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Stereotype-based modulation of person perception

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ABSTRACT

A core social–psychological question is how cultural stereotypes shape our encounters with other people. While there is considerable evidence to suggest that unexpected targets—such as female airline pilots and male nurses—impact the inferential and memorial aspects of person construal, it has yet to be established if early perceptual operations are similarly sensitive to the stereotype-related status of individuals. To explore this issue, the current investigation measured neural activity while participants made social (i.e., sex categorization) and non-social (i.e., dot detection) judgments about men and women portrayed in expected and unexpected occupations. When participants categorized the stimuli according to sex, stereotype-inconsistent targets elicited increased activity in cortical areas associated with person perception and conflict resolution. Comparable effects did not emerge during a non-social judgment task. These findings begin to elucidate how and when stereotypic beliefs modulate the formation of person percepts in the brain.

Introduction

The ability of the human brain to transform complex three dimensional visual stimuli that are encountered under varying processing conditions (e.g., lighting, distance, and viewpoint variations) into meaningful representations of persons is nothing short of astonishing. According to a large corpus of neuroscientific work, this feat requires the recruitment of an extensive and partially unique set of brain regions. Their interplay is often portrayed in a hierarchical fashion. More specifically, visual person-related information is assumed to travel from photoreceptor cells located in the back of the eye through the optic nerve to the thalamus and via primary visual cortices to what has been termed the *core system of person perception* (Gobbini and Haxby, 2007; Haxby et al., 2000; Rossion, 2008; Sergent et al., 1992; Weiner and Grill-Spector, 2010). In this core system the structural analysis of human faces and bodies is accomplished (i.e., person perception), before the information gets used by an *extended system* of brain sites to infer person knowledge such as an individual's emotional state, intentions and/or personality (Gobbini and Haxby, 2007; Haxby et al., 2000; Ishai, 2008).

It has also been observed, however, that brain connectivity is mostly bidirectional and that initial information reaching a cortical region is often processed under the influence of intra- and cross-regional cortical interactions (Felleman and van Essen, 1991; Friston, 2005; Tononi et al., 1992). In addition, from a computational point of view it has been deemed unlikely that feedforward mechanisms alone can achieve flexible and invariant visual recognition in a complex and rapidly changing environment (Ahissar and Hochstein, 2002; Deco and Rolls, 2004; Lamme and Roelfsema, 2000; Mumford, 1992). Therefore, an alternative perspective has emerged that characterizes person perception as dynamic, flexible and specialized to a perceiver's learning history, expectations and current processing goals (Amodio, 2010; Egner et al., 2010; Ofan et al., 2011; Peelen et al., 2009; Puri et al., 2009; van Bavel et al., 2008; in press). At the heart of this top-down perspective lies the idea that perceivers do not merely interpret their surroundings by analyzing incoming information, but rather that they try to understand sensory input by linking it to previous experience (Bar, 2009; Bruner, 1973; Friston, 2005; Gilbert and Sigman, 2007). According to this approach, person perception may not only inform person inferences, but person inferences may also influence person perception.

In everyday life, a well-traveled route to infer knowledge about others lies in the process of social stereotyping. As culturally embedded beliefs based on people's social group memberships, stereotypes provide predictions about the apparent personalities and deeds of others without the cumbersome necessity of getting to know them. Although stereotypic beliefs frequently shape the unfolding of human interactions (Brewer, 1988; Fiske and Neuberg, 1990), the extent of their activation and application during an

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encounter typically depends on a target's specific appearance as well as a perceiver's temporary processing goal (for a review see Macrae and Quadflieg, 2010). Once activated, however, stereotypic beliefs profoundly bias the way in which information about others is sought out, attended to, interpreted and remembered (Cameron and Trope, 2004; Jussim and Fleming, 1996; Trope and Thompson, 1997).

The propensity to stereotype others also draws attention to individuals who may warrant further scrutiny. In particular, people tend to direct their interest toward others who violate prevailing cultural stereotypes, such as female motor mechanics (Hutter et al., 2009) and accomplished African Americans (Kernahan et al., 2000). That atypical individuals merit additional analysis (i.e., stereotypic beliefs cannot explain their behavior) is evidenced in the post-perceptual operations that follow target registration. Stereotype-discrepant persons, for instance, trigger elaborative processes that strive to resolve apparent categorical inconsistencies and enhance person memory (Crocker et al., 1983; Jackson et al., 1993; Macrae et al., 1999). While there is accumulating evidence that an encounter with an atypical group member can impact inferential and memorial aspects of person construal, it is unclear whether equivalent effects emerge during the formation of person *percepts*. Based on the assumption that perception ultimately comprises an interaction between available stimulus input and the brain's predictions regarding likely stimulus identities (Cavanagh, 1991; Gilbert and Sigman, 2007; Gregory, 1997; Sterzer et al., 2009), however, stereotypes may also guide fundamental aspects of person perception.

Serving as critical groundwork to address this claim is work that explores how the brain undertakes the perceptual analysis of static human faces and bodies. Based on a large corpus of neuroimaging and brain-damaged patient studies, the core neural system of person perception is currently thought to comprise several areas in the ventral visual stream which have been termed the occipital face area (OFA, e.g., Gauthier et al., 2000), fusiform face area (FFA, Kanwisher et al., 1997), extrastriate body area (EBA, Downing et al., 2001) and the fusiform body area (FBA, Peelen and Downing, 2005). While both the OFA and FFA show increased activity when people view human faces compared to other objects (Haxby et al., 1999; Rossion, 2008; Sergent et al., 1992; Yovel and Kanwisher, 2005), the EBA and FBA display enhanced activity to human bodies (Peelen and Downing, 2007). It is through the combined effort of these four cortical regions that the structural representation of an individual's facial and bodily appearance can be achieved (Gobbini and Haxby, 2007; Haxby et al., 1999, 2000; Peelen and Downing, 2007; Weiner and Grill-Spector, 2010; Yovel and Kanwisher, 2005). What remains to be determined is whether social expectations such as those arising from stereotypic beliefs can influence the processing of visual face and body information in this set of areas.

To address this issue, we invited participants to complete a localizer task while undergoing functional magnetic resonance imaging (fMRI) to identify critical components of their core person-perception network (i.e., FFA, OFA, EBA, FBA). In addition, participants were asked to make judgments about men and women depicted in various stereotype-consistent and stereotype-inconsistent occupations (see Fig. 1). Specifically, participants reported either the sex of each target (i.e., person categorization) or the color of a dot (i.e., color classification) that was located on the image. Goal orientation was manipulated in this way as prior research has suggested that stereotype activation is impeded when non-social processing goals guide target appraisal (Macrae et al., 1997; Wheeler and Fiske, 2005). In line with previous work, we anticipated that target typicality (i.e., stereotype-inconsistent > stereotype-consistent) would modulate activity in brain regions dedicated toward person perception, but only under social-processing conditions.

Material and methods

Participants

Eighteen Caucasian undergraduate students from the University of Aberdeen (9 men), aged between 19 and 26 years (mean: 22.4 years) participated in the imaging study. All volunteers were native English speakers, right-handed as determined by the Edinburgh handedness inventory (Oldfield, 1971), and reported normal or corrected-to-normal vision. Two additional participants were recruited but excluded from analysis due to study interruption caused by a feeling of claustrophobia (1 male) and excessive head motion in the scanner (1 male). None of the participants had a history of neurological or neuropsychiatric disorders or were currently taking psychoactive medications. Informed consent

Fig. 1. Examples of stimuli used during the categorization task: (A) cleaner, (B) judge, (C) florist, and (D) footballer.