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Person perception

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Jean Decety

John T. Cacioppo

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SHORT CONTENTS

CONTENTS

Person Perception

Bruce D. Bartholow *and* Cheryl L. Dickter

Abstract

This chapter is concerned with the ways in which the use of various psychophysiological measures, and the theory that underlies their use, has advanced understanding of person perception. A social neuroscience approach can be useful for testing theory and advancing the science of person perception. In particular, event-related brain potentials (ERPs) provide a time-sensitive means of measuring and separating the rapidly unfolding cognitive and affect-related processes theorized in many models of person perception, and functional brain imaging permits a detailed picture of the neural structures that subserve these processes. Neuropsychological studies also offer important insights into the functions of particular regions of the brain that appear crucial for effective person perception. Most importantly, linking these neural indices with important psychological and behavioral outcomes can provide a more comprehensive understanding of person perception than can be gained by any self-report, behavioral, cognitive, neural, or biological approach alone.

Keywords: person perception, cognitive neuroscience, psychophysiological measures, stereotyping, perception of emotion, face perception, impression formation

In his influential 1990 text, *Interpersonal Perception*, Ed Jones nicely encapsulated the essence of person perception as how people try to determine what another person is "really like" inside. More specifically, Jones described how people "come to understand what makes a particular person—including ourselves—behave in particular ways" (p. 1). People seem innately driven to make such determinations. Indeed, given the ways in which cognitive processing is biased toward formation of and reliance on categories and expectancies (see Allport, 1954; Bruner, 1957), it is virtually impossible for social interactions to proceed in any other way. According to Jones (1990), when we perceive a person we draw conclusions about him or her, often rapidly and

automatically, sometimes thoughtfully and carefully. A brief (and nonexhaustive) list of the psychological processes involved in this pursuit includes some of the most basic, foundational issues in social psychological research: causal attribution, expectancies, assessment of situational constraint—and its converse, the correspondence bias—and various self-presentation goals and strategies. In this chapter we will be concerned with the ways in which the use of various psychophysiological measures, and the theory that underlies their use, has advanced understanding of person perception. However, given the attention paid to them in other chapters in this volume, we will only briefly consider some topics of central interest to person perception researchers,

such as stereotyping, perception of emotion, face perception, and impression formation.

Why Study Person Perception from a Social Neuroscience Perspective?

Before reviewing the literature on the social neuroscience of person perception, it is important to first briefly examine what can be gained by using a social neuroscience approach to studying this topic. Person perception research has a deep and important history in social psychology. It goes without saying that the behavioral methods traditionally used in person perception research, including recall (i.e., person memory), response latency, and self-reported evaluations (among others; see Olson, Roese, & Zanna, 1996), have provided a strong foundation for advancing our understanding of how and why people attempt to draw conclusions about others' traits. However, the nature of the cognitive and affective processes thought to be important for person perception makes certain theoretical questions difficult to address when using behavioral and self-report methods alone. For example, when participants are better able to recall information about people in one condition versus another, we infer that the information in the former condition received more extensive processing than the information in the latter condition. In this sense, recall represents one *outcome* of some cognitive activity associated with memory, but a number of processes likely intervene between stimulus encoding and recall that are not well represented in a memory measure.

In contrast, augmenting a memory measure (or other measures) with one or more psychophysiological measures can provide insight into theoretically relevant intervening processes. As we review more extensively later in this chapter, for example, event-related brain potentials (ERPs) have been used in a number of studies to elucidate the stage(s) of processing at which information that violates previously formed impressions of others is processed differently (e.g., more extensively) than information that confirms prior impressions (e.g., Bartholow, Fabiani, Gratton, & Bettencourt, 2001; Bartholow, Pearson, Gratton, & Fabiani, 2003; Van Duynslaeger, Van Overwalle, & Verstraeten, 2007). Such information is important for understanding not only the timecourse of person perception processes (e.g., Ito, Thompson, & Cacioppo, 2004), but also the specific mechanisms of information processing that are involved.

More generally, it is important to consider what kinds of information can be gained by the use of particular psychophysiological and/or neuropsychological measures and methods. For example, the two primary brain-based measures used in social neuroscience research on person perception, ERPs and functional magnetic resonance imaging (fMRI), provide data relevant to quite different levels of analysis. Specifically, ERPs provide excellent temporal resolution of brain activity (on the order of milliseconds following a stimulus event), relevant to the timing of relevant psychological processes. Such data can be very useful for testing hypotheses derived from multiple-stage models of person perception, such as various dual-process models (see Chaiken & Trope, 1999). However, ERPs can provide only very limited information on the specific neural structures producing relevant information-processing activity (see Chapter 6 in this volume for more information on ERP measures). The converse is true of fMRI: the temporal resolution of the signal is quite sluggish by comparison, on the order of 4–6 seconds following an eliciting stimulus event, but spatial resolution is very good, allowing for quite specific inferences concerning the neural sources of relevant psychological processes. Such data can be very useful for both exploratory purposes, such as identifying structures involved in forming impressions (e.g., Mitchell, Cloutier, Banaji, & Macrae, 2006), and for testing hypotheses concerning differences in the activity of specific structures across experimental conditions.

Another important difference between ERP and fMRI measures is that whereas ERPs represent a fairly direct measure of the electrical activity of the brain associated with information-processing operations (see Rugg & Coles, 1995), the fMRI BOLD (blood oxygen level dependent) signal is a rather indirect measure, reflecting the dynamics of blood flow and resource utilization (represented by the ratio of oxygenated to deoxygenated hemoglobin in the blood) in various parts of the brain. In other words, fMRI highlights areas of the brain where activity is assumed to have recently increased or decreased, but does not, technically, represent the activity of neurons as the brain processes information.

Cognitive Neuroscience Studies of Person Perception

Although the social neuroscience of person perception is still a relatively new field, the literature is sufficiently large as to limit the coverage any single chapter can provide. Here, we have chosen to focus primarily on research in which measures of brain activity or brain functionality were used. This decision was

purely a practical one, and is in no way intended to suggest that studies using other psychophysiological measures, such as cardiovascular and other autonomic nervous system measures, are not as useful as brain-based measures.

ERP Studies

Although the existence of bioelectrical potentials in the brain had been known for decades prior (e.g., Bartholow, 1882), Hans Berger (1929) was the first to describe a method for recording the electrical activity of the human brain (the electroencephalogram; EEG) from the surface of the head by placing a pair of electrodes on the scalp and connecting them to a differential amplifier. Other scientists (e.g., Davis, Davis, Loomis, Harvey, & Hobart, 1939) later discovered that when stimuli are presented during EEG recording, epochs of the EEG that are time-locked to stimulus onset can be defined. With repeated sampling, that portion of the EEG representing the neural response to a specific stimulus (or stimulus class) emerges from the ongoing, "background" EEG signal as a series of positive and negative voltage deflections known as components. Decades of systematic research has linked these components to specific information-processing operations (see Rugg & Coles, 1995). In general, component amplitude reflects the extent of neural activation associated with a particular cognitive operation (or set of operations), while component latency reflects the time required to carry out that operation (e.g., Gehring, Gratton, Coles, & Donchin, 1992; Fabiani et al., 2007; Rugg & Coles, 1995). However, it is important to stress that any given component likely represents numerous simultaneously occurring processes (see Coles & Rugg, 1995).

Armed with this knowledge, social psychologists began a series of fruitful collaborations with cognitive psychophysiologists in the early 1990s to better understand the information-processing operations involved in person perception (e.g., Cacioppo, Crites, Gardner, & Berntson, 1994). These early studies focused primarily on a late positive component in the ERP known as the P3 or P300, so named because of its positive voltage and peak latency (in early studies) around 300 ms post-stimulus. This component had been widely studied by cognitive psychophysiologists for many years, and had been associated with the brain's response to novelty (Friedman, Cycowicz, & Gaeta, 2001), in that P300 amplitude increases as the subjective probability of an eliciting event decreases (e.g., Donchin & Coles, 1988;

Duncan-Johnson & Donchin, 1977; Squires et al., 1975). The P300 has been described as a manifestation of context updating in working memory, based on numerous studies indicating better subsequent memory for stimuli that elicit larger P300 amplitude (e.g., Donchin, 1981; Donchin & Coles, 1988; Friedman & Johnson, 2000), and more generally as an indication of the motivational significance or relevance of an eliciting stimulus (see Nieuwenhuis, Cohen, & Aston-Jones, 2005). The peak latency of the P300 serves as a neural indicator of stimulus evaluation or categorization time, with longer latencies indicating more effortful categorization (see Coles, 1989). Despite its name, it is not uncommon for the P300 to peak substantially later than 300 ms in tasks involving complex social or emotional stimuli (see Bartholow & Amodio, 2009; Bartholow & Dickter, 2007), a fact that has led some to posit a difference between the "classic" P300 elicited in purely cognitive tasks and a "late positive potential," or LPP, elicited by stimuli that carry more social or emotional significance (e.g., Schupp et al., 2000).

Given that the P300 serves as an index of subjective probability in categorization processes (e.g., Donchin & Coles, 1988; Friedman et al., 2001), Cacioppo and his colleagues (Cacioppo et al., 1993) reasoned that it also should mark the implicit categorization of evaluatively consistent and inconsistent attitude objects. In their initial study, Cacioppo et al. (1993) developed stimulus sets consisting of valenced (i.e., positive and negative) words presented in sequences in which word valence either was evaluatively consistent or was evaluatively inconsistent. As predicted, Cacioppo et al. found that P3 amplitude was much larger to a given target type when it was preceded by words from a different evaluative category (e.g., a negative target following positive words) than when it was preceded by words from the same evaluative category (e.g., a negative target following negative words).

Using a variation of this method, Cacioppo et al. (1994) began to investigate the neural underpinnings of person perception. This work showed that P300 amplitude also indexes evaluative categorization of positive and negative personality traits, and that this effect is associated with categorization per se rather than response processes (Crites, Cacioppo, Gardner, & Berntson, 1995), suggesting that the P300 might assess implicit interpersonal attitudes. In a similar experiment, Osterhout, Bersick, and McLaughlin (1997) showed that a P300-like, late positivity in the ERP waveform is sensitive to violations of gender stereotypical noun-pronoun agreement in sentence

comprehension (e.g., "Our aerobics instructor gave *himself* a break"). This effect was independent of participants' self-reported judgments of the acceptability of the sentences, further suggesting that the P300 might provide a relatively covert indication of implicit person judgments.

A more recent study conducted by Ito, Thompson, and Cacioppo (2004) further confirmed this notion. Ito and colleagues had White participants view images of White men's and Black men's faces embedded within series of positively- and negatively-valenced images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2001). Based on previous work showing that the P300 is sensitive to changes in evaluative categorization, Ito and colleagues hypothesized that P300 amplitude elicited in the context of frequent negative images would be smaller to infrequent Black faces than to infrequent White faces, and that the P300 elicited in the context of frequent positive images would be larger to infrequent Black faces than to infrequent White faces. Their results showed only modest (and nonsignificant) differences in these predicted directions. However, the difference in P300 amplitude elicited by White compared to Black faces was correlated with scores on self-reported measures of racism, such that those with more negative attitudes toward Blacks showed larger P300 amplitude differences. Thus, these findings support the idea that the P300 elicited in tasks of person perception can serve as a sensitive measure of implicit attitudes (see also Ito & Cacioppo, 2007).

Based in part on the work of Cacioppo and colleagues and Osterhout et al. (1997), Bartholow et al. (2001) reasoned that the processing of interpersonal expectancy violations also should be manifest in P300 amplitude. Numerous studies in social and developmental psychology indicate that expectancy-violating information about people often is recalled better than expectancy-confirming information (see Stangor & McMillan, 1992). Theoretical models (e.g., Srull & Wyer, 1989) posit that this recall advantage reflects updating of working memory that occurs during *inconsistency resolution*, the process by which people attempt to reconcile the discrepancy between new information and existing "person concepts." The longstanding notion that the P300 reflects the process of working memory updating (e.g., Donchin, 1981; Donchin & Coles, 1988; Friedman & Johnson, 2000) suggests that P300 amplitude should reflect the neural processes associated with inconsistency resolution.

Bartholow and colleagues (2001; see also Bartholow et al., 2003) tested this idea in a set of experiments in which participants read paragraph descriptions of several fictitious individuals in order to form impressions of them, and then read sentences (presented one word at a time) depicting behaviors that were either consistent or inconsistent with those impressions. Consistent with the working-memory updating hypothesis of the P300 (Donchin & Coles, 1988), P300 amplitude elicited by expectancy-violating sentence-ending words was larger than that elicited by expectancy-consistent sentence-ending words. Expectancy-violating behaviors also were better recalled than expectancy-consistent behaviors, further supporting the notion that P300 amplitude reflects the extent to which stimuli are processed during memory encoding (see Fabiani & Donchin, 1995). Moreover, P300 amplitude was greater to negative than to positive expectancy-violating behaviors, consistent with research indicating that negative information about people is more informative or relevant to person perception than positive information (see Peeters & Czapinski, 1990; Reeder & Coovert, 1986; Sherman & Frost, 2000; Trafimow & Finlay, 2001; Ybarra, 2002; Ybarra, Schaberg, & Keiper, 1999). Figure 27.1 presents relevant ERP waveforms showing these effects.

Bartholow et al.'s (2001) findings indicated that the recall advantage long known to accompany expectancy violations (e.g., Stangor & McMillan, 1992) results from evaluative categorization processes occurring quite rapidly following perception, and strongly implicate a role for working memory updating—one of a host of so-called executive cognitive functions, thought to be mediated by activity in the prefrontal cortex (see Miyake et al., 2000)— in the process of inconsistency resolution (see also Macrae, Bodenhausen, Schloersheidt, & Milne, 1999). To further test the role of executive working memory in the inconsistency resolution processes reflected in the P300, Bartholow, Pearson, Gratton, and Fabiani (2003) conducted an experiment in which participants consumed either alcohol or a placebo beverage just prior to engaging in the person perception task used by Bartholow et al. (2001). Alcohol's effects on interpersonal behaviors are commonly attributed to impairment of executive cognitive functions thought mediated by the prefrontal cortex (e.g., Hoaken, Giancola, & Pihl, 1998; Peterson, Rothfleisch, Zelazo, & Pihl, 1990; Steele & Josephs, 1990). Thus, Bartholow et al. (2003) reasoned that inconsistency resolution might be

Negative trait condition

Pz

0 200 400 600 800 1000

Expectancy-consistent ————
Expectancy-violation ··············

Positive trait condition

Pz

10 µV

0 200 400 600 800 1000
Time (ms)
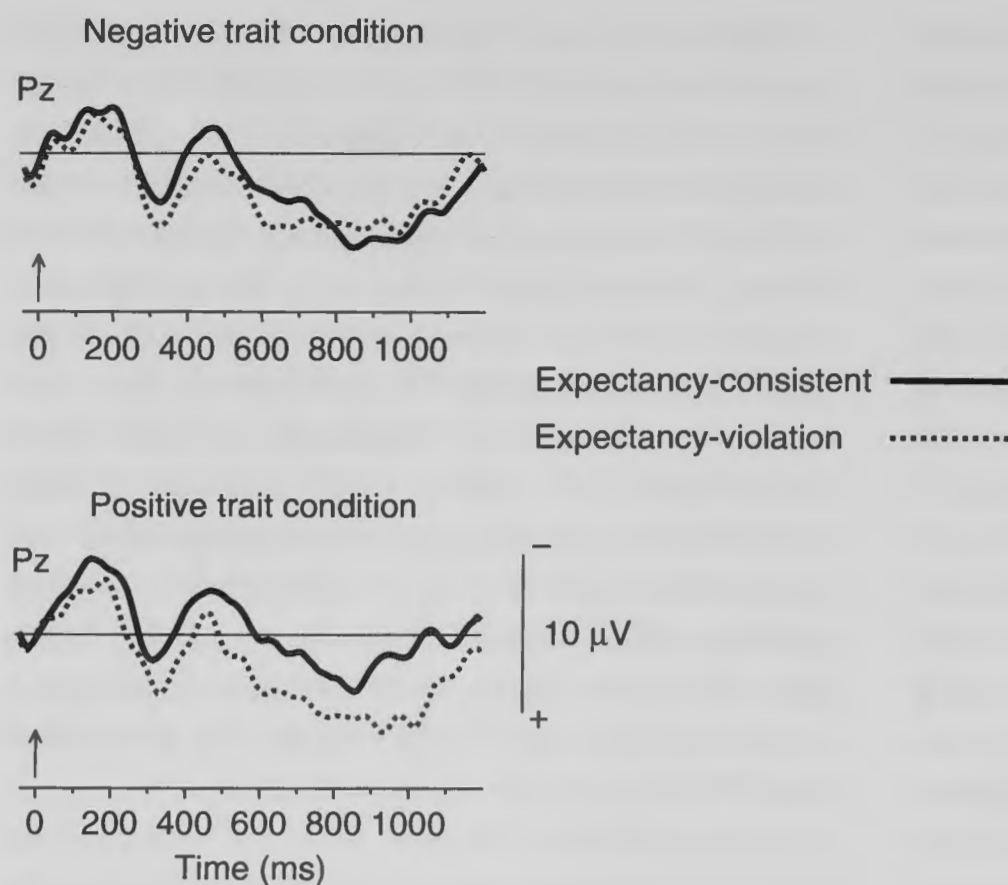
Fig. 27.1 ERP waveforms elicited by expectancy-consistent and expectancy-violating behaviors as a function of whether targets had positive traits or negative traits. Consistency or violation with initial trait impressions was determined by the valence of relevant behaviors, for example, a negative behavior in the positive trait condition would be an expectancy violation. Reprinted from Bartholow, B. D., Fabiani, M., Gratton, G., & Bettencourt, B. A. (2001), with permission of SAGE Publications.

impaired during intoxication, and used ERPs to track the time course and severity of hypothesized impairments.

For participants in the placebo condition, the P300 and recall data largely replicated those of the earlier report (Bartholow et al., 2001), in that expectancy violations—particularly negative behaviors—elicited larger P300 than expectancy confirmations, and recall was better for negative than positive expectancy-violating behaviors. However, for participants who consumed alcohol the opposite pattern emerged, with generally larger expectancy-violation effects associated with positive behaviors presented in a negative context, and better recall for positive than negative expectancy-violating behaviors. Bartholow et al. (2003) interpreted this reversal in terms of alcohol-induced activation of the cerebral reward system influencing processing of reward-congruent information in working memory (see London, Ernst, Grant, Bonson, & Weinstein, 2000). This study also illustrates the use of alcohol as a tool in social neuroscience research. Given that many social-cognitive phenomena are presumed to be mediated by prefrontal cortical activity, examining social cognitive processes in healthy individuals temporarily impaired by alcohol provides a method for bridging gaps between research in neuropsychology, social cognition, and cognitive neuroscience (see also Macrae et al., 1999).

The expectancy violation studies conducted by Bartholow et al. (2001, 2003) provided an initial understanding of the neural events associated with *intentional trait inferences*. Participants in those studies were instructed to form impressions of target persons based on trait-related information provided about them. Later violations of those traits elicited enhanced neural responses, indicating that traits had been inferred from the earlier information. However, outside of the laboratory, people generally are not told to form impressions of others on the basis of their behavior; rather, this process happens spontaneously, a process known as *spontaneous trait inference* (see Uleman, 1999; Uleman et al., 1996, 2005). In a recent series of studies, Van Overwalle and his colleagues (e.g., Van Duynslaeger, Van Overwalle, & Verstraeten, 2007; Van Overwalle, Van den Eede, Baetens, & Vandekerckhove, 2009; Van Duynslaeger, Sterken, Van Overwalle, & Verstraeten, 2008) have used ERPs to investigate similarities and differences in the neural activity elicited under intentional versus spontaneous trait-inference conditions. For example, Van Duynslaeger et al. (2007) modified the paradigm developed by Bartholow et al. (2001) by telling half of their participants to simply "read the stimulus materials carefully," making no mention of forming impressions, and telling the other half of the participants to form an impression of each target (cf., Bartholow et al., 2001, 2003). Van Duynslaeger et al. found that P300 amplitude was enhanced to trait-inconsistent compared to trait-consistent behaviors in both the intentional and spontaneous trait inference conditions, indicating that the inconsistency-resolution process is very similar in both cases. However, compared to expectancy violations encountered under intentional inference instructions, source analysis indicated that

expectancy violations encountered under spontaneous trait inference conditions elicited greater activation in the temporo-parietal junction, a neural region implicated in representing others' mental states (Frith & Frith, 2001) and considered a primary generator of the P300 (see Nieuwenhuis et al., 2005).

A number of person perception processes are known to be strongly affected by the social category memberships of both the perceiver and the targets. Certain very basic social categories (i.e., those that are most readily identifiable), such as gender and race, are particularly influential. In recent years, ERPs have been applied to the study of very basic attention-related and evaluative processes occurring during the perception of race (see Ito & Bartholow, 2009). ERP studies of race perception consistently show that racial information is processed very quickly and automatically. For example, Ito and Urland (2003) showed that ERP waveforms elicited by pictures of White and Black faces begin to diverge as early as around 120 ms after picture onset (i.e., the N100 component), a finding that held regardless of whether participants explicitly categorized the faces by race or according to some other social dimension (e.g., gender). The most consistent finding to emerge from studies in this literature is that the P200 (or P2) component is larger to racial outgroup than ingroup faces, and the N200 (or N2) is larger to racial ingroup than outgroup faces (e.g., Dickter & Bartholow, 2007; Ito, Thompson, & Cacioppo, 2004; Ito & Urland, 2003, 2005; Kubota & Ito, 2007; Walker, Silvert, Hewstone, & Nobre, 2008; Willadsen-Jensen & Ito, 2006, 2008). Precise interpretation of these patterns is still elusive given that this literature remains relatively small and only recently has emerged. However, current understanding suggests that increased P2 and N2 responses in race perception tasks reflect automatic encoding and orienting toward racial category information.

Initial studies in this literature (e.g., Ito & Urland, 2003, 2005) relied on White participants, and therefore it was unclear whether the enhanced P2 to Black targets and N2 to White targets reflected responses to features of race specifically (e.g., skin tone; facial structure) or reflected a more general distinction between outgroup and ingroup targets. Dickter and Bartholow (2007) conducted the first race perception ERP study using both Black and White participants. Their results showed the typical pattern for White participants, with larger P2 amplitude to Black than to White targets and larger N2 amplitude to White than to Black targets. Among Black participants, however, these patterns

were reversed (i.e., larger P2 to White than to Black targets; larger N2 to Black than to White targets), supporting the perspective that the "race categorization" effects seen in previous studies actually represent differential outgroup and ingroup categorization effects. Similar results also have been reported by Willadsen-Jensen and Ito (2008) using Asian participants viewing Asian and White faces.

The fact that processing of ingroup faces consistently increases N2 amplitude raises questions concerning how this "ingroup categorization" N2 compares to N2 responses elicited by other stimulus conditions. For example, increased N2 amplitude has been associated in numerous studies with processes related to conflict detection, in that the N2 often is larger on trials that elicit competing response activations, such as incongruent Stroop trials (e.g., Liotti, Woldorff, Perez, & Mayberg, 2000) and incompatible trials in flanker tasks (i.e., stimulus arrays including stimuli mapped to opposing behavioral responses; see Kopp, Rist, & Mattler, 1996; van Veen & Carter, 2002). Additionally, the N2 often increases as a function of stimulus infrequency, such that low-probability stimuli elicit larger N2s than higher-probability stimuli, regardless of whether the stimuli themselves elicit competing response activations (e.g., Jones, Cho, Nystrom, Cohen, & Braver, 2002; Nieuwenhuis, Yeung, Van Den Wildenberg, & Ridderinkhof, 2003). It has been unclear whether these conflict- and infrequency-related N2s also respond to race perception, however.

Recently, Dickter and Bartholow (2010) investigated the potential interaction among these various stimulus conditions by presenting White participants with pictures of White and Black men's faces in the context of a flanker task, in which centrally presented target faces (which had to be categorized by race via button press) were flanked on either side either by same-race faces (i.e., compatible trials; e.g., Black target and Black flankers) or by other-race faces (i.e., incompatible trials; e.g., Black target and White flankers). Trial type frequency was manipulated by varying the probability of compatible trials across trial blocks, resulting in 80% compatible, 50% compatible, and 20% compatible conditions. Dickter and Bartholow found the typical ingroup categorization effect, with larger N2 to White target trials than to Black target trials. However, this effect was qualified by both compatibility and frequency conditions (i.e., a Race x Compatibility x Probability interaction). As shown in Figure 27.2, the N2 was sensitive to compatibility
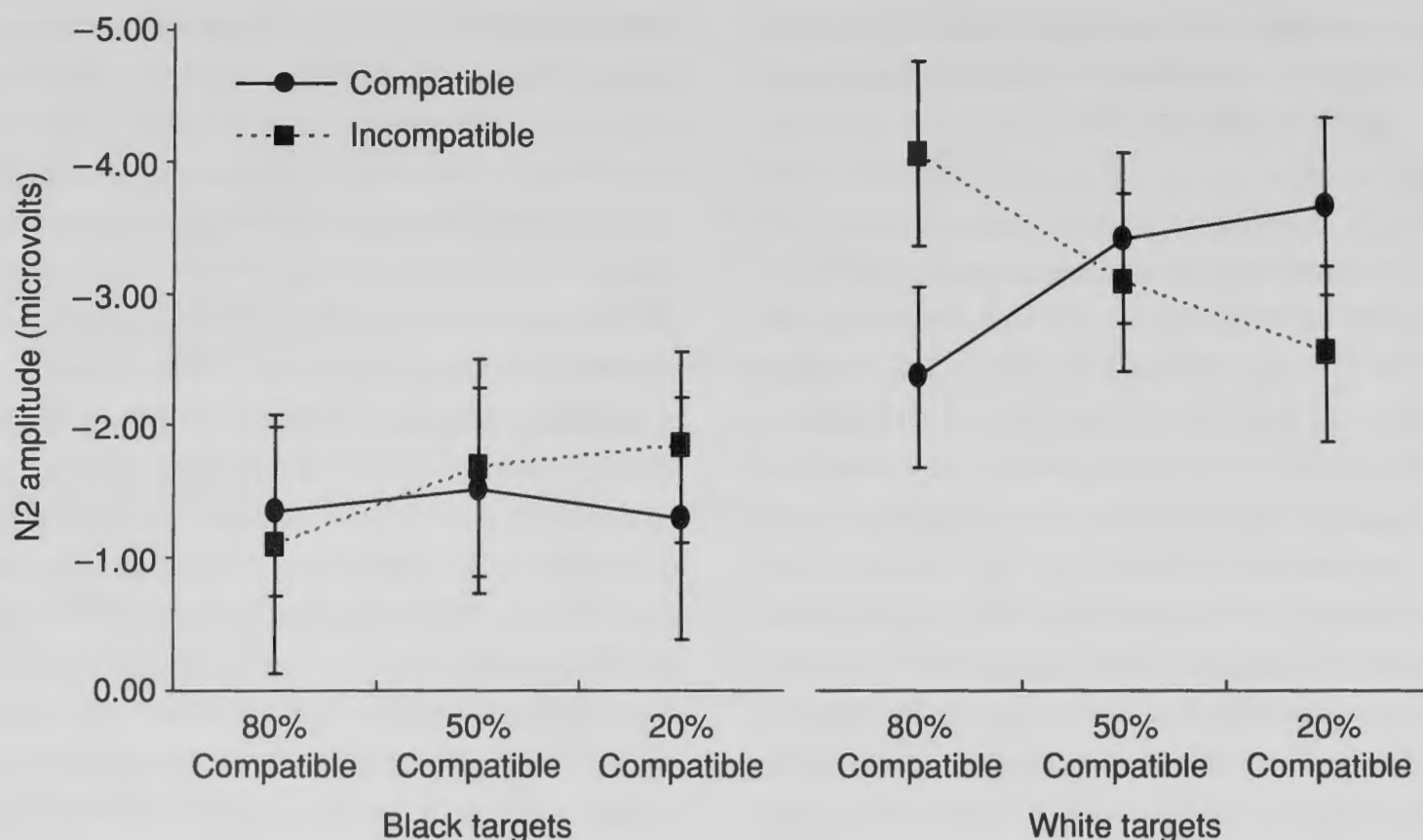
Fig. 27.2 Mean N2 amplitude (measured from frontal electrode locations) as a function of target race, trial compatibility and the probability of compatible trials. It is striking that compatibility and infrequency—stimulus conditions known to reliably affect N2 amplitude—had virtually no effect for Black target trials.

Adapted with permission from Dickter, C. L. & Bartholow, B. D. (2010).

and trial type frequency in a predictable manner (see Bartholow et al., 2005; Bartholow, Riordan, Saults, & Lust, 2009), but only on White (ingroup) target trials. Dickter and Bartholow posited that this pattern could reflect that ingroup targets elicit stronger engagement of the processes underlying generation of the N2 than outgroup targets, leading to stronger effects of compatibility and infrequency on ingroup trials. Consistent with this notion, considerable work using a variety of methods indicates that White participants spontaneously attend more to Black male than to White male faces (e.g., Trawalter, Todd, Baird, & Richeson, 2008; Cunningham et al., 2004; Dickter & Bartholow, 2007). Thus, it could be that among White participants Black targets elicit narrower, more focused attention than White targets, which would reduce the influence of both flanker compatibility and the probability of compatible arrays—factors that both rely on manipulations of (peripheral) flanker information—on Black target trials.

That the processing of ingroup faces reflected in the N2 is more sensitive to other manipulations than the processing of outgroup faces was recently demonstrated in a very different context by Henry, Bartholow, and Arndt (2010). These researchers investigated the effects of mortality salience, known to elicit preferences for ingroup members assumed to share one's cultural worldview and to intensity of ingroup identification (e.g., Solomon, Greenberg,

& Pyszczynski, 2000), on ERP responses elicited by White and Black faces displaying neutral, happy, and angry facial expressions. Henry et al. found that the ingroup N2 effect was larger and more widespread across scalp locations for participants in the mortality salience condition (who, prior to the facial expression task, were asked to write down the feelings that the thought of their own death aroused in them) compared to those in a control condition (who, prior to the task, wrote about dental pain). Moreover, whereas control participants showed a larger N2 to happy than to angry White faces, a pattern consistent with previous research (Kubota & Ito, 2007), those in the mortality salience condition showed larger N2s to angry than to happy White faces. Henry et al. posited that the preference following mortality salience to view ingroup members favorably, coupled with the sensitivity of the N2 to perceived stimulus infrequency (e.g., Nieuwenhuis et al., 2003), could lead to enhanced conflict when processing threatening/angry ingroup targets.

The cognitive neuroscience of face processing is reviewed in detail elsewhere in this volume (see Chapter 25). However, given that person perception often is studied with face stimuli, as is evident by our review, here we provide a brief overview of some the face processing research most relevant to this chapter. Given their importance for conveying social information, researchers have long been interested in understanding whether faces are accorded

special status within the universe of stimuli that people encounter. ERP studies of face perception have identified a negative-going component, typically peaking around 170 ms following target onset and largest at lateral, temporo-parietal electrode locations, known as the N170, which appears particularly sensitive to faces (e.g., Eimer, 2000; Kanwisher, McDermott, & Chun, 1997). Source localization data indicate that the N170 primarily reflects activity in the fusiform gyrus (Herrmann et al., 2005), a cortical structure often associated with face processing. Indeed, some have even referred to this structure as the "fusiform face area" (e.g., Kanwisher & Yovel, 2006). Other research, however, does not support the specialization of the fusifom gyrus for face processing, indicating instead that this area is active to any stimuli with which participants have particular expertise (e.g., Gauthier et al., 1999, 2000).

Nevertheless, some researchers have tested whether social factors, such as racial ingroup/outgroup status of the targets, influence the amplitude of the N170 elicited by faces. Unfortunately, findings to date have been equivocal. For example, based on the notion that participants generally have more experience/ expertise interacting with members of ingroups, the "expertise hypothesis" predicts that the N170 should be larger for racial ingroup targets than racial outgroup targets. This pattern has been found in one published report (Ito & Urland, 2005). However, other research has shown that the N170 is larger to atypical faces and inverted faces than to "typical" faces (e.g., Halit et al., 2000), an effect attributed to a disruption of the configural processing often applied to faces. Based on these ideas, some researchers have argued that N170 amplitude elicited by racial outgroup faces, which arguably are less typical for perceivers and which are thought to be processed in a less configural manner (Mitchell et al., 2006), should be larger than the amplitude elicited by racial ingroup faces. Several recent studies have found such a pattern (Stahl et al., 2008; Walker et al., 2008).

How can these seemingly contradictory findings be reconciled? Consideration of methodological differences among these studies reveals that, in each study in which the N170 was reported to be larger to racial outgroup than ingroup faces, participants had been asked to focus on face identity (e.g., by having participants detect when two consecutively presented faces matched, or by having participants try to remember the faces), whereas studies reporting different patterns have asked participants to

focus on other stimulus dimensions (e.g., by having participants scan for nonface stimuli or make valence judgments). If we assume that the N170 reflects structural face encoding, and that perceivers typically process racial outgroup faces in a less configural and shallower manner (e.g., as reflected in poorer memory for outgroups), tasks that require attention to identity may selectively increase recruitment of face processing mechanisms to racial outgroup relative to ingroup targets. However, more work is needed to understand the factors that influence the N170 and its relevance for person perception.

Functional Neuroimaging Studies

Complementing recent electrophysiological research on person perception are a number of recent reports investigating the neural structures involved in this process. The majority of such studies have employed fMRI. Unlike ERP recording, which provides a fast but spatially coarse measure of the electrical activity generated in the brain in response to some stimulus, fMRI provides a measure of the hemodynamic response (i.e., blood flow) elicited by a stimulus in very specific neural structures (see Chapter 5 in this volume for a more detailed discussion of fMRI methods).

Social categorization

Functional MRI methods have proven particularly useful for investigating the neural structures that appear to be involved in perceiving and forming judgments about individuals in a variety of situations. In typical person perception experiments involving fMRI, participants passively view faces of people from varying social categories (e.g., Cunningham et al., 2004) or make social judgments about such faces (e.g., judging personality traits; see Todorov, Baron, & Oosterhof, 2008). Not surprisingly, face stimuli consistently increase hemodynamic response in the fusiform gyrus, consistent with the ERP research reviewed previously indicating that the N170 component associated with face perception is generated in the fusiform (Herrmann et al., 2005).

Of course, perception of faces also conveys social category information. Like ERP studies, brain imaging research has shown that faces varying according to social category membership differentially activate the areas involved in face processing. For example, Golby, Gabrieli, Chiao, and Eberhardt (2001) found that both Black and White participants experienced greater activity in the fusiform gyrus when viewing pictures of racial ingroup compared

to outgroup members. Similarly, Van Bavel, Packer, and Cunningham (2008) found that participants randomly assigned to one of two mixed-race teams showed greater fusiform activity to pictures of their own teammates compared to pictures of members of the other team, regardless of their own or the targets' race and regardless of whether they categorized the targets according to team status or race. These findings suggest that fusiform activity associated with ingroup bias can occur regardless of perceptual expertise or any kind of threat or reward associated with ingroup relative to outgroup members. However, recent work also suggests some specialization in the left fusiform gyrus for sex-based categorization, as activation in this area is greater when participants categorize targets along the sex dimension compared to a different dimension (Cloutier, Turk, & Macrae, 2008).

The amygdala also has been shown to be sensitive to judgments of social category membership. The amygdala is a neural structure considered part of the limbic system, often linked with emotional processes; specifically, the amygdala is thought to be instrumental in the processing of threatening stimuli (LeDoux, 1996; Liddell et al., 2005) and has been shown to be more sensitive to negative than positive information (Satpute & Lieberman, 2006; Wager, Phan, Liberzon, & Taylor, 2003; but see Cunningham, Van Bavel, & Johnsen, 2008, for a different interpretation). As with the fusiform regions, the amygdala has been shown to be involved in racial categorization. Specifically, several studies have shown greater amygdala activation to Black targets than White targets, and have demonstrated that the amount of activity in this region is correlated with race-related prejudice (Cunningham et al., 2004; Phelps et al., 2000). It appears that these effects are not limited to White participants, either; that is, both White and Black participants show greater amygdala activity to Black than to White targets, suggesting that greater amygdala activation to Blacks is not due to novelty effects but may reflect negative cultural associations of Blacks (Lieberman, Hariri, Jarcho, Eisenberg, & Bookheimer, 2005). However, it also should be noted that some recent work indicates greater amygdala activation for novel ingroup compared to novel outgroup targets (Chiao et al., 2008; Van Bavel et al., 2008), suggesting that different psychological mechanisms might be involved in mediating activity in this important neural structure depending upon the goals of the perceiver and/or the importance or significance of the target (see Van Bavel et al., 2008).

Neuropsychological research also has contributed to our understanding of the neural processes important for social categorization. For example, Mason and Macrae (2004) investigated the contributions to individuation and categorization of neural processes situated in the right and left hemispheres (left and right visual fields, respectively) in both healthy controls and a split-brain patient. Participants viewed pictures of two simultaneously-presented faces and indicated (during an individuation task) whether the pictures were of the same person or (during a categorization task) whether the pictures showed people of the same sex. All participants performed better on the individuation task when faces were presented to the right hemisphere (i.e., left visual field). Functional MRI data showed that the individuation task yielded increased activation in right inferior frontal and right occipito-temporal areas and that the categorization task yielded increased activation in the left inferior frontal and left superior temporal gyri. These findings suggest that hemispheric differences may exist during social categorization and individuation, and support a more general model of processing asymmetry in the brain (e.g., Rhodes, 1985).

Impression formation
Due to the apparent role of the amygdala in evaluating valence, recent studies have investigated how positive and negative information influences amygdala activation during impression formation (e.g., Fiske, Cuddy, & Glick, 2007). Investigations of impression formation using fMRI tend to couple self-reported judgments with neural measures, and researchers look for correlations between participants' self-reported judgments and amygdala activation. One recent area of investigation has been the evaluation of trustworthiness. Social psychological research has demonstrated that social perceivers can make judgments about a target individual's trustworthiness very quickly after viewing the target's face (e.g., Willis & Todorov, 2006). Functional imaging investigations of trustworthiness have demonstrated that amygdala activation to faces increases as the perceived trustworthiness of faces decreases, using both explicit and implicit trustworthiness evaluations (Engell, Haxby, & Todorov, 2007; Todorov, Baron, & Oosterhof, 2008; Winston, Strange, O'Doherty, & Dolan, 2002). Evidence from neuropsychological research provides further support that the amygdala is involved in perceptions of trustworthiness; specifically, patients with complete bilateral amygdala damage were less able

to judge targets on the trustworthiness dimension than normal participants, especially for untrustworthy target faces (Adolphs, Tranel, & Damasio, 1998).

Research on the role of the amygdala in impression formation has not been limited to perceptions of trustworthiness, however. For example, Todorov and Engell (2008) conducted an fMRI study in which participants viewed target faces with neutral emotional expressions. These faces had previously been rated on 14 different trait dimensions by a separate group of participants. When participants in the fMRI study viewed these faces, amygdala activation indicated general sensitivity to negativity, correlating positively with prior ratings of negative traits and negatively with prior ratings of positive traits. Additionally, amygdala activation was largest on dimensions with clear negative or positive associations (e.g., trustworthiness) and smallest on traits with ambiguous associations (e.g., dominance).

The neural correlates of facial attractiveness also have been investigated in recent fMRI work. A large number of social psychological studies have detailed the important role of facial attractiveness in person perception, with much evidence supporting a universal (i.e., cross-cultural) standard of facial beauty (e.g., Jones & Hill, 1993). Studies using neuroimaging methods have attempted to examine how the nervous system responds to variations in facial attractiveness and have identified a number of structures, especially the amygdala (Winston, O'Doherty, Kilner, Perrett, & Dolan, 2007) and the medial orbito-frontal cortex (OFC; Ishai, 2007; O'Doherty et al., 2003), that respond to facial beauty. Researchers believe that these regional activations are thought to reflect the positive emotions that attractive faces evoke; additionally, these brain regions have been previously associated with the processing of rewarding stimuli (Chatterjee, Thomas, Smith, & Aguirre, 2009). Research also has demonstrated that the brain regions associated with facial beauty may differ depending on the explicit task. For example, Chatterjee and colleagues (2009) presented participants with pictures of target faces. When participants were explicitly judging facial attractiveness, fMRI results showed greater activation in the ventral occipital, anterior insular, dorsal posterior parietal, inferior dorsolateral, and medial prefrontal cortices to attractive versus unattractive faces. However, when participants were not attending to attractiveness, only activation in the ventral occipital cortex was related to targets' facial attractiveness. Taken together, these studies indicate that brain regions associated with perceptual, decision-making, and reward processes are activated by facial attractiveness, and perhaps indicate a biological predisposition to process beauty.

Emotion perception

Social neuroscience studies of person perception also have contributed to the emerging literature on the processing of emotional faces (for a more complete treatment of neuroscience studies of emotion recognition, see Chapter 16). Early work demonstrated that the amygdala was associated with the processing of facial expressions that showed fear. In fact, healthy participants showed increased amygdala activity to fear expressions compared with other emotions (e.g., Adolphs et al., 1998), and patients with amygdala lesions showed impairment in the recognition of facial fear (Adolphs, Tranel, Damasio, & Damasio, 1994; Calder et al., 1996). Additionally, in a study of "normal" adult males, individuals who demonstrated a deficit in facial fear recognition showed reduced activation in the amygdala compared to individuals with normal facial fear recognition, providing further support that the amygdala is instrumental in the processing of facial fear (Corden, Critchley, Skuse, & Dolan, 2006). However, other studies have indicated that increased amygdala activity is not limited to the processing of fearful faces. Yang and colleagues (2002) presented participants with happy, sad, angry, fearful, and neutral faces. Functional MRI results demonstrated that amygdala activation was greater for all emotional faces compared to the neutral faces, indicating that the amygdala's role may be broader than previously assumed (Yang et al., 2002). Other recent work consistent with this notion suggests that the amygdala responds to stimuli with particular motivational significance (Cunningham et al., 2008). From this perspective, the considerable literature showing amygdala sensitivity to negative information could be re-cast in terms of negative information having more relevance or significance than positive information, a view consistent with a voluminous literature in person perception (see Bartholow et al., 2001; Peeters & Czapinski, 1990; Ybarra, 2002) and social perception more generally (e.g., Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Ito, Larsen, Smith, & Cacioppo, 1998; Taylor, 1991).

Benuzzi and colleagues (2004) used a neuropsychological approach to examine additional areas of the brain that are instrumental in processing emotion from faces. Specifically, they compared the responses of patients with mesial temporal lobe

epilepsy with those of normal controls in a series of facial recognition and matching tasks. Results indicated that patients with right-hemisphere damage showed deficits in identifying fear in target faces, as compared to the other participants. Analyses of fMRI data in control participants showed increased activation to fearful faces in the inferior frontal cortex, the fusiform gyrus, and other occipito-temporal regions. These data indicate that a number of structures besides the amygdala, especially areas in the inferior frontal lobe and right mesial temporal structures, are involved in the processing of negative facial expressions.

Conclusions

As is evident by this and other recent reviews (e.g., Amodio & Lieberman, 2009; Bartholow & Amodio, 2009; Bartholow & Dickter, 2007; Ito, Willadsen-Jensen, & Correll, 2007), the use of neuroscience methods to gain better understanding of person perception processes has increased rapidly in recent years. At the outset of this chapter, we outlined a number of reasons why a social neuroscience approach can be useful for testing theory and advancing the science of person perception. In particular, ERPs provide a time-sensitive means of measuring and separating the rapidly-unfolding cognitive and affect-related processes theorized in many models of person perception, and functional brain imaging permits a detailed picture of the neural structures that subserve these processes. Neuropsychological studies also offer important insights into the functions of particular regions of the brain that appear crucial for effective person perception. Most importantly, linking these neural indices with important psychological and behavioral outcomes can provide a more comprehensive understanding of person perception than can be gained by any self-report, behavioral, cognitive, neural, or biological approach alone (cf., Ochsner & Lieberman, 2001; Ochsner, 2004).

However, despite the promise of and interest in this relatively recent advancement, it is vital for both scientists and consumers of knowledge in this area to keep in mind that research in social neuroscience is only as valuable to advancing knowledge as the research methods and paradigms employed. In other words, the *science* component of social neuroscience is more important than the advanced technological tools we employ or the colorful and detailed images they produce. To paraphrase John Cacioppo (2003), one of the true pioneers of this field, we as social psychologists and others interested

in person perception cannot stop using our heads simply because we now have the capability to image the brain. It is also important for contemporary scientists to recognize the importance of the ground-breaking work of early visionaries who first saw the potential to enhance understanding of person perception by measuring bodily responses. One of the first studies of this kind was conducted by Rankin and Campbell (1955), who realized that skin conductance (i.e., changes in the electrical properties of the skin due to perspiration, often associated with anxiety) could be a useful indication of White participants' attitudes toward Blacks, even when their self-reported evaluations were generally positive. Research using peripheral psychophysiological measures continues to make important theoretical advances in person perception to this day (e.g., Mendes, Blascovich, et al., 2007; Mendes, Gray, et al., 2007). The recent focus on central nervous system measures, such as the electrocortical and functional brain imaging research reviewed here, adds to this important tradition in social psychophysiology.

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