theory-based endeavor. Hypotheses are formed based on previous observations and theory, submitted to empirical tests, and then revised as needed. Much of the cachet that social neuroscience research has enjoyed in recent years appears to arise from its innovative methodology. However, the longevity of social neuroscience as an approach will no doubt depend on its ability to contribute to theory. As in other areas of research, it will be important for social neuroscientists to let their theoretical questions drive their use of methodology and not vice versa.

2. *Neural correlates of social-psychological processes should be validated with behavioral and/or individual-difference measures.* The brain is an extremely complex organ, and measurable neural activations are almost always likely to be multiply determined. That is, many different factors can contribute to activity of a particular neural region at any given time. Although many scientists have relied on subtraction procedures in fMRI and ERP research to isolate task-specific activations, the subtraction procedure may not be sufficient to establish validity of the neural response. For most investigations involving social psychology, the best way to validate the meaning of a pattern of neural activity is to show that neural activations obtained using subtraction are correlated with theoretically related behavior. Alternatively, experimental precision may be gained through the use of individual-difference factors in interaction designs, whereby a hypothesized neural response occurs only among certain individuals under specific conditions.

3. *Social neuroscience research should focus on mechanisms of social processes.* The ability to address questions of mechanism is one of social neuroscience's greatest assets. Social neuroscience researchers are not typically interested in brain mapping but rather in the implications of known neural functions for understanding social processes. By applying knowledge of functional and anatomical interconnectivity in the brain, researchers

may develop new theories of how basic mechanisms interact to produce social-psychological phenomena. Moreover, neuroimaging methods such as fMRI and ERP provide powerful tools for measuring the activity of neural mechanisms directly and unobtrusively. We believe that the unique potential of social neuroscience for addressing questions about psychological mechanisms is what will ultimately make it indispensable to the field.

4. *Social neuroscience research should integrate the theory and methods of neuroscience and social psychology.* A truly integrative approach combines theoretical perspectives to form novel hypotheses, tests them using a multidisciplinary set of methods, and offers interpretations of findings that make use of the theoretical traditions of each constituent field. That is, integrative research goes beyond using new methods to measure existing constructs; it incorporates ideas from other literatures to better understand a construct from one's own literature. For example, many researchers have discovered physiological markers of prejudice, such as amygdala activity indexed by fMRI or startle-eyeblink modulation. However, simply using a new method does not in itself reveal something new about the underlying process. By associating prejudice with amygdala activity, one can access the large literature on the role of the amygdala in emotional learning and its neural interconnectivity to broaden understanding of the phenomenon of prejudice and to generate interesting new hypotheses. Much of the potential of social neuroscience to have a lasting impact rests on researchers' success in drawing inferences from diverse perspectives in this way.

Contributions of Social Neuroscience to Cognitive Neuroscience

Social neuroscience research has already advanced our understanding of several important social-psychological phenomena, such as prejudice activation and control, emotions, and attitudes. Indeed, it can be argued that most research taking the social neuroscience approach is geared toward understanding social and affective processes. But what has social neuroscience done for cognitive neuroscience lately? Our research on the function of the error-perception process in externally motivated prejudice control provides one example of how a consideration of social factors may elucidate a basic neurocognitive mechanism. As another example, Eisenberger and Lieberman (2004; Eisenberger, Lieberman, & Williams, 2003) showed that the ACC is involved in social exclusion, a form of "social" pain, suggesting a more elaborate function of the previously delineated pain circuit. Recent work by Taylor and colleagues has expanded on the known functions of the hormone oxytocin through a consideration of social factors (Taylor et al., 2004; Taylor & Gonzaga, Chapter 21, this volume). By comparing levels of oxytocin with profiles of participants' personal relationships and psychological stress levels, they found evidence that oxytocin is involved in social distress and may serve to motivate social behavior rather than being a consequence of affectionate social interaction, as previously believed. Finally, research by Harmon-Jones and his colleagues (e.g., Harmon-Jones & Allen, 1998) has addressed a debate over the interpretation of frontal cortical asymmetry effects by examining the role of a uniquely social emotion: anger. Previously, some theorists have described frontal asymmetry as reflecting the valence of one's emotional state, with left-sided activity relating to positive emotions and right-sided activity relating to negative emotions (e.g., Silberman & Weingartner, 1986). Other theorists have described the asymmetry as reflecting one's motivational orientation, such that left-sided activity is associated with approach and right-sided activity with withdrawal (Davidson, 1992). Unfortunately, research had examined only the effects of stimuli that were either positive *and* approach-related or negative *and* withdrawal-related, thereby confounding any attempts to disentangle the alternative interpretations. Harmon-Jones and his colleagues proposed that anger—a negative emotion that is approach-oriented—would provide the critical test of these competing views (see Harmon-Jones, 2003, for a review). Across several studies, they found that anger was linked to greater left-sided activity, supporting the motivation account. These recent lines of research provide examples of how the social neuroscience approach may lead to theoretical advances in cognitive neuroscience, psychoneuroimmunology, and psychophysiology.

Importance of Social Neuroscience Findings for the Nonneuroscientist

An important role for social neuroscientists to take is that of the interpreter. It is incumbent on social neuroscientists to communicate the implications of their findings for other theoretical perspectives, such as traditional social psychology, cognitive psychology, neuroscience, and psychoneuroimmunology, so that researchers in these fields can (1) integrate new findings obtained through a social neuroscience approach into their existing theories and (2) appreciate the value of social neuroscience. Effective communication of social neuroscience's contributions will be essential for its survival as an emerging field.

Conclusion

Social neuroscience holds great promise for advancing the understanding of the mind and brain. As an emerging field, the social neuroscience approach is still developing, finding its identity, and occasionally experiencing growing pains. Nevertheless, the social neuroscience approach has already led to many important contributions to prejudice research and to psychological science more broadly, as detailed throughout the present volume, and there continues to be much enthusiasm among students for interdisciplinary

training in social psychology and neuroscience. Ultimately, like previous hybrid fields such as "social cognition," "cognitive neuroscience," and "psychoneuroimmunology," the greatest potential contribution of social neuroscience lies in its ability to bring together researchers with diverse backgrounds who are working toward the common goal of understanding mind, body, and behavior in order to make discoveries that could only be achieved through their joint effort.

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