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Review

More Than Meets the Eye: Split-Second Social Perception

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Recent research suggests that visual perception of social categories is shaped not only by facial features but also by higher-order social cognitive processes (e.g., stereotypes, attitudes, goals). Building on neural computational models of social perception, we outline a perspective of how multiple bottom-up visual cues are flexibly integrated with a range of top-down processes to form perceptions, and we identify a set of key brain regions involved. During this integration, 'hidden' social category activations are often triggered which temporarily impact perception without manifesting in explicit perceptual judgments. Importantly, these hidden impacts and other aspects of the perceptual process predict downstream social consequences – from politicians' electoral success to several evaluative biases – independently of the outcomes of that process.

Visual Perception of Social Categories

Based upon the mere glimpse of another individual, knowledge about that person's gender, race, and other social categories seems to spring to mind spontaneously. The visual construal of social categories feels instantaneous and immediate, as if it were a direct product of 'reading' visible facial cues. This experience of social perception aligns with early research on the topic, which emphasized its automatic, immediate, and unavoidable nature [1–3].

A considerable body of research has shown that multiple social categories are perceived spontaneously when we encounter another individual [2]. Consequently, early work in the field of social psychology focused on either the inevitability of categorization or on its varied downstream consequences. Meanwhile, research in the cognitive, neural, and vision sciences sought to uncover the determinant cues and basic mechanisms driving perceptions of facial stimuli. Recently, a unified **social vision** (see Glossary) approach has emerged [4–6] in which the visual aspects of social perception are theoretically and empirically integrated with the products that follow. This approach moves beyond the historic disciplinary divide in which each level of analysis was studied in relative isolation. As such, the social vision approach has afforded novel insights into how we form our initial perceptions of others, revealing important complexity that occurs before a stabilized judgment is formed. Moreover, such dynamics during the process of forming categorical percepts of other people have recently been shown to carry downstream social consequences – predicting politicians' electoral success, producing gender bias, and even eliciting prejudice against racial or sexual minorities.

Because downstream interpersonal consequences typically took center-stage in social perception research, a **feed-forward** approach was generally assumed (Figure 1A, Key Figure). As such, perceptual cues were presumed to activate a single, dominant social category

Trends

Recent research shows that visual perceptions of the social categories of others are not only highly sensitive to bottom-up facial features but are also affected by higher-order social cognitive factors (e.g., stereotypes, attitudes, and goals).

Emerging work suggests a rapid and flexible integration among multiple bottom-up visual cues and top-down social cognitive processes – a process that often triggers 'hidden' social category activations that are not observed in explicit perceptual judgments.

Aspects of the initial perception process itself appear to drive important downstream social consequences (e.g., evaluative biases or politicians' electoral success) independently of the outcomes of that process.

Recent studies point to a key network comprised of the fusiform gyrus, orbitofrontal cortex, and anterior temporal lobe in helping to form flexible social perceptions through an integration of facial cues and top-down social-conceptual information.

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Key Figure

Dynamic Interactive (DI) Model of Social Perception

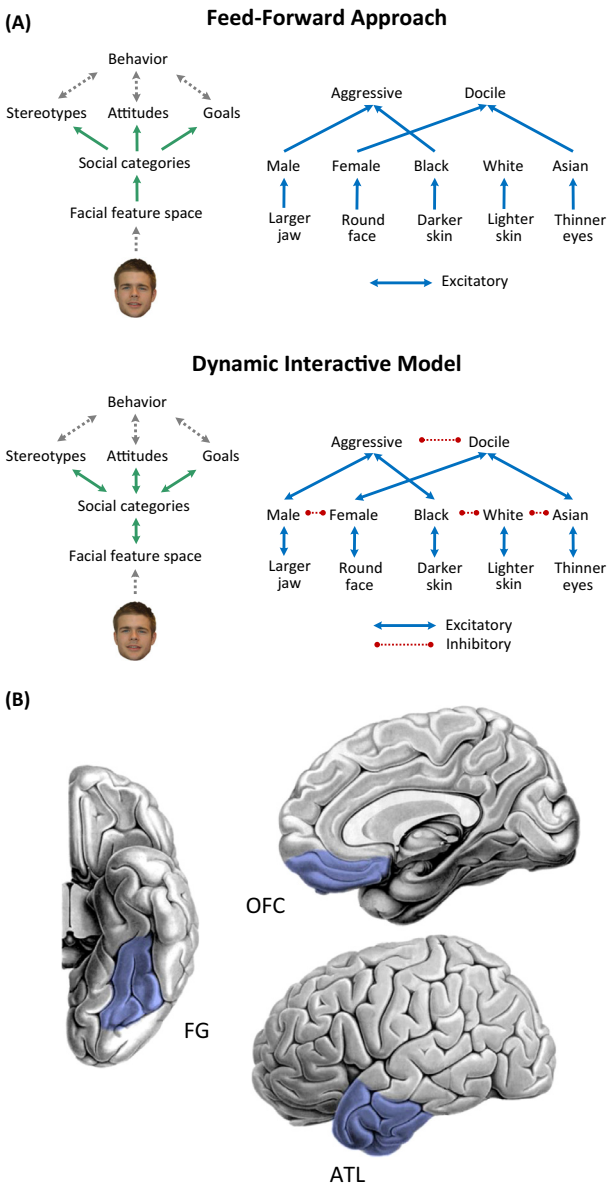

Figure 1. (A) A feed-forward approach to social perception (top) assumes that the face of a target is visually encoded by some feature space or set of feature detectors, which thereafter activates related social categories. Those categories then automatically activate related stereotypes, attitudes, and goals, which affect and may be affected by high-level behavior. The dynamic interactive (DI) model [4] (bottom), posits additional feedback influences inherent to the system, wherein stereotypes, attitudes, and goals constrain and inform category activation and featural representation. In contrast to the feed-forward approach, the DI model predicts that category activation (e.g., male) and featural representation (e.g., larger jaw) are impacted not only by lower-level visual processing but also by activated stereotypes (e.g., aggressive) in a top-down fashion. Featural representation is simplified for illustration; feature spaces using pixel-based models or computational models of ventral-visual processing may also be implemented. Permission to use the sample face image was obtained [86]. (B) A neural network for flexible split-second social perception, including the fusiform gyrus (FG), orbitofrontal cortex (OFC), and anterior temporal lobe (ATL). The FG is involved in visual processing of faces, and the ATL retrieves social-conceptual associations related to perceived characteristics such as social categories (e.g., stereotypes, person-knowledge). Such social-conceptual information may then be used by the OFC to implement top-down visual predictions that modulate FG representations of faces in line with those predictions. This network supports rapid and flexible integration of bottom-up facial cues and higher-order social cognitive processes.

representation, which in turn elicited related **stereotypes**, **attitudes**, and goals, thereafter impacting evaluative judgments and interpersonal behavior [1–3]. In this article we offer a more comprehensive perspective in which social perception is characterized as the dynamic integration of both visual processing of facial features and higher-order social cognitive processes (e.g., stereotypes, attitudes, goals) that were historically probed only as a 'downstream' product of social perception.

Glossary

Attitudes: a positive or negative evaluation related to a social category (or person, object, thing, or event).
Attractors: a state toward which a dynamical system tends to evolve.
Computational model: a mathematical model used to study the behavior of complex systems. Neural computational models provide an algorithmic and process-level description of cognition using core principles of information processing in neural systems.
Effective connectivity: analyses that use statistical models of functional neuroimaging data to infer that the activity of one neural region is exerting a directed and causal influence on the activity of another neural region.
Electroencephalography (EEG): a noninvasive technique that measures electrical potentials in the brain, and which provides high-resolution temporal information but low spatial resolution.
Extrastriate areas: cortex next to V1, involved in early visual processing of stimuli.
Feed-forward: a system or form of processing in which information moves in only one direction in a directed fashion without any feedback influences.
Implicit association test (IAT): a reaction-time measure used to assess the strength of the implicit associations in memory of an individual, independently of any conscious expression.
Lateral inhibition: the process of an excited neuron, node, or representation diminishing the activity of its neighbors, creating competition between them.
Magnetoencephalography (MEG): a noninvasive technique that measures magnetic fields generated by electrical currents in the brain, and which provides high-resolution temporal information and typically better spatial resolution than EEG (although worse than fMRI).
Multi-voxel pattern analyses (MVPA) or multi-voxel representations: a multivariate approach to fMRI data where individual stimuli, conditions, or tasks are distinguished on the basis of voxel response patterns.
Social vision: an emerging field combining social psychology and vision science.