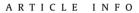# Outcome dependency alters the neural substrates of impression formation

CrossMark

Daniel L. Ames *, Susan T. Fiske

Princeton University, USA

ABSTRACT

How do people maintain consistent impressions of other people when other people are often inconsistent? The present research addresses this question by combining recent neuroscientific insights with ecologically meaningful behavioral methods. Participants formed impressions of real people whom they met in a personally involving situation. fMRI and supporting behavioral data revealed that outcome dependency (i.e., depending on another person for a desired outcome) alters previously identified neural dynamics of impression formation. Consistent with past research, a functional localizer identified a region of dorsomedial PFC previously linked to social impression formation. In the main task, this ROI revealed the predicted patterns of activity across outcome dependency conditions: greater BOLD response when information confirmed (vs. violated) social expectations if participants were outcome-independent, and the reverse pattern if participants were outcome-dependent. We suggest that, although social perceivers often discount expectancy-disconfirming information as noise, being dependent on another person for a desired outcome focuses impression-formation processing on the most diagnostic information, rather than on the most tractable information.

© 2013 Elsevier Inc. All rights reserved.

Introduction

Consistent impressions of inconsistent people

The ability to distill the vast amount of interpersonal information that people encounter each day into compact impressions is critical for making sense of the social world. As such, a central goal of cognitive neuroscientists studying social processes has been not only to define the mental operations and neural processes that give rise to social impressions, but also to characterize the nature of these impressions themselves. One consistent observation from behavioral research has been that not all social information counts equally—rather, certain pieces of information come to compose central expectations about people, and these expectations exert a strong pull over how subsequent information is interpreted. Historically, social psychologists have expressed this observation in terms of trait centrality (Asch, 1946), trait primacy (Asch, 1946), implicit personality theory (Rosenberg and Sedlak, 1972), social schemata (Delia and Crockett, 1973), prototypes (Cantor and Mischel, 1979), and various theories of stereotyping (Hamilton and Sherman, 1996).

In parallel, cognitive neuroscience has long viewed this drive toward coherent representations as a general property of cognition and perception (e.g., Sporns et al., 2004; Tononi et al., 1998). Likewise, the importance of perceivers' expectations in guiding these integrative processes

has been expressed in numerous theoretical contexts (and numerous brain regions), including visual perception (e.g., feature integration theory; Schoenfeld et al., 2003; Treisman and Gelade, 1980), language acquisition (e.g., native language neural commitment; Kuhl, 2004; Saffran et al., 1996), discourse comprehension (Martín-Loeches et al., 2008) and memory formation (e.g., hippocampal/neocortical interactions theory; Wang and Morris, 2010).

These various perspectives all predict (correctly) that people will tend to form coherent, stable impressions of other people, objects, and scenes. This is adaptive, because representing the world as coherent and stable makes the world more comprehensible and easier to act on. However, the brain's proclivity to extract structure and patterns from noisy inputs leads to more-than-occasional cognitive missteps. People see coherent objects where none exist, confidently invest money to capitalize on illusory stock market patterns, and construct memories that comport well with expected event structures, but poorly with actual events (e.g., Bartlett, 1932; Whitson and Galinsky, 2008).

Given the brain's general (over)zealousness for building coherence, it is unsurprising that (at least according to the dominant models in social psychology) people typically construe other agents as consistent entities whose actions are guided primarily by stable dispositions (Gilbert and Malone, 1995; Jones and Harris, 1967; c.f. Malle, 2006). This personality-driven construal (notably, a primarily Western phenomenon, Choi et al., 1999) is, in many ways, unrealistic. People are, in fact, remarkably variable in their behavior across time and situations (Ross and Nisbett, 1991). Yet "knowing" that people are variable does not necessarily diminish the drive toward stable social impressions—just as "knowing" that the stairs in M.C. Escher's

* Corresponding author at: Department of Psychology, Princeton University, Princeton, NJ, USA. Fax: +1 609 258 1113.
  E-mail address: dames@princeton.edu (D.L. Ames).

Ascending and Descending (1960) are logically irreconcilable does not diminish the drive to construct a visually coherent staircase. An important question then, is how people maintain consistent impressions of other people when other people are so inconsistent.

The tools of cognitive neuroscience can be usefully applied to this question, having already delineated the biological underpinnings of several "coherence problems" (see Achieving consistency by discounting the inconsistent and Achieving consistency by integrating the inconsistent sections), as well as many of the structures that contribute to social impression formation. By far the most consistent area to emerge in studies of impression formation is a dorsal region of medial prefrontal cortex (dmPFC; for meta-analyses and reviews, see Denny et al., 2012; Mitchell, 2009; van Overwalle, 2009; Wagner et al., 2012). Several other regions, including the temporo-parietal junction (TPJ), amygdala, posterior cingulate cortex (PCC), inferior frontal gyrus (IFG), and superior temporal sulcus (STS), have also been implicated in impression formation processes (Cloutier et al., 2011; Freeman et al., 2010; Ma et al., 2011; Mende-Siedlecki et al., in press; Mitchell et al., 2005; Schiller et al., 2009). Yet this research reveals very little about what specific processing strategies might be deployed to resolve what is arguably the fundamental problem of impression formation (Hamilton and Sherman, 1996): creating highly coherent representations from highly divergent information. Moreover, neuroimaging studies that attempt to examine impression formation under relatively naturalistic conditions are all but absent from the literature. This is perhaps puzzling, since the functional value of impression formation (at least as described by some cognitive neuroscientists) lies largely in being able to understand and predict other people. By understanding others and predicting their behavior, one can improve one's social interactions, and better achieve desired outcomes—both social and material. Yet these studies rely on forming impressions of "people" (usually face databases and/or invented names) with whom participants will never interact, who cannot help perceivers to desired outcomes, and who may not even be regarded as "real." Thus, the question of how dMPFC (or other regions) might respond under more involving conditions remains unanswered.

Achieving consistency by discounting the inconsistent

A review of relevant research points toward two (conflicting) approaches that people might use to create and sustain coherent social impressions. The first is to discount or explain away information that does not conform to preconceived expectations. Well-established theories from neuroscience (Kersten et al., 2004), cognitive psychology (Anderson, 1998) and social psychology (Fiske and Linville, 1980; Snyder and Swann, 1978) converge on the notion that selectively discounting expectancy-disconfirming information is an efficient learning strategy, relieving people of the burden of interpreting information that is difficult to process and that, given what is already "known" seems more likely to represent noise than signal (consistent with a Bayesian learning approach; Anderson, 1998).

Achieving consistency by integrating the inconsistent

However, not all expectancies are accurate; therefore, not all expectancy-disconfirming information is noise. Inaccurate impressions arise partially from the fact that people often form these impressions based on minimal evidence. For example, people can provide a judgment of others' trustworthiness after seeing their face for as little as 33 ms (Todorov et al., 2009). The amygdala, orbitofrontal cortex, and anterior insula have been frequently implicated in these rapid, intuitive impressions. These judgments, though not necessarily accurate, nonetheless predict important outcomes, including political elections and criminal sentences (for an overview, see Ames et al., 2011). This and other research (e.g., Ambady and Rosenthal, 1993; Devine, 1989) highlights the fact that social expectancies, while strongly felt and

demonstrably influential, are often based on scant evidence. Thus, under-informed expectances routinely become the lenses through which other people are viewed. In principle, information that violates these expectancies provides a means of correcting the prescription of these lenses, delivering valuable cues as to when impressions may be erroneous, while simultaneously provisioning the perceiver with the raw materials for building a more nuanced understanding. Revising impressions takes effort, however, and often the core goal of maintaining cognitive consistency trumps the objective of perceiving the world accurately (Hamilton and Sherman, 1996), people being cognitive misers (Fiske and Taylor, 2013).

Still, people do sometimes attend more to unexpected information than to expected information, with inferior frontal and temporoparietal cortices often playing a key role in reorienting visual attention toward expectancy violations (e.g. Corbetta and Shulman, 2002; Mitchell, 2008; Schank and Abelson, 1977), and posterior STS frequently observed in conjunction with unexpected changes in social gaze or movement (Frith and Frith, 2010; Pelphrey et al., 2003; Saxe et al., 2004). Moreover, these violations, when attended to, can inform social impressions (Srull and Wyer, 1989). Some of these findings appear to conflict with the literature reviewed in the previous section, suggesting that people may sometimes employ a second impression formation strategy, one that maintains coherent impressions, not by explaining away incongruous information, but by adjusting the impression to accommodate that information.

Which one when?

In sum, there are at least two competing approaches by which people might maintain consistent impressions of other people—explaining away inconsistency to preserve the impression, and altering the impression to fit the inconsistency. Given that previous literature provides examples of both approaches to maintaining coherent impressions (both social and nonsocial), it seems likely that the appropriate question is not *which* approach people use, but rather *which one when*.

Neural predictions and rationale

The present study investigates one answer to this question (recognizing that there may be more than one). It begins with the following premise: people pay attention to information that helps them get what they want. This suggests that when people depend on someone else for a desired outcome (when they are *outcome-dependent* on that person), perceivers may attend to information about the other person that they would ordinarily ignore (including, perhaps, expectancy-disconfirming information). This idea is supported by behavioral research showing that people selectively allocate limited cognitive resources toward people who are most apt to have functional implications (Ackerman et al., 2006; Rodin, 1987; Sporer, 2001). Also consistent with this hypothesis, several behavioral studies from the social attention literature reveal that being outcome-dependent focuses interpersonal attention (as measured in looking time) on inconsistencies (Erber and Fiske, 1984; Neuberg and Fiske, 1987; Ruscher and Fiske, 1990).

But while the thesis that outcome dependency increases attention to otherwise-ignored information is well supported, the hypothesis that outcome dependency alters impression formation processes has (perhaps surprisingly) received little support from this literature (see Discussion section). However, this may be largely explained by methodological limitations. Prior investigations into the effect of outcome dependency on impression formation have lacked a dependent variable that measures, in real time, the extent to which any given piece of information engages the cognitive processes subserving impression-formation. Cognitive neuroscience provides such a measure, as well as a large corpus of data indicating what areas of the brain most reliably index these processes. As noted in Consistent