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Toward socially inspired social neuroscience

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ABSTRACT

Social neuroscience, often viewed as studying the neural foundations of social cognition, has roots in multiple disciplines. This paper argues that it needs a firmer base in social psychology. First, we outline some major opportunities from social psychology—the power of social context and social motives in shaping human behavior. Second, as the social cognition field moves away from studying only deliberate, explicit processes to studying also automatic, implicit processes, adopting a dual-process perspective, social neuroscience also lends itself to both automatic and controlled processes. Finally, social neuroscience is especially suited to study the efficiency and spontaneity of social judgments. All this brings social behavioral grounding to cognitive neuroscience. Among the implications for social neuroscience: Social cognition intrinsically evokes affect, so social *cognitive affective* neuroscience glues together a variety of fields in psychological and neurosciences.

1. Introduction

Social neuroscience, studying neural foundations of social cognition, is one of the most recent and exciting developments in the fields of psychology and cognitive neuroscience. One of the first attempts to develop a neural model of social cognition was largely divorced from research in social psychology (Brothers, 1990). In fact, at the time, the major source of data and inspiration was research on single cell recording from the monkey brain showing that specific neurons in the inferotemporal cortex responded to faces (e.g., Gross et al., 1972; Perrett et al., 1982). Since then, with the accessibility of functional magnetic resonance imaging (fMRI) technology, there has been a proliferation of papers exploring processes relevant to the study of social cognition.

The first researchers who started developing neural models of social cognition processes using brain imaging were inspired by developmental psychology and not social psychology (e.g., Fletcher et al., 1995; see Frith and Frith, 1999 for an early review). One of the important developmental findings was that children become able to represent the states of other minds at about age of 4 (Wimmer and Perner, 1983), an ability that remains out of reach for many people born with autism (Baron-Cohen, 1995; Frith, 2001). This finding served as a basis for the development of models of "theory of mind" (Gallagher and Frith, 2003). Another line of relevant research came from work with patients who have brain lesions. Despite this research providing fascinating examples of dissociations between implicit and explicit processes (e.g., Schacter, 1987)—a topic of central interest in social cognition (Bargh, 1994; Greenwald and Banaji, 1995)—social psychologists were largely uninterested in work with patients with brain lesions (but see Klein et al., 1996).

The field of social neuroscience started capturing the attention of many social psychologists in the last 5 years (Ochsner and Lieberman, 2001), with the accessibility of fMRI equipment. Other techniques (EEG, GSR, heart rate) were important, long-standing exceptions in the field (e.g., Cacioppo et al., 1996), but brain-imaging techniques captured broader scientific imagination. A quick search on PsycINFO,

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the major search database for psychologists, reveals more than 100 publications referring to social neuroscience. All but seven of them were published after 2000. Since then, social neuroscience research is represented at every major social psychology conference and several active research groups come from mainstream social psychology.

We believe that one of the major virtues of the new field of social neuroscience is that it brings together scientists across different disciplines, each discipline providing unique insights about social cognition. This special issue exemplifies this inter-disciplinary endeavor. In this paper, we have three objectives. First, we describe some major lessons of social psychology for a socially inspired social neuroscience. Second, we detail the changing metaphors in the social cognition field and some of the basic characteristics of social judgments. All sections argue the relevance of social behavioral theory and experiments for social neuroscience.

2. Social context

According to Allport's (1954) famous definition, social psychology studies how the actual, imagined, or implied presence of other people influences an individual's thoughts, feelings, and behaviors. One of the major discoveries of early social psychology experiments was that this influence is much greater than people realize. If we have to extract one principle from social psychology, this will be the principle of situationism or the power of the situation over behavior (see Lieberman, 2005; Ross and Nisbett, 1991; for similar perspectives). Consider some of the most famous studies in social psychology. In Sherif's (1935) studies on norms, after observing the apparent motion of a single point of light in a darkened room, participants in groups converged to stable norms about the illusory movement of the light. In Asch's (1956) studies on conformity, participants provided incorrect responses to a simple perceptual task (comparing the length of lines) after several confederates provided the same incorrect response. In Darley and Latané's (1968) studies on bystander intervention, the probability of helping a person in an emergency decreased with the presence of other people. Participants were using the behavior of others to infer the seriousness of the situation. In Milgram's (1963) studies of obedience to authority, participants were willing to deliver incredibly strong electric shocks to a stranger despite his protest at multiple points during the experiment (in reality, a confederate ostensibly in the role of learner who is penalized for giving wrong answers to a word leaning test). They did this because the situation required it. All these studies demonstrate the power of the situation over individual behavior. Decades of social psychological research have confirmed that the situation must be taken into account when describing human behavior (Fiske, 2004).

Most relevant here, the social context differentially affects behavior elicited by the same stimuli. Lewin (1938, 1951), one of the founding fathers of social psychology, was well aware of the impact of social context at the most basic perceptual level. He observed that common objects could evoke different reactions from a person depending upon the presence of others. For example, Lewin showed that housewives would cook organ meats in war-time scarcity only if their peers did so. Lewin (1951) elaborated a psychological field theory in discussing situational effects on behavior, from which he derived his ideas of life space. He argued that the effect of a given stimulus on the perceiver depends on the stimulus constellation, or properties of the stimulus, and the state of the perceiver. Though form, size, and color are inherently perceptual features, the perception of the stimulus depends on its visual background and the rest of the visual field. What is more, the same stimulus acquires a different valence (affective charge) depending on the perceiver's goals. Behavior is a joint function of person and situation, and the situation is primarily social.

The basic rules of studying how the thought, feelings, and behavior of individuals are influenced by the actual, imagined, or implied presence of others do not change along with the researchers, dependent variable, or measurement technique. As we move into the realm of neuroscience, the power of the social context continues to matter. Immediate reactions to a social stimulus depend to a large extent on the context (Trope, 1989), and further interpretation of the stimulus is also derived from the context (Lewin, 1951; Trope, 1986, 1989). For instance, an emotional expression may be perceived as positive or negative depending upon the social context. Seeing an ambiguous facial expression in the context of learning that the person is a coach whose team is losing is interpreted as anger but in the context of learning that the person is a coach whose team is winning is interpreted as happiness (Trope, 1986). This interpretation affects subsequent judgments of the person (e.g., how angry this person is in general).

Recreating the social context in the constrained conditions of an fMRI experiment is a challenging but not impossible task. The same concerns are valid for social psychology experiments. Experimental research with its focus on internal validity necessarily sacrifices external validity. However, it is possible to design experimental situations with real meaning to participants. After all, experiments do not need to physically resemble real life situations (what Aronson and Carlsmith, 1968 called mundane realism) but only to create psychologically meaningful situations. Social neuroscience already shows such research can be done.

For example, a study on social decision making (Sanfey et al., 2003) created a realistic social context. Participants met the experimenter and the "other participants" (confederates) in the lobby of the psychology building before the scanning session. They were then told that their interactions in the scanner would be with the people they just met. Participants even saw pictures of the confederates in the scanner before each social decision, a strong remainder of the social context. Sanfey et al. found that people had stronger negative emotional reactions, as indicated by neural activity in the anterior insula (an area of the brain associated with disgust), to unfair offers made by a person than to unfair offers made by a computer program.

Not all social neuroscience studies that successfully recreate a powerful social context require such extravagant deception. An exploration of the neural bases of social rejection (Eisenberger et al., 2003) simply gave participants a cover story stating that the other players in the game were in other fMRI scanners as well. Instead of photographs of people, these researchers employed animated players in a "cyberball" world that represented the participants themselves and the "other players." It is noteworthy that the cyberball paradigm replicated a previous behavioral paradigm (Williams et al., 2000) that explored the effects of ostracism and social exclusion. In fact, *it seems essential that experimental paradigms be tested for their behavioral effects before implementing them in an fMRI environment*. Eisenberger et al. were able to create a social context believable enough to replicate behavioral effects and gain insights into the neural correlates of their phenomenon. Specifically, they found that social rejection in the game (not having the ball thrown to you by the other two animated players) activated areas of the anterior cingulate cortex (ACC) and the right ventral prefrontal cortex, areas activated in neuroimaging studies of physical pain.

These studies show ways to create meaningful social context in fMRI experiments. *The future belongs to fMRI experiments able to study real social interaction in real time*. One of the exciting recent methodological developments in the field is hyperscanning (King-Casas et al., 2005). In hyperscanning, people in different fMRI scanners can interact with each other, and neural activity during the interaction can be measured in real time. So far, the methodology focuses on economic games involving limited interactions (e.g., making monetary offers), but its potentials for the study of social cognition are far reaching.

3. Social motives

Considering social context requires an appreciation of the motivated perceiver. The Lewinian and "New Look" tradition argued that social motives inevitably influence people's thoughts, feelings, and behavior (Fiske, 2004), suggesting a "Warm Look" or consideration of affect and motives in any social context (Sorrentino and Higgins, 1986). Personality and social psychologists have repeatedly uncovered a few essential motives that are necessary in explanations of social behavior across a range of phenomena over the past 100 years, potentially useful to neuroscience.

The core social motive is belonging, from which stem the cognitive motives understanding and controlling and the affective motives self-enhancing and trusting (Fiske, 2002, 2004; Stevens and Fiske, 1995). Belonging highlights people's need to fit in to different social groups. Derived from the belonging need are the motives understanding, a desire to make a socially shared sense of the world, and controlling, a need to feel effective contingencies between one's actions and one's outcomes. Belonging also spawns the affective self-enhancing motive, a desire to feel oneself as worthy or at least improvable, and the trusting motive, a desire to feel that ingroup others will be benign. These ideas have resonated within social psychology and guided research for decades. Effective work in social neuroscience must also take these ideas into account.

For example, the cited Eisenberger et al. (2003) study suggests some possible neural mechanisms of social belonging and social rejection. The cited Sanfey et al. (2003) study suggests some neural mechanisms of interpersonal trust and its violation. We suspect that violations of socially shared understanding, effective social control, and positive self-views will also prove fruitful venues of truly social neuroscience.

4. Social context, motives, and research on race perception

As a specific example of applying neuroscience approaches to motivated social cognition, consider perceptions of racial outgroups. Brain imaging and event-related potential (ERP) studies on race perception have relied on the rich literature in social psychology as a watershed for exploring the neural dynamics involved in stereotyping, prejudice, and other forms of outgroup perception. This stands in sharp contrast to initial attempts within neuroscience to understand race as a biological difference manifested in differences in brain size and shape (see Eberhardt, 2005 for a review of this literature). In prejudice studies, white participants saw European-American and African-American faces (Hart et al., 2000; Phelps et al., 2000). Participants showed greater amygdala and insula activation to unfamiliar black than to unfamiliar white faces, especially if they scored high on implicit measures of prejudice. Similar findings were revealed when white participants were exposed to black faces for 30 ms but were significantly reduced when that exposure time was lengthened to 525 ms (Cunningham et al., 2004). Along similar lines, Lieberman et al. (2005) showed that this amygdala effect also occurred in black as well as white subjects. The authors suggested that this may be evidence that prejudice results in part from social learning.

However, in keeping with our emphasis on social context and social motives, the increased amygdala response to African-American faces most reliably occurred when the white participants were engaged in a one-back recognition task, a categorical same/different task, or a gender categorization task (Hart et al., 2000; Phelps et al., 2000), or in a categorical judgment about the faces, whether the person fell into one or another age social category (Harris and Fiske, unpublished; Wheeler and Fiske, 2005). When participants were asked to change their social goal and make individuating judgments (what are the person's likes and dislikes) or perform a visual search task (is there a dot on the face), the increased activation in the amygdala to black faces diminished below significance. Converging evidence from ERP studies also demonstrates that, once the social goals are changed, the processing of the same faces changes within the first 200 ms (Ito and Urland, 2003; Ito et al., 2004). What is striking about these studies is that participants were exposed to exactly the same stimuli, but the nature of processing clearly differed as a function of their social goals. People's social goals even carried over to subsequent nonsocial tasks as whites' efforts to appear nonprejudiced cost them executive control in a purely cognitive (Stroop) task afterwards (Richeson et al., 2003). Social goals and motives change the interpretation of social and nonsocial stimuli from the earliest moments until afterwards.

5. Attribution theory and the changing metaphors in social cognition

Another example of social context comes in people's inferences about other people's personality traits. How people understand other people has been a central question for social psychology (Heider, 1958), and attribution research has been at the fore of the field. Attribution theory is grounded in the more cognitive social motives of understanding and control. Unlike the perception of objects, perceiving people is at its most basic reciprocal process; the person serves as both the perceiver and the target. Heider (1958) captured this special feature of person perception and contributed the idea that a person as an object in a social environment is unique. Other major differences include the fact that people are also "action centers" (p. 21), agents capable of doing something that affects the perceiver. They can act purposefully and willingly, can harm or benefit the perceiver, and vice versa. Furthermore, they have wishes, abilities, and sentiments while they continue to perceive each other. Therefore, Heider argues, as "naive scientists," perceivers are intuitively aware of these factors and take them into account when perceiving another individual (see Fiske and Taylor, 1991 for a review).

An established intellectual tradition in social psychology has matured around attribution theory since Heider, evidenced in the work of Gilbert and Malone (1995), Jones (1979), Kelley (1972), and Ross (1977). The classic attribution models (Kelley, 1972) assumed that people perform a complicated analysis of the co-variance of potential causes and effects of behavior to arrive at a causal attribution. Decades of research on how people make causal inferences from behavior have outlined the principles of attribution: consensus across actors, consistency over time, and distinctiveness over entities (Ferguson and Wells, 1980; McArthur, 1972; Orvis et al., 1975; Pruitt and Insko, 1980; Zuckerman, 1978). Consensus (social desirability) and distinctiveness (unique effects) similarly matter when people ask whether a single behavior is attributable to an underlying disposition (Jones and Davis, 1965).

A parallel line of research in developmental psychology, theory of mind (ToM), similarly concerns understanding how people infer the mental states of others (Saxe et al., 2004). A false belief paradigm is often used to understand the neural mechanisms involved. For example, in the "Sally Ann" task (Wimmer and Perner, 1983), participants are asked to guess where a character in a cartoon (Sally Ann) will look for an object (a ball) that had been moved from its previous location while she was away. Researchers interpret a correct response of "the original location" as an understanding by the participant of the mental state of Sally Ann. False belief paradigms may not be sufficient to unearth the process of inferring the mental states of others (e.g., Saxe and Wexler, 2005), so researchers in the ToM tradition have studied how people infer goals from bodily action, attention from eye gaze, and emotion from the expressions of others (Frith and Frith, 2001). Across a number of studies, a network of brain regions—medial prefrontal cortex, superior temporal sulcus, and anterior temporal poles—has been consistently identified to be active in thinking about other people.

ToM research and attribution research study the same problem of understanding other people, but, until recently, there has not been an explicit dialogue between developmental and social psychologists (Malle et al., 2001). Recently, using a classic attribution paradigm within social psychology (McArthur, 1972), we demonstrated that *dispositional* inferences (the person caused the behavior)—but not other social inferences—activated medial prefrontal cortex (Harris et al., 2005), a key region in the "mentalizing" network identified in ToM research. This work points to the possibility of fine delineation between different types of person inferences. Behavioral paradigms developed in social psychology can also map these types of inferences (e.g., Mitchell et al., 2004).

Both lines of research—ToM and classic attribution research—study conscious, deliberate thinking about other people. Attribution of mental states and dispositions follows well-defined inference rules, the person sometimes is a "naive scientist." However, thinking about other people often does not comply with these rules. In the history of social cognition, the "naive scientist" view, which dominated the 1970s, was followed by the "heuristics-and-biases" view (Nisbett and Ross, 1981). People used minimal, often superficial, information to arrive at a quick, often biased, judgment. In the subsequent decades, two new metaphors of social cognition were introduced—first, the "cognitive miser" (Fiske and Taylor, 1984), and second, the "motivated tactician" (Fiske and Taylor, 1991). The "cognitive miser" view acknowledged that heuristic judgments are functional—relying on fewer attentional resources in the service of fast action. The "motivated tactician" view acknowledged the importance of goals and context—people operate in often functional, flexible ways, depending on their goals.

The changes in the guiding metaphors were not a result of paradigm shifts but a result of often unexpected experimental findings. In the first study documenting the fundamental attribution error (Ross, 1977) or the correspondence bias (Gilbert and Malone, 1995), Jones and Harris (1967) set out to show that people would not make dispositional attributions for a person's behavior in the presence of strong situational pressures limiting one's behavioral options, i.e. would acknowledge the power of the situation. In the particular experiment, participants were asked to infer a person's true attitude (pro- or anti-Cuba) from an essay (pro-Castro) that the person either decided to write on hew own or was assigned to write in a class. The normative analysis prescribes that people should infer correspondence between the attitude and the essay only when the latter was written under free choice. Alas, people inferred correspondence in both conditions (free vs. forced choice), insufficiently adjusting for the influence of the situation. This puzzle has generated detailed process theories of dispositional inferences (Gilbert, 1998; Gilbert et al., 1998; Trope, 1986; Trope and Alfieri, 1997; Trope and Gaunt, 2000). Crudely stated, according to these theories, whereas behaviors are categorized automatically in dispositional categories (e.g., "aggressive"), adjustments for the constraining effect of the situation require attentional and motivational resources. The field of person perception has moved from assigning a greater role to deliberative processes to a greater role to spontaneous, automatic processes (Uleman et al., 2005). What we have discovered along the way is that many of the processes involved in person perception are automatic, anticipating social neuroscience opportunities.

As experimental findings accumulated, the importance of goals and context became evident; although automatic processes might be the initial default, often-preferred mode, people evidently go beyond them, giving rise to metaphors of the perceiver as a "motivated tactician" (Fiske and Taylor, 1991), flexible enough to use more than one strategy, including more thoughtful, deliberate, control overlaid on an automatic substrate. For example, people can form heuristic, category-based impressions based on expectations and social categories, attending to expectancy-consistent information, disregarding inconsistent information, and forming impressions based on social category consensus. But, if their outcomes depend on the other person, they move to a process that increases attention to inconsistencies, makes personalized dispositional attributions about the other as a unique individual, and forms an idiosyncratic impression of the other person (Erber and Fiske, 1984; Neuberg and Fiske, 1987; Ruscher and Fiske, 1990). A continuum of impression formation results, ranging from relatively automatic category-based to relatively controlled individuated impression formation (Fiske and Neuberg, 1990). Such results in various laboratories revived Williams James's pragmatic premise, paraphrased as "thinking is for doing" (Fiske, 1992).

The widely accepted framework for thinking about person perception became known as dual-process theories, based on two-to-three dozen related theories (collected by Chaiken and Trope, 1999; see also Kahneman, 2003; Smith and DeCoster, 2000). Theories differ in characterizing these processes and on the defining criteria. However, the general consensus holds that some social cognitive processes are less effortful, less deliberate, and faster than other processes. One of the implications of this dual-systems view is that these processes depend on different rules and are amenable to different manipulations. For example, cognitive load should interfere less with the relatively rapid, automatic, processes than with relatively slower, controlled, deliberate processes. Bargh (1994) described four dimensions of automaticity: whether a process is started intentionally, whether the process is efficient, whether the process occurs outside of awareness, and whether the process is controllable. We focus here on two key features that characterize many inferences about other people: their spontaneous and their efficient nature, with direct implications for social neuroscience.

6. Spontaneous nature of social inferences

One of the best classroom demonstrations of spontaneous social thinking is showing students the apparently self-propelled, intentional movement of animated triangles, following the Heider and Simmel (1944) classic study. Heider and Simmel found that their participants described these movements in terms of meaningful social actions. This and subsequent studies (e.g., Bassilli, 1976; Berry et al., 1992; for review see Scholl and Tremoulet, 2000) have demonstrated that people spontaneously perceive the physical movements in social terms. In fact, the paradigm has been deployed in fMRI studies (e.g., Castelli et al., 2000, 2002). These studies have shown that observing the movement of the animated shapes activates a network of brain regions consistently recruited in understanding of social action—superior temporal sulcus and medial prefrontal cortex. Moreover, the connectivity between the different brain regions seems to be impaired in individuals with autism (Castelli et al., 2002), who do not spontaneously understand the actions in social terms.

Evaluation and affect follow directly spontaneous perceptions of other people, so they are central for social cognition (Fiske, 1982; Zajonc, 1980). Brain structures implicated in evaluation of stimuli could be part of the network underlying spontaneous social understanding. Heberlein and Adolphs (2004) showed that a patient with bilateral amygdala damage failed to "see" the social meaning in the Heider and Simmel stimuli, despite intact visual perception and intact ability to describe social stimuli. The same patient had also specific impairments in identifying facial expressions of fear (Adolphs et al., 2005). Adolphs and colleagues showed that this impairment was specifically due to the patient's failure to utilize information from the target faces' eyes. However, when the patient was instructed to attend to the eyes, his performance matched the performance of normal participants. Unfortunately, the patient was able to maintain this performance only under explicit instructions to attend to the eyes. In the absence of such instructions, his performance deteriorated to previous levels. These findings suggest that amygdala plays a key role in spontaneous social cognition. They also show that such processes are potentially flexible and can occur by more than one route.

Understanding of facial gestures also involves spontaneous processes. Most research has investigated recognition of expressions of negative emotions, consistent with the view that negative social stimuli have attention-grabbing power (Fiske, 1980; Pratto and John, 1991). In an early demonstration, the identification of angry faces was not affected by the set size of neutral faces surrounding the angry face (Hansen and Hansen, 1988), suggesting a spontaneous pop-up of significant social stimuli. Furthermore, findings of increased amygdala activation in response to subliminally presented angry or fearful expressions (Morris et al., 1998; Whalen et al., 1998) suggest that such expressions were perceived despite the lack of awareness of the stimuli. People not only effortlessly recognize expressions of emotions from facial appearance but also draw trait inferences from such appearance. Probably, the ability to draw such inferences builds on the ability to read facial gestures and would rely on similar brain regions. For example, untrustworthy-looking faces activated amygdala and anterior insula even when the participant's task was to judge the age of the faces (Winston et al., 2002). Similarly, basic affect evaluations (good/bad) are independent of the participant's task (Cunningham et al., 2003).

People also make spontaneous trait inferences from behaviors (Uleman et al., 1996). Moreover, these trait inferences from minimal information (e.g., "Jessica threw a chair at her classmate.") are bound to the faces of those who enacted the behavior (Carlston and Skowronski, 1994; Carlston et al., 1995; Todorov and Uleman, 2002, 2003, 2004) even if the explicit memory for the behavior is lost. An important question is whether such trait knowledge is spontaneously retrieved in face perception. In fact, in one of the first papers attempting to describe a neural model of social cognition, Brothers (1990) argued that dispositional knowledge about a person is automatically retrieved in face perception. Consistent with this hypothesis, perception of personally familiar individuals (e.g., close friends) activates a distributed network of brain regions that extend beyond the visual memory of a face (Gobbini et al., 2004). These regions include precuneus, superior temporal sulcus, and medial prefrontal cortex. In the Gobbini et al. study, the person knowledge was acquired over extended periods of time and multiple interactions. Todorov et al. (in press) showed that trait inferences acquired in a minimal interaction context were spontaneously retrieved in face perception. These studies used one-back repetition task, in which participants decided whether each face was the same as or different from the previous face, to make sure that the task neither required person evaluation nor retrieval of person knowledge. Nevertheless, neural activity was modulated by the knowledge associated with the face. Furthermore, the retrieved knowledge is highly specific (Todorov et al., in press). For example, faces that were associated with disgusting behaviors evoked stronger activity in anterior insula than faces associated with aggressive behaviors, consistent with studies suggesting that processing of disgust-related stimuli activates anterior insula (Calder et al., 2000; Murphy et al., 2003; Phan et al., 2002; Phillips et al., 1997).

Behavioral experiments have identified a number of processes that occur spontaneously, and recent neuroimaging studies have started to explore the neural structures that underlie these processes. For a truly social neuroscience, exciting issues lie ahead. For example, differential neural processing of facial expressions of emotions is relatively easy to understand in terms of facial features (Ekman, 1982). In these cases, as well as in cases of differential neural responses to trustworthy and untrustworthy faces (Winston et al., 2002) or attractive and unattractive faces (Aharon et al., 2001), neural responses depend on the visual appearance of the face. A computational mechanism that links particular perceptual features (or a configuration of features) to conceptual representations could account for differential neural responses. However, trait inferences triggered by behaviors are not directly readable from the perceptual input. Observing dissociations, where the same face triggers a distinctive neural response as a function of prior associations, poses new challenges for research.

Probably, the most important question is *how bottom–up, stimuli-driven processes and top–down, knowledge-driven processes interact*. This is an issue also central for research on recognition of expressions of emotions. Although a number of studies (e.g., Blair et al., 1999; Calder et al., 2000, 2001; Kesler/West et al., 2001; Morris et al., 1996; Phillips et al., 1997; Sprengelmeyer et al., 1998) have attempted to isolate typical brain markers for detecting expressions of emotions (e.g., fear—amygdala, disgust—anterior insula), it is far from clear that this strategy has been completely successful (Feldman Barrett, in press). Most social stimuli are inherently ambiguous, and their disambiguation can occur rapidly and outside of conscious awareness (Trope, 1986; Trope and Alfieri, 1997). Consider the expressions of basic emotions. A typical Ekman face expressing fear is identified by more than 75% of people as expressing fear. However, if the face is preceded by a short behavioral description (e.g., a woman whose long-prepared plans to treat her sister are frustrated), more than 75% identify the face as expressing anger (Carroll and Russell, 1996). The same processes are at play when people perceive ambiguous behaviors (Trope and Alfieri, 1997).

Context can modify the neural representations of emotional expressions. Kim et al. (2003) showed that faces expressing surprise activated the amygdala but only when they were perceived as negative. A subsequent study (Kim et al., 2004) obtained similar findings when participants saw explicit contextual information ("She just lost $500.") disambiguating the meaning of surprise. Given that the blood oxygenation level dependent (BOLD) response peaks on average 6 s after the presentation of the stimulus, fMRI studies will be most likely insufficient to completely identify the processes at play, so more temporally sensitive methods will be crucial. For example, the initial process could be bottom–up, driven by facial features (identifying a unique emotion), but then this process is quickly overwritten by top–down processes. Furthermore, the bottom–up processes most likely do not reach conscious awareness at all.

7. Efficiency of social inferences

Social category information such as gender, race, and age is accessed very rapidly from faces (Ito et al., 2004; Ito and Urland, 2003; Fiske, 1998). As outlined in the previous section on attribution theory, behaviors are automatically categorized in trait categories (Gilbert et al., 1998; Lupfer et al., 1990; Smith and Lerner, 1986; Todorov and Uleman, 2003; Winter et al., 1985). Cognitive load (e.g., rehearsing digits while reading the behavior information) interferes with dispositional inferences (e.g., is this person aggressive) but does not interfere with the trait categorization of the behavior (e.g., aggressive behavior). To return to the example of the coach observing his team (Trope, 1986), the identification of the emotional expression within the particular context (losing vs. winning) is independent of cognitive or attentional load.

Most relevant to socially inspired neuroscience, *people extract surprising amounts of personality information from a minimal contact with strangers* (Albright et al., 1988; Ambady and Rosenthal, 1992; Ambady et al., 1995; Borkenau and Liebler, 1992; Kenny et al., 1992). In fact, people extract such information from facial appearance in the absence of any contact (Hassin and Trope, 2000; Zebrowitz, 1999). These person inferences are highly efficient and often can have important consequences. For example, 1-s exposure to the faces of political candidates for the US Senate was sufficient for participants to decide who looks more competent, and these competence judgments predicted about 70% of the election outcomes (Todorov et al., 2005). Moreover, 100-ms exposure to faces is sufficient for people to make a variety of trait inferences (Willis and Todorov, in press). In this study, attractiveness was included to serve as a benchmark for other social judgments. Surprisingly, judgments of trustworthiness were as easily made as judgments of attractiveness. In fact, these judgments did not improve with increased presentation of the faces, i.e. 100-ms and 1000-ms exposure produced equivalent results. The efficiency of trustworthiness judgments is consistent with findings implicating amygdala in the computation of these judgments (Winston et al., 2002). In fact, Adolphs et al. (1998) have shown that patients with bilateral amygdala damage fail to discriminate between trustworthy and untrustworthy looking individuals. The findings suggest that trait inferences from faces are relatively automatic, made fairly rapidly from minimal information, and computed in brain regions dedicated to evaluation of stimuli. They also support the importance of a core social motive to ascertain the trustworthiness of others.

A number of unresolved issues await further research. In the case of trait inferences from faces, we do not know what facial features make a face look trustworthy or competent. The finding that such inferences can be made after 100-ms presentation suggests that people can use specific facial features. Whalen et al. (2004) have shown that the larger size of fearful eye whites (sclera) is sufficient to modulate neural activity in the amygdala. Whether such features can be identified in the case of trait inferences from faces is an empirical question.

In the case of trait inferences from behaviors, we do not know what brain structures are involved in the computation of the inferences. Mitchell and his colleagues (Mitchell et al., 2004, 2005) have conducted a series of fMRI studies modeled upon behavioral studies on impression formation. Participants were presented with faces and behaviors and asked either to form an impression of the person or to memorize the sequence of behaviors. Mitchell et al. found robust activity in medial PFC only when people had an impression goal. Given the behavioral literature that trait inferences from behaviors are independent of the participants' goals (Todorov and Uleman, 2002, 2003), this finding suggests that medial PFC is involved in *explicit* deliberate impression formation (e.g., Harris et al., 2005) but not necessarily in spontaneous impression processes. These are only few of the unresolved questions, and they all deal with the nature of first impressions. However, the bigger research question is how people update person representations in light of new information.

If behavioral research on person perception has been moving toward assigning a smaller and smaller role to deliberate, computationally taxing strategies until now, *the future seems to belong to the goal dependence of social cognitive processes, including relatively automatic processes*. Although until recently these processes were conceived as inflexible, growing research suggests that different automatic processes can be recruited as a function of current goals and motives (Ferguson et al., in press). A few core social motives, noted earlier, will likely prove central in these contexts.

8. Social cognitive affective neurosciences as glue

As this article has shown, attributions of intent figure centrally in social perception because people are agents. Because of their perceived intent, people as stimuli also arouse affect in perceivers. Affective reactions stem from the perceiver's goals colliding with the outside world (e.g., Mandler, 1975; Simon, 1975). Major disruptions cause emotional reactions, which cue coping in the case of negative disruptions (e.g., Taylor, 1991). Theoretically, an interruption is mostly negative, but a positive disruption (e.g., unexpected facilitation) can cause positive emotions. Disruptions arguably vary in certainty, responsibility, timing, and the like, resulting in distinct emotional reactions depending on cognitive appraisals (e.g., Roseman, 1984; Smith and Ellsworth, 1985; Weiner, 1986). Thus, emotions often result from the interaction of perceiver mental states (cognition, motivation) and the situation.

Social relationships particularly provide an opportunity for the disruption or facilitation of one's goals. Relationships entail interdependence, that is, depending on others for reaching one's goals jointly (Kelley and Thibaut, 1978). These related other people then create strong potentials for arousing emotion when they facilitate or disrupt goals, especially in unexpected ways (Berscheid, 1983). Even social groups can evoke emotions because of such dynamics of interdependence (Fiske et al., 2002). Thus, the intent of other social entities is especially important to evoking emotion.

The consequence for social neuroscience is that it can never be solely cognitive but will inevitably entail emotion as well. The neural systems will likely prove interconnected between affect and cognition, as much of the works reviewed here already indicate. Thus, the brain is not divided up in the same way as our departments of psychology and neurosciences, which intra-disciplinary forces threaten to pull apart at the seams. *Social neuroscience intrinsically entails cognition, emotion, motivation, and readiness for behavior*. These intertwined systems will require all types of brain researchers to collaborate, and we would argue to draw on the rich data of social behavioral research, profiting from its insights. Ultimately, we are glued together in trying to understand the social, cognitive, affective, and neural processes of whole humans, who are profoundly social beings.

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