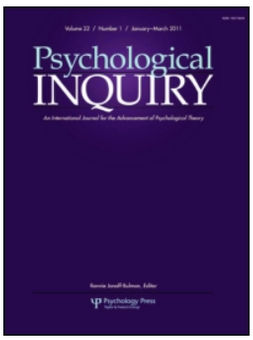

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TARGET ARTICLE

Perceiving the World Through Group-Colored Glasses: A Perceptual Model of Intergroup Relations

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ABSTRACT

Extensive research has investigated societal and behavioral consequences of social group affiliation and identification but has been relatively silent on the role of perception in intergroup relations. We propose the perceptual model of intergroup relations to conceptualize how intergroup relations are grounded in perception. We review the growing literature on how intergroup dynamics shape perception across different sensory modalities and argue that these perceptual processes mediate intergroup relations. The model provides a starting point for social psychologists to study perception as a function of social group dynamics and for perception researchers to consider social influences. We highlight several gaps in the literature and outline areas for future research. Uncovering the role of perception in intergroup relations offers novel insights into the construction of shared reality and may help devise new and unique interventions targeted at the perceptual level.

KEYWORDS

Intergroup relations; perception; social identity

One brisk Saturday in November 1951, the Dartmouth Indians and Princeton Tigers—two college football teams—met in Princeton's Palmer Stadium. It was the last game of the season, and Princeton was undefeated. A few minutes after the opening kickoff, it became apparent that it was going to be a very rough game. Tempers flared and accusations began to fly. A few days later, the Princeton newspaper called the game a "disgusting exhibition" and reported that the "blame must be laid primarily on Dartmouth's doorstep." The Dartmouth paper, however, saw it differently. This back-and-forth inspired psychologists at Dartmouth and Princeton to join forces and understand exactly how members of these elite colleges could come to such a stark disagreement over the supposedly objective facts of the game.

First, they administered a questionnaire to Dartmouth and Princeton students a week after the game. Most Princeton students thought the other side started the rough play, whereas the Dartmouth students thought that both sides were to blame (Hastorf & Cantril, 1954). Because this difference could be chalked up to errors in their memory or even exposure to the biased newspaper reports, the professors brought in a new batch of students from each school, showed them a tape of the exact same game, and recorded their responses as they watched the game unfold before their eyes. Even with the facts in front of them, students from the two universities continued to disagree about the state of reality. The authors concluded "the 'same' sensory impingements emanating from the football field, transmitted through the visual mechanism to the brain, also obviously gave rise to different experiences in different people" (Hastorf & Cantril, 1954, p. 132). This result should come as little surprise to avid sports fans, as similar disagreements happen on football fields, basketball courts, and ice hockey rinks every day.

People's affiliations with groups—ranging from sports teams to political parties to nations—appear to have a profound influence on how they perceive and interpret others and the world around them. In turn, perception of others and the environment influences how people interact with others. These perceptual biases can have significant consequences. For instance, inmates with more Afrocentric facial features received harsher criminal sentences than those with less Afrocentric features (Blair, Judd, & Chapleau, 2004). The effect of perception on judgment and behavior is not limited to the legal justice domain, but research on these factors is still relatively scarce in the intergroup literature. Understanding the unique effects of perception offers novel insights into the construction of shared reality and may afford intergroup interventions that operate through changes in perception. In the current article, we propose a bidirectional model for understanding the role of intergroup relations in perception.

Social Identity as a Fundamental Motive

Belongingness and Group Affiliation

In the 1960s, Maslow placed belonging behind only the need for safety and basic physical needs like air and water (Maslow, 1968). A few decades later, researchers proposed that our need to belong, which is fulfilled through social affiliations and acceptance, is a fundamental human motive. They argued that the need to belong is as central to psychological well-being as

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Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/hpli.

food and shelter are for physical well-being (Baumeister & Leary, 1995). These belonging needs dictate an extraordinary amount of human cognition. For instance, people high in the need to belong are particularly accurate in decoding social cues (Pickett, Gardner, & Knowles, 2004) and tend to have selectively superior memory for social events and information (Gardner, Pickett, & Brewer, 2000). Likewise, social exclusion can make people socially anxious (Baumeister & Tice, 1990), increase the feeling of loneliness (Peplau & Perlman, 1982), and may even turn some people antisocial (Twenge, Baumeister, Tice, & Stucke, 2001). People can fulfill this fundamental need—as well as many other psychological needs—by building interpersonal relationships and affiliating with social groups. Social groups fulfill a wide variety of basic psychological needs (Correll & Park, 2005), providing a feeling of status (Tajfel, 1982), a sense of distinctiveness (Brewer, 1991), and a source of knowledge about the world (Kruglanski, 1989) to group members. As a consequence, groups and relationships that are important to an individual tend to become incorporated into one's representation of the self (Brewer, 2004; Brewer & Gardner, 1996) and shape our sense of reality (Hardin & Higgins, 1996).

Social Identity and Self-Categorization

A large body of research has now established that people identify with groups, and this process has significant consequences for intergroup relations (Tajfel, 1982). More than 60 years ago, Sherif and Sherif (1953) examined how group identities could manifest in group conflict. They brought together teenage boys who had no prior relationship with one another to camp at Robber's Cave State Park in Oklahoma. The boys were randomly assigned to one of two groups—the Eagles or the Rattlers—and spent the first part of camp bonding with their group members and enjoying regular camp activities together. In the second part of camp—the competition stage—the two groups were put into competition with one another through a variety of games and activities. It is important that in most cases the two groups competed for limited resources (e.g., picnic food, trophies). Within the time frame of a week, verbal prejudice and aggressive behaviors toward boys from the opposing camp escalated quickly (Sherif & Sherif, 1953). This classic experiment helped inspire research devoted to studying the power of group identities.

People belong to multiple social groups—ranging from well-established groups like race, gender, and nationality to more fluid ones like schools and sports teams. At any given moment, people may categorize on the basis of these collective identities or their individual identity—a process known as self-categorization (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987; Turner, Oakes, Haslam, & McGarty, 1994). When group identities and sense of belonging are salient, people tend to perceive themselves and others as interchangeable exemplars of a social category as opposed to unique individuals (Turner et al., 1987). These social identities can exert a profound influence on how people perceive and interact with their social surroundings (Hastorf & Cantril, 1954; Postmes & Jetten, 2006; Turner et al., 1987). Indeed, there is extensive evidence that self-categorization with a social group can influence judgments of the *social* world, leading to biases in memory (Bernstein, Young, & Hugenberg, 2007; Ostrom & Sedikides, 1992; Park & Rothbart, 1982), evaluation (Ashburn-Nardo, Voils, & Monteith, 2001; Otten & Moskowitz, 2000; Van Bavel & Cunningham, 2009), and behavior (Sherif & Sherif, 1953; Tajfel, Billig, Bundy, & Flament, 1971). Extensive research has investigated the societal and behavioral consequences of forming and identifying with social groups (Sherif & Sherif, 1953; Tajfel & Turner, 1979).

Although it is hardly surprising that sustained intergroup competition can elicit favoritism toward an ingroup, researchers have found that this pattern of discrimination can occur under very trivial circumstances (Tajfel et al., 1971). For instance, early investigations of the "minimal group paradigm" had people perform a trivial task such as guessing the number of dots in a rapidly presented image or expressing preference for abstract paintings from Klee and Kandinsky (J. D. Brown, Collins, & Schmidt, 1988; Tajfel et al., 1971). Surprisingly, even such minimal and arbitrary assignment of "groups" led people to express ingroup favoritism in resource allocation, giving more money to anonymous ingroup members (Tajfel, 1982). These minimal group studies illustrate the ease with which people identify with and favor their ingroup (Brewer, 1979). In fact, the form of flexible group formation occurs in every society ever observed—making it a human universal (D. E. Brown, 1991). This research underscores the deep and pervasive influence of groups on the human mind and brain (Brewer, 2004; Caporael, 1997).

Although scholars in fields such as psychology (Allport, 1954), economics (Akerlof & Kranton, 2000), political science (Conover, 1988), sociology (Mills, 1967), organizational behavior (Ashforth & Mael, 1989), and neuroscience (Cikara & Van Bavel, 2014) agree that group living is fundamental to understanding human behavior, this research has been surprisingly silent on the *perceptual processes* that mediate the relationship between social identity and behavior. Undoubtedly, higher order cognition and behavior are important to study when understanding intergroup phenomena. Here, we argue that perception is another important—if overlooked—element of social identity and intergroup relations. We propose that bridging social identity and perception will not only help elucidate intergroup relations and the construction of shared reality but also better reflect the dynamic integration of the human mind (Cunningham, Zelazo, Packer, & Van Bavel, 2007; Freeman & Ambady, 2011a; Turke-Browne, 2013). Treating social psychological issues independent of perception and cognition carves the mind at false joints (see Gantman & Van Bavel, in press; Vinson et al., in press). Bridging these fields will better reflect the operation of the human mind and integrate insights from scientists and practitioners from all perspectives.

We propose the perceptual model of intergroup relations. After describing the model, we present evidence from the existing literature that provides support for the model. Because the existing literature involving intergroup relations and perception is somewhat limited, we also discuss influences from other social concerns on perception. We suspect the process through which social identity tunes perception is *not* qualitatively distinct from other top-down effects of social processes on

perception (Adams, Ambady, Nakayama, & Shimojo, 2010; Balcetis & Lassiter, 2010). We discuss social influences on perception across each sensory modality and review the growing literature on intergroup perception and action. Because there is much more research on the path of the model leading from social identity to perception than from perception to intergroup relations, we focus our review on the former. However, we identify gaps in the literature and targets for future research.

Perceptual Model of Intergroup Relations

The perceptual model of intergroup relations characterizes how social identity can alter perception across modalities (vision, audition, olfaction, tactile, and gustatory perception) and how these perceptual processes can mediate intergroup relations (see Figure 1). Because the relationship between social group identification and intergroup relations has been well established in the field of social psychology (Ellemers, Spears, & Doosje, 2002; Tajfel, 1982; Turner et al., 1987), we focus on the effect of social identity on perception, with attention to the implications for behavior. Of importance, we assert that each of these relationships is susceptible to characteristics of the groups involved and their intergroup dynamics, including the degree to which perceivers identify with their groups, the competitive or cooperative nature of the group, and so on. In this way, perception is one psychological process (of many) that underlies the well-established relationship between social identification and intergroup relations.

The central premise of our model is that social identification influences perception. This notion has not been studied much in social psychology, until recently. For instance, activating concepts related to racial stereotypes (e.g., crime) influences perception, inducing visual attention toward Black faces, and this relationship seems to be bidirectional such that exposure to Black faces increases the tendency to perceive crime-related objects such as a gun (Eberhardt, Goff, Purdie, & Davies, 2004). Even groups that are not readily distinguishable by visual features (e.g., minimal groups) can elicit biases in perception (see Van Bavel & Cunningham, 2011). Thus, the relationship between groups and perception ranges from long-standing

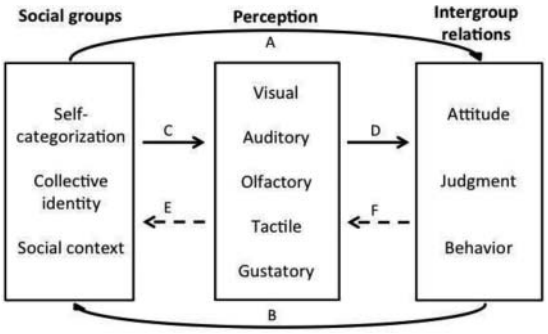

Figure 1. A perceptual model of intergroup relations. *Note.* According to the model, perception in a host of modalities can mediate the well-established relationship between social group identification and intergroup relations. Solid arrows (Paths A, B, C, D) indicate existing empirical work, and dotted arrows (Paths E and F) indicate that very little, if any, empirical work exists to date. This simple model is not exhaustive and does not exclude the possibility for cross-modal interactions.

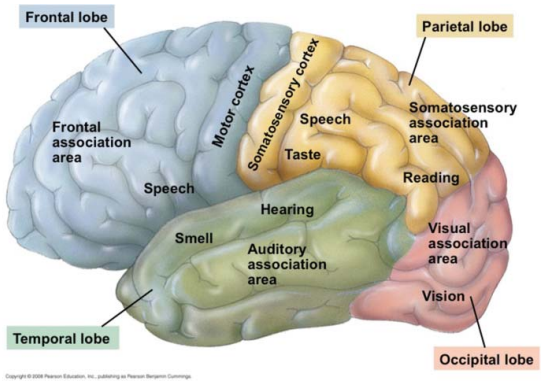

Figure 2. Representation of the five sensory modalities in the sensory cortex. Figure reproduced from Campbell et al. (2008).

social categories with obvious visual cues to novel groups that are perceptually ambiguous.

Our model extends across all sensory modalities. Although the term *perception* has been used by social psychologists mostly to refer to visual perception (and visual representation without direct visual input), our model includes visual perception (sight), tactile perception (touch), auditory perception (sound), olfactory perception (smell), and gustatory perception (taste). Each sensory modality has discrete representational systems in the brain (see Figure 2), and there is increasing information on how cross-modal perception is represented in both behavior and cortical anatomy (Calvert, 2001; Driver & Noesselt, 2008; Ghazanfar & Schroeder, 2006). Research on the relationship between social identity and perception has almost exclusively focused on *visual* perception, and there is very little research on other sensory modalities. In this article, we present evidence within each modality on how perception can be shaped by social factors—particularly those related to social identity.

Another central premise of our model is that changes in perception can alter intergroup relations. Very little research has empirically tested this relationship. However, a few recent studies suggest that perceptual cues can change attitudes, judgment, and behavior both in and outside of the laboratory. For instance, preferential visual attention to the eyes of own-race (vs. other-race) individuals predicted own-race bias in face recognition such that people were better able to recognize people from their own race and more willing to interact with own-race over other-race members (Kawakami et al., 2014). Moreover, biased perception predicted disparities in resource allocation—specifically the perception of African Americans as "Blacker"—and was associated with less willingness to grant resources to this racial group (Krosch & Amodio, 2014). In a separate context, perceived physical proximity led highly identified group members (i.e., Yankees fans) to express more discriminatory attitudes toward members of a threatening outgroup (i.e., the Red Sox) and a preference for sitting farther away from them at a sporting event (Xiao, Wohl, & Van Bavel, 2016). Thus, recent research has begun to articulate how perception influences behavior in intergroup relations.

In addition to these laboratory experiments, perception can have substantial consequences for real-world phenomena. The perceptual judgment of facial features predicts voting intentions (Caruso, Mead, & Balcetis, 2009; Stern, Balcetis, Cole, West, & Caruso, 2016) and election outcomes (Atkinson, Enos, & Hill, 2009; Todorov, Mandisodza, Goren, & Hall, 2005). For instance, the perceived competency of politician's faces consistently predicted election outcome (Atkinson et al., 2009; Todorov et al., 2005). Perhaps more surprising, voters who rated photographs with lightened skin tone as more representative of Barack Obama were more likely to vote for him in the 2008 presidential election (Caruso et al., 2009). The effects of perceptual ambiguity and biases have also been explored extensively in the legal justice domain (Blair et al., 2004; Granot, Balcetis, Schneider, & Tyler, 2014; Kahan, Hoffman, & Braman, 2009). Afrocentric facial features predicted judgments of Black stereotypic traits and real-world criminal-sentencing decisions, such that inmates with more Afrocentric features received harsher sentences than those with less Afrocentric features (Blair et al., 2004). Not only does the perception of Afrocentric facial features lead to stereotypic inferences of others (Blair, Judd, Sadler, & Jenkins, 2002), but auditory perception—in this case, vocal cues—has also been found to elicit stereotyping (Ko, Judd, & Blair, 2006). Although such evidence is still scarce, these findings offer preliminary evidence that perceptual biases can lead to changes in intergroup attitudes, judgment, and behavior, offering a basic cognitive process through which we could understand and predict intergroup outcomes.

Perception

Decades ago, the "New Look" in perception suggested that values and needs organize people's visual perception of the physical world (Bruner & Goodman, 1947). Rather than perceiving the world as it is, people's motives, experiences, and expectations can modify how they experience external stimuli. For instance, motivational factors such as perceived effort (Proffitt, Stefanucci, Banton, & Epstein, 2003) and desirability (Balcetis & Dunning, 2010) appear to shape perceptions of physical aspects of stimuli, such as spatial distance. To the extent that perceptual inputs are afforded social value by way of social group affiliations and identities, people should perceive these stimuli differently. These biased representations of the world are more than mere perceptual errors; rather, they are evolved adaptive biases that are beneficial to survival (Haselton & Buss, 2000; D. D. Hoffman, Singh, & Prakash, 2015; Gwynne & Rentz, 1983). For instance, vigilance of potential threats from outgroups may have advantages for the survival and well-being of one's ingroup. To the extent that the perceived stimuli are imbued with value by way of social group affiliations, people should perceive these stimuli differently.

Naturally, any claims about perception hinge on the precise definition of the term *perception*—an exercise that is highly contentious (Burge, 2010; Hochberg, 1956; Norman, 2002). For instance, many cognitive scientists continue to employ a very narrow definition of perception that excludes attention, inference, prediction, or expectations (Firestone & Scholl, 2015; Pylyshyn, 1999). This approach whittles the fascinating and broad domain of perception to sawdust (Gantman & Van Bavel, in press) and ignores recent advances in vision science (Vinson et al., in press). In contrast, social psychologists use the term *perception* more loosely to refer to a wider range of processes (e.g., judgment, estimation, mental representation). In this article, we use the broad term *perception* to include both perception that occurs in the presence of direct physical stimuli and perceptual representation that occurs without such direct input (in the mind's eye; see Baum & Jonides, 1979). We define perception as the organization, identification, and interpretation of sensory information to represent our environment (Schacter, Gilbert, & Wegner, 2011).[1] However, we strive to demarcate the different elements of perception to help clarify where in the perceptual processing stream social identity is exerting an influence.

We freely acknowledge that many studies in this area might be characterized as evidence of group-based influences on perception even if they do not meet the strict criteria for low-level perception. Nonetheless, we think these investigations are useful for advancing our understanding of social identity and intergroup relations. For instance, we include attention in the domain of vision, even as some scholars argue that attention has little bearing on issues of cognitive penetrability (Firestone & Scholl, 2015). In our view, the more pertinent question for research is not *whether* top-down influences penetrate perception but rather *which components* of the perceptual processing stream are sensitive to social identity concerns. After all, perception involves multiple component processes that come online and interact in a recurrent fashion within milliseconds of being presented with a stimulus (see Wyatte, Jilk, & O'Reilly, 2014). After perceptual input reaches the retina, multiple brain regions operate on this input, selecting the significant from the mundane (Lim, Padmala, & Pessoa, 2008), often determined by emotion (Anderson & Phelps, 2001) and motivation (Egner & Hirsch, 2005), attention and expectations (Summerfield & Egner, 2009), via top-down reentrant processes (Clark, 2013; Gilbert & Li, 2013). In this way, perceptual representations of the world allow humans (and other organisms) to predict outcomes and pursue goals; brains are essentially prediction machines (Clark, 2013). As such, the architecture of the mind and brain does not respect strict boundaries between some encapsulated perceptual module and other brain regions (Gantman & Van Bavel, in press; Vinson et al., in press). We extend this contemporary view of perception to the domain of intergroup relations.

The Function of Perception

According to the ecological approach to perception, perception serves an adaptive function, such that it guides biologically and socially functional behavior, and promotes goal attainment and

[1] Logically, as the definition of perception becomes narrow, it becomes less susceptible to top-down influences. Although we suspect that group identification might influence very rudimentary elements of perception, our model makes no formal commitments to this extreme form of cognitive penetration. Although we suspect that certain group-level concerns can penetrate early low-level perception, future research will ultimately be required to arbitrate this issue. In any event, a more fruitful scientific question concerns *which* perceptual processes are influenced by these concerns and under what circumstances these biases emerge and predict behavior.

survival by informing and shaping action (Gibson, 1979; McArthur & Baron, 1983; see also Clark, 2013). As Gibson (1979) noted, "The medium, substances, surfaces, objects, places, and other animals have affordances for a given animal. They offer benefit or injury, life or death. This is why they need to be perceived" (p. 127). Throughout human history, groups have provided a primary source of goal attainment, helping humans meet basic needs from access to food and mating opportunities to social needs, like belonging (Brewer, 2004; Caporael, 1997; Correll & Park, 2005). Social psychologists have argued that perception serves to inform people about the opportunities for action and costs associated with achieving their goals (Proffitt, 2006). Perception research has provided evidence for the functional role of perception. For instance, small increases in electric shocks cause large increases in subjective pain perception (Rollman & Harris, 1987). The faster increase in perceived pain as a function of stimulus intensity, compared to other modalities such as vision, is functional in that it serves to warn us of physical danger and prepare us to withdraw before the shocks become too strong.

Here we extend this logic—perceiving is often for doing—to the domain of intergroup relations. An important element of our proposed model is that changing perception produces consequences in intergroup relations, as manifested in intergroup attitudes and behaviors. Indeed, biases in perception have already been linked to real-world behaviors, ranging from criminal sentencing (Blair et al., 2004) to voting (Caruso et al., 2009). This suggests that perceptual changes might have downstream consequences for intergroup attitudes and behaviors, offering an important process through which scholars can understand and predict intergroup outcomes.

Perception Can Be Socially Constructed

Perception is sensitive to influences from numerous social factors. Although some may suspect that "low-level" or "basic" processes such as visual perception should not vary across cultures (Fodor, 1983), evidence gathered by psychologists and anthropologists suggests otherwise. In the 1960s, a group of researchers tested adults and children from a wide range of human societies on a number of visual illusion paradigms that had been well established and studied within Western society, including the famous Mueller–Lyer illusion (Segall, Campbell, & Herskovits, 1966). The Mueller–Lyer illusion is an optical illusion where two lines of the same length tend to be perceived to be of different lengths systematically, due to the direction of the arrows at both ends of each line (see Figure 3a). Results from 16 societies showed substantial differences in their susceptibility to the visual illusion, with Americans at one end of the spectrum and the other end being almost free from the illusion (see Figure 3b; Henrich, Heine, & Norenzayan, 2010). This is directly contrary to the intuition that perceptual illusions are difficult to eradicate. In fact, the right cultural exposure seems to eliminate the perceptual experience of Westerners. This cultural variability in susceptibility was also found for other visual illusions, including the Sander-Parallelogram and both Horizontal-Vertical illusions (Segall et al., 1966). These findings suggest that visual exposure during ontogeny to cultural and societal factors may calibrate people's visual systems, which could create and perpetuate culture-specific perceptual illusions (Segall et al., 1966). Therefore, cultural socialization can influence fairly basic visual perception.

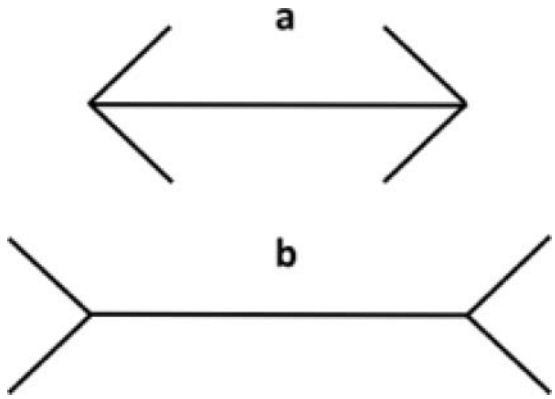

Figure 3a. Mueller–Lyer Illusion. *Note.* The lines labeled a and b in the figure are the same length. However, Westerners usually perceive line b as longer than line a. Figure reproduced from Henrich et al. (2010). © Cambridge Press. Reproduced by permission of Cambridge Press. Permission to reuse must be obtained from the rightsholder.

In addition to long-term adaptation to features in one's visual environment, perceptual experience may also be flexibly shaped by more fluid factors such as motivation, needs, and contexts (Adams et al., 2010; Balcetis & Lassiter, 2010). The New Look perspective provided an initial proposal and demonstration that perception is subject to influences from top-down motivational factors (Bruner & Goodman, 1947). In one experiment, children from well-to-do and poor families made perceptual judgments about the size of coins, as well as same-size but nonvaluable objects (cardboard discs). As expected, coins were perceived to be physically bigger than cardboard discs, and this perceptual bias was proportional to the value of the coin. More interesting, poor children, to whom coins should be more appealing, judged them to be physically bigger than well-to-do children did (Bruner & Goodman, 1947). In each of the

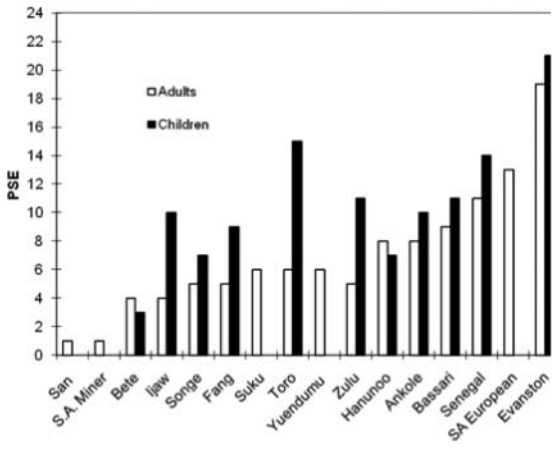

Figure 3b. Muller–Lyer results. *Note.* Point of subjective equality (PSE) is the percentage that line a must be longer than line b before individuals perceive them as equal in length, which reflects the strength of the illusion. Results from 16 societies showed substantial differences in their susceptibility to the visual illusion. European and American samples were significantly more susceptible to the illusion than non-Western samples, suggesting that culture exerts a powerful influence on perception. Figure reproduced from Henrich et al. (2010). © Cambridge Press. Reproduced by permission of Cambridge Press. Permission to reuse must be obtained from the rightsholder.

following sections we consider the role of each sensory modality, as well as cross-modal effects, in the domain of intergroup relations.

Visual Perception

As people interact with members and symbols of social groups, they often first see them with their eyes. People tend to think of themselves as visual animals and prioritize vision over other sensory modalities (Schifferstein, 2006), partly due to the common experience that visual information often dominates other senses (McGurk & MacDonald, 1976). Thus, it is not surprising that most of the existing work on the influence of social identity on perception has focused on *visual* perception. In this section, we review several domains in visual perception that have received a substantial amount of attention from researchers, including face perception, emotion perception, and distance perception.

Face Perception

People encounter hundreds of faces every day, both familiar and unknown. It can lead to an embarrassing or even dysfunctional social interaction if they fail to recognize and remember faces accurately. On top of individual differences in how well people remember faces, a host of other social processes can influence face memory. In one study, people rated the photographs of a real (Barack Obama) and hypothetical biracial presidential candidate (Caruso et al., 2009). They then rated the extent to which each photograph was representative of the candidate. Unknown to these raters, these photographs included not only unaltered images but also lightened and darkened versions of images of the biracial candidates. As a result, people rated the lightened photographs as more representative when the political party affiliation of the candidate matched their own (e.g., Democrats rating a Democratic candidate) but dark photographs as more representative when their political party affiliation did not match (see Figure 4, reprinted from Caruso et al., 2009). Therefore, political party identity influenced people's memory of the perceptual elements of these faces. People's memory of faces has also been shown to favor their own racial group.

Indeed, a large body of research examining face processing has employed stable and well-established groups, such as racial and cultural groups. Some recent work has demonstrated that perception of "Blackness" in African Americans was influenced by economic resource scarcity (Krosch & Amodio, 2014). These researchers presented people with pairs of degraded face images and had them choose the one that looked more "Black." In reality, all faces were generated by layering a random noise pattern on the same base image to create variations in physiognomy and skin tone. Aggregating all responses resulted in a face representation of a Black person from people in the scarce condition and a representation from those in the control condition. Ratings from a separate sample of people showed that the representation from the scarce resource condition was more stereotypical of Blacks than the control condition (see top panel in Figure 5; Krosch & Amodio, 2014). Status (white collar vs. blue collar) has also been shown to influence perception of race

Figure 4. Lightened, unaltered, and darkened photos of a novel candidate and Barack Obama. *Note*. People's ratings of the candidate's skin color varied as a function of their political party identity. They rated the lightened photographs as more representative when the political party affiliation of the candidate matched their own (e.g., Democrats rating a Democratic candidate) but dark photographs as more representative when their political party affiliation did not match. Figure reproduced from Caruso et al. (2009).

from faces, such that lower status increased the likelihood of perceiving a racially ambiguous face as Black (vs. White; see Figure 6; Freeman, Penner, Saperstein, Scheutz, & Ambady, 2011). In another study, researchers had people rate a racially ambiguous face from *very African American* to *very Caucasian* and found that segregation made people rate the face more Black or White depending on which group it was segregated into (Enos & Celaya, 2016). Thus, several studies have found that group dynamics flexibly shape the perception of facial characteristics of race.

Even groups that are not readily distinguishable by visual features can elicit biases in perception. One study randomly assigned people to a group using the classic dot estimation

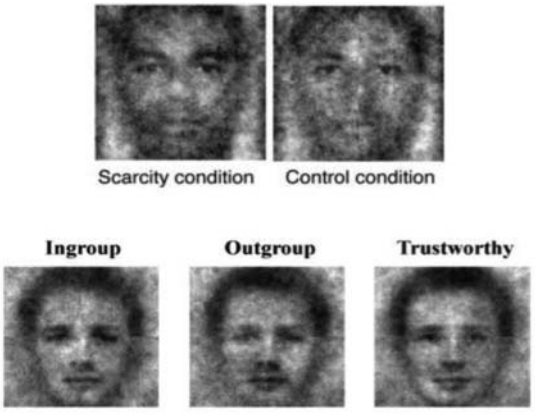

Figure 5. Top panel: Aggregate images of racially ambiguous faces generated in the scarcity versus control conditions. Bottom panel: Aggregate images of mental representation of the ingroup, outgroup, and trustworthy person. *Note*. Both studies used the reverse correlation technique. Top panel reproduced from Krosch and Amodio (2014), and bottom panel reproduced from Ratner et al. (2014).

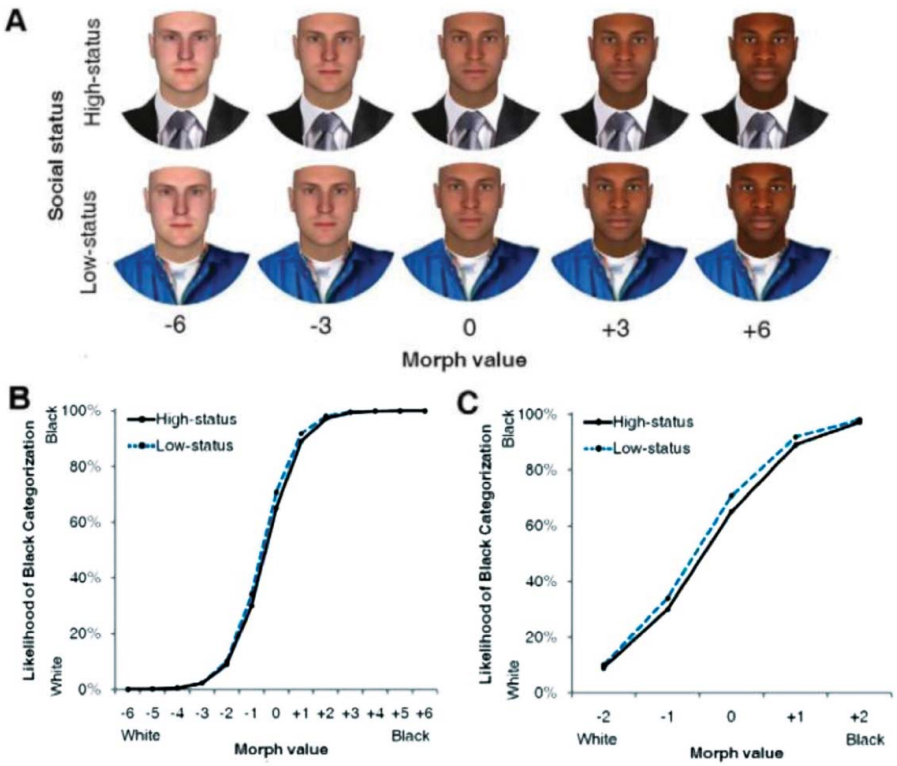

Figure 6. (A) Sample stimuli of high- and low-status faces ranging in morph values from White (−6) to Black (+6). (B) The likelihood of Black categorization plotted as a function of the morph value separately for high- versus low-status manipulation. (C) The same plot zoomed in on the middle of the morph value, demonstrating the strongest influences of status are in the middle of the morph continuum—where faces are perceptually ambiguous. Figure reproduced from Freeman et al. (2011).

procedure (J. D. Brown et al., 1988; Tajfel et al., 1971). Then participants determined the numerical style—the group membership—of two presented blurry images (Ratner, Dotsch, Wigboldus, van Knippenberg, & Amodio, 2014). Using the same reverse correlation technique described earlier (Krosch & Amodio, 2014), these researchers generated the face representations of the minimal ingroup face and the minimal outgroup face (see bottom pattern in Figure 5). A separate study using the same technique resulted in an aggregate image of a "trustworthy person," and it bore a striking resemblance to the "ingroup face" (see bottom panel in Figure 5). Therefore, even arbitrary group distinctions with no information regarding the group members' character or visual features elicited different visual representations of ingroup versus outgroup members, and these recent findings collectively speak to the power of social identities on face perception.

Shifting from studying racial groups to minimal groups has enabled researchers to isolate the influence of social group membership from factors such as familiarity, experience, and expertise (Sporer, 2001; Young & Hugenberg, 2010). For instance, according to a phenomenon often reported in the literature as the other-race effect, people are better at *remembering* same- than other-race faces (Meissner & Brigham, 2001). Although it was initially understood that greater visual experience with same- than other-race faces might account for this phenomenon, it was not until recently that researchers began to discover the influence of social identity on the other-race effect. Merely knowing that a person is an ingroup member improves face *recognition* even while holding perceptual expertise constant (Bernstein et al., 2007; Van Bavel & Cunningham, 2012). In an initial demonstration, researchers manipulated the perceived race of racially ambiguous (Hispanic-Black) faces using different hairstyles and found that this simple *perceived* racial category shift led to improved recognition when the face was believed to be an own-race individual (MacLin & Malpass, 2001, 2003). More recently, a similar effect was found using minimal groups without manipulating features of the perceived face, providing strong evidence for the effects of mere social categories on face memory (Bernstein et al., 2007; Van Bavel, Swencionis, O'Connor, & Cunningham, 2012). In studying this effect, researchers found that highly identified group members had the largest recognition advantage for ingroup compared to outgroup faces. Moreover, this memory advantage for ingroup members can override racial biases in memory—producing better memory for ingroup members, regardless of their race (Hehman et al., 2012; Van Bavel & Cunningham, 2012). These and other studies confirmed that social identities drive face recognition and memory.

More recent research has elucidated the *perceptual* processes underlying the ingroup advantage in face recognition. One question researchers have asked is whether these social category effects are at play in *perceptual integration* of facial features. Specifically, researchers tested a type of configural processing known as holistic processing. In holistic processing, faces are processed as a whole (or a template) in which individual features are integrated. One prominent approach to studying the perceptual basis of holistic processing is using face composites, in which replacing the bottom half of a face with a bottom half of a different face (i.e., a composite face) creates a different gestalt, making the top half appear different (see Figure 7 from

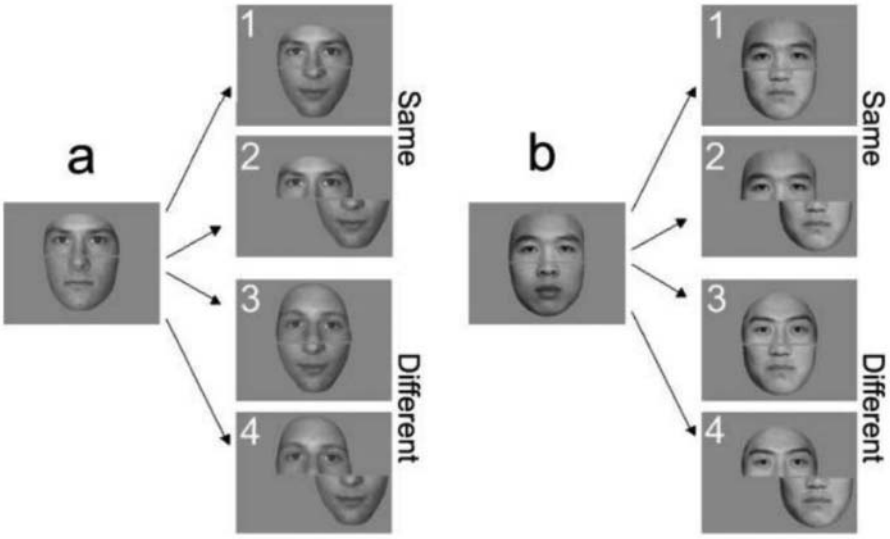

Figure 7. Example of face composite task. *Note*. The composite stimuli were created by slicing original Caucasian (a) and Asian (b) faces in the middle of the nose and then joining different top and bottom parts. This gestalt effect is disrupted when the top and bottom halves of faces are misaligned. Figure reproduced from Michel et al. (2006). © SAGE Publications. Reproduced by permission of SAGE Publications. Permission to reuse must be obtained from the rightsholder.

Michel, Rossion, Han, Chung, & Caldara, 2006). It is important to note that this gestalt effect is disrupted when the top and bottom halves of faces are misaligned. The face-composite effect (i.e., the identity recognition advantage of aligned over misaligned faces) is thus considered a hallmark of holistic processing (Michel et al., 2006).

Using this technique, researchers found that Caucasian subjects showed a greater *whole-part advantage* (i.e., a benefit from the whole-face context when processing facial parts) for same-race than other-race faces, suggesting that same-race faces are perceived more holistically than other-race faces (Michel, Caldara, & Rossion, 2006; Tanaka, Kiefer, & Bukach, 2004). On the other hand, although Asians without experience with Caucasians also had holistic processing for own-race (i.e., Asian) faces, Asians with extensive experience with Caucasians had a comparable whole-part advantage for both races. Further, identical morphed face stimuli were processed more holistically by Caucasian perceivers when categorized as same-race than when categorized as other-race faces—illustrating the influence of social identity on face perception (Michel, Corneille, & Rossion, 2010). Researchers using groups other than race also found that that faces categorized as ingroup members (i.e., fellow university students) were processed more holistically than those categorized as outgroup members (Hugenberg & Corneille, 2009). These findings suggest that rather than simply being due to low-level physical features of the face, it is the perceiver's subjective categorization of a face as belonging to their own or a different group that plays a critical role in the perceptual processing style. Therefore, social categorization with a group—without any low-level visual differences or differential familiarity—appears sufficient to shape face perception.

Recent advances combining social psychology and cognitive neuroscience have yielded fruitful findings to help us better understand the processes behind how social group membership influences face perception (Van Bavel & Cunningham, 2011). Functional neuroimaging and brain lesion studies have identified an area of the fusiform gyrus involved in facial recognition—termed the fusiform face area (FFA). The FFA responds preferentially to faces relative to other objects—including scrambled faces, nonface stimuli, and other body parts (Kanwisher, McDermott, & Chun, 1997; Sergent, Ohta, & MacDonald, 1992). Members of an experimentally created ingroup preferentially recruited the fusiform gyri—including the FFA—even when they were matched in exposure to face stimuli from a less significant social category (Van Bavel, Packer, & Cunningham, 2008, 2011). In addition, individual differences in FFA activity for ingroup versus outgroup faces were correlated with recognition memory differences for ingroup versus outgroup faces (Golby, Gabrieli, Chiao, & Eberhardt, 2001; Van Bavel et al., 2011). It is important that the effects of group membership on the FFA were functionally dissociated from early visual processing in the primary visual cortex—suggesting that these results were specific to face perception rather than attention. Also of importance, this study provides evidence that social identity can exert a top-down influence on FFA function and may be involved in subordinate-level (vs. superordinate-level) encoding of stimuli in the absence of long-term exposure. These findings link these systems to face memory, distinguish them from simple attentional biases, and illustrate how neuroscience methods such as fMRI can help dissociate the effects of identity on different components in the visual processing stream.

Research using electroencephalography has identified exactly how early in visual processing the effects of social identity can emerge. Structural face encoding has been linked to the N170—a negative signal that peaks at occipitotemporal scalp sites approximately 170 ms after stimulus onset (Bentin, Allison, Puce, Perez, & McCarthy, 1996). Factors such as familiarity have been shown to exert top-down modulation of N170, such that N170 amplitudes in response to personally familiar faces were larger than that to faces of less personal importance (Caharel, Courtay, Bernard, Lalonde, & Rebai, 2005). Past research has obtained mixed findings regarding whether N170 is reliably modulated by the social group membership (e.g.,

race) of the perceived face (Ito & Bartholow, 2009). A more recent investigation found that minimal group membership shaped N170 magnitude to faces, suggesting that ingroup faces are more strongly encoded than outgroup members very early in perceptual processing (Ratner & Amodio, 2013). More recent research suggests that ingroup bias can emerge as early as 100 ms after seeing a face—meaning that social identity can penetrate the earliest components of visual perception (Earls, Morris, Cunningham, & Van Bavel, 2016). These findings nicely replicate the earlier neuroimaging results of social identity on face processing (Van Bavel et al., 2008, 2011) and suggest that these influences emerge very early in the visual processing of ingroup and outgroup faces.

Perception of Physical Properties

Although it may not be surprising that social group memberships shape the perception of faces—stimuli that contain such rich *social* information—it is striking that they can shape perception of *nonsocial* features of our environment. Recent research has shown the susceptibility of perception of physical objects and properties to the influence of high-level social constructs and processes. For instance, recent work using the Shooter Task (Correll, Park, Judd, & Wittenbrink, 2002) provides evidence for the influence of race on people's perception of weapons (or innocuous objects). Specifically, people acquired visual information rapidly about a weapon when it was carried by a Black suspect and about an innocuous object when carried by a White suspect (Correll, Wittenbrink, Crawford, & Sadler, 2015). Eye-tracking revealed that people used different visual information in their decision to shoot or not—relying more on ambiguous information with stereotypic, compared to counter-stereotypic, targets (Correll et al., 2015). Such evidence speaks to the modulation of physical perception by social groups and underscores the implications for real-world behaviors, like police officers' decision to shoot a suspect.

Size Perception

Subjective perception and judgments of physical properties, such as size, may not be an accurate reflection of reality but susceptible to a host of top-down influences. As mentioned earlier, children from well-do-to families and poor families made judgments about size of coins and cardboard discs (Bruner & Goodman, 1947). In this seminal work, which helped give rise to the New Look perspective, size perception was assessed in two ways. The first measurement targeted *memory* by having each child estimate the size of coins from memory. The second measurement targeted *perceptual matching* by presenting coins individually at the center of the palm of the left hand of each child and having them adjust a light circle positioned six inches to its left to be the same size as the presented coin. Results from both measurements revealed a similar pattern, such that *recalled* and *perceived* size of coins both varied as a function of the value of the perceived stimulus (i.e., coin) to the perceiver (i.e., poor or well-to-do children). In this research, using different measurements provided convergent evidence for the top-down influences of motivation and needs on size judgments. Of course, it also made it difficult to isolate where in the perceptual processing stream the bias occurred.

Some researchers have subsequently criticized this research for the failure to test the precise processes underlying the effect. For instance, Klein and colleagues argued that distortions in size perception are more dependent on the method used to obtain size judgments than on the perceived value of the stimuli (Klein, Schlesinger, & Meister, 1951). Others have argued that the extent to which perception can be influenced by higher level affective states is highly context dependent and can be very limited in certain situations (Carter & Schooler, 1949; Tajfel & Wilkes, 1963). It needs to be noted, however, that most of the criticism of the New Look hypotheses has focused on the fact that the hypotheses require some revision, as opposed to denying the claim that perception can be influenced by higher level constructs and processes. Indeed, there is an abundance of subsequent research that has yielded similar findings (Bruner & Postman, 1948; Bruner & Rodrigues, 1953; Dukes & Bevan, 1952; Holzkamp & Perlwitz, 1966; Proffitt, 2006; Proffitt et al., 2003).

In addition, research examining biological threat and social threat both corroborate the malleability of size perception. For instance, spider phobics judge spiders as physically larger and moving more quickly toward them compared to people who are less fearful of spiders (Leibovich, Cohen, & Henik, 2016; Riskind, Moore, & Bowley, 1995; Shiban et al., in press; Vasey et al., 2012), an effect attributed to both valence and personal relevance (Leibovich et al., 2016; Shiban et al., in press). Likewise, members of majority groups tend to overestimate the population size of minority groups and the rate at which minority groups are growing (Alba, Rumbaut, & Marotz, 2005; Outten, Schmitt, Miller, & Garcia, 2012). We have found parallel threat-induced effects with size perception, such that a threatening group (e.g., Mexican immigrants) was estimated as not only physically closer but also larger in population size (Xiao et al., 2016). All these effects point to a physical looming effect of threat, such that threatening outgroups and their group members may be perceived to be closer, larger, and moving faster toward the perceiver. In addition, recent work has found that manipulation of intergroup segregation in the laboratory can influence people's judgment of physical characteristics of other fellow participants such as their height and weight (Enos & Celaya, 2016), which together with other work presented here speaks to the malleability of size perception as a function of social and intergroup processes.

Distance Perception

Subjective perception and judgments of physical distance are also susceptible to similar top-down influences. For instance, the needs and motivations of the perceiver can influence their estimates of physical distance. People judged a threatening object (a live tarantula), but not an innocuous object (a cat toy), as physically closer (Harber, Yeung, & Iacovelli, 2011). However, the more self-worth that people reported, the farther away they estimated the tarantula, which led these authors to conclude that psychosocial resources play a role in judgments of physical distance (Harber et al., 2011). Interpersonal needs and motives also shape relevant distance judgments.

Researchers manipulated acceptance and rejection by having people recall such experiences or by having a confederate act in an inclusive or exclusive manner in a cyberball-type task (Knowles, Green, & Weidel, 2013). People in these experiments judged accepting individuals to be physically closer than rejecting individuals, and judged uninvolved individuals to be closer than nonsocial objects, after rejection but not after acceptance (Knowles et al., 2013). These researchers thus argue that people's desire for connection and belongingness influences judgments of physical distance, such that rejection motivated people to create physically distance from sources of rejection and draw near those who were more accepting.

We argue that social identities can also shape distance judgments. Just as categorical labels can lead people to exaggerate perceived distance between arbitrary categories (Tajfel & Wilkes, 1963), self-categories (*us* vs. *them*) may also distort representations of the *physical* world, accentuating both perceived differences *between* social categories and similarities *within* a social category. In a series of studies, people overestimated the distance on a map between a domestic and a foreign location, relative to the distance between two domestic locations *and* relative to the distance between two foreign locations (Burris & Branscombe, 2005). These findings provide evidence that social categorization, just like any other categorization process, could shape how people perceive physical properties.

Not only does identifying with a social group make group members estimate that the outgroup is physically farther away, but these biased estimations of physical distance can be flexibly shaped by intergroup dynamics. For instance, motivation to feel positive about one's ingroup, especially in the presence of threats from outgroups, not only manifests in various behavioral outcomes (Branscombe, Ellemers, Spears, & Doosje, 1999; Tajfel & Turner, 1979) but also leads to perceived physical proximity of the threatening group, especially among people who were highly identified with their ingroup (Xiao & Van Bavel, 2012). Moreover, the presence of ingroup support, such as being surrounded by one's ingroup members, was able to alleviate the effects of intergroup threat on perceptual proximity (Cesario & Navarrete, 2013). Similarly, physical factors such as a secure (vs. permeable) intergroup barrier and psychosocial factors such as an apology from a threatening outgroup also reduced perceived proximity of the threatening outgroup (Xiao et al., 2016). In sum, perception of distances to threatening groups is shaped by specific dynamics between the ingroup and the outgroup.

Other Physical Properties

Although the majority of research on top-down modulation of physical perception has focused on distance and size perception, other physical properties may also be shaped by social identities. For instance, visual judgments of geographical slant are influenced not only by *physiological resources* (e.g., physical fitness, age, and being physically refreshed) but also by *psychosocial resources* such as social support (Schnall, Harber, Stefanucci, & Proffitt, 2008). People accompanied by a friend judged a hill to be less steep compared to those alone, and those who simply thought of a supportive friend rated a hill as less steep than those who thought of a neutral or a disliked person (Schnall et al., 2008). These findings suggest that psychosocial resources may shape perception of physical properties.

Visual Attention

Attention, defined as the momentary effective reaction-potential of the perceptual response, is multiply determined. Stimulus salience, prior knowledge, nature of task, learning, and interaction between the observer and the perceived stimuli could all interact to determine where the observer pays attention and fixates. Although salient bottom-up characteristics often grab attention (Carrasco, Ling, & Read, 2004), it is possible for prior experience and expectation to also drive attention (Rodin, 1987; Roskos-Ewoldsen & Fazio, 1992; Sporer, 2001; Van Bavel & Cunningham, 2012). In one study, people were able to determine the gender of rapidly presented photographs of faces that were located off to the side from where they were attending (Reddy, Moradi, & Koch, 2007). Important to note, when this "periphery task" was about orientation of disks rather than gender of faces, task performance dropped significantly, suggesting that faces are meaningful social stimuli and people have a great deal of experience perceiving them. These findings provide evidence that when stimuli are imbued with sufficient social meaning and motivational relevance, they can be accurately perceived even if they are not selectively attended to in the visual field (see also Park et al., 2016). Evidence such as this helps motivate hypotheses regarding the impact of social group membership on visual attentional processes.

Visual attention has been investigated using other tasks, yielding convergent evidence for the vulnerability of visual attention to social constructs. One example is visual search, in which the task is to find a particular stimulus among many stimuli as quickly as possible. Reaction times are usually measured to gain a quantitative assessment of the ease of search. One source of influence on the success and ease of visual search comes from salient bottom-up physical properties of the stimulus, such as luminance, shape, size, and so on. However, if visual stimuli are imbued with social and motivational value, their influence may trump the benefits afforded by low-level physical characteristics of the stimuli. In one study, researchers examined whether priming racial identity would influence Black–White biracial individuals' ability to visually search for White and Black faces (Chiao, Heck, Nakayama, & Ambady, 2006). People were instructed to detect the presence or absence of a single target face as fast and accurately as they could. As a result, biracial individuals primed with their White identity showed a relative search advantage for White faces and those primed with their Black identity showed a relative search advantage for Black faces (Chiao et al., 2006). These researchers interpreted their findings as a demonstration that visual perception is malleable to top-down influences, such as one's racial identity. Because visual search tasks primarily assess visual attention, it is possible that such top-down influences provided by one's racial group membership primarily acted on the attentional stage of visual perception (Brosch & Van Bavel, 2012; Van Bavel & Cunningham, 2012).

Indeed, other work has found rapid attentional orienting as a function of social group membership using a separate task—the dot probe task (MacLeod, Mathews, & Tata, 1986).

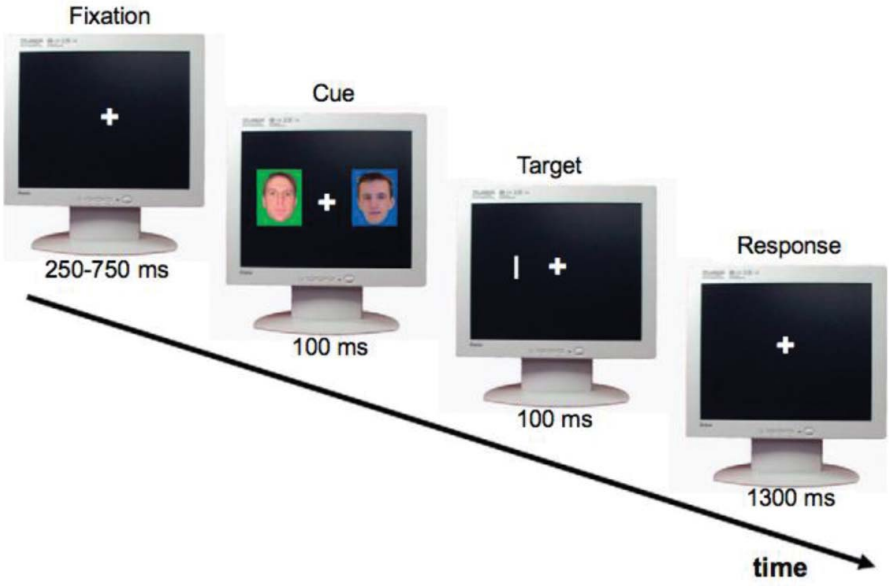

Figure 8. An illustration of the dot probe task. *Note*. In this task used by Brosch and Van Bavel, each trial started with a fixation cross. Then the cue, consisting of two images presented on the left and right sides of the monitor, was presented for 100 ms. Following offset of the face pair, the target, a horizontally or vertically oriented rectangle, appeared for 100 ms in the location of one of the previously presented faces. Participants responded to the orientation of the target by pressing a key. Figure reproduced from Brosch and Van Bavel (2012). © Elsevier. Reproduced by permission of Elsevier. Permission to reuse must be obtained from the rightsholder.

In this task, people respond to a target that replaces one of two cues—face images presented on the left and right side of a computer screen. On each trial, one image was a face belonging to their ingroup and the other of their outgroup (see Figure 8 for an illustration of this task). By analyzing reaction times, the researchers could infer rapid orienting toward either the ingroup or outgroup faces (Brosch & Van Bavel, 2012). Simply learning about group membership led to a change in people's attentional orienting—in this case, outgroup members captured their rapid visual attention. Further, the researchers found that attention toward outgroup versus ingroup members was moderated by the accessibility of people's collective identities. Thus, salient identities are most likely to influence rapid attentional and perceptual processing.

In addition to inferring visual attention using behavioral tasks such as the dot probe, researchers have assessed visual attention more directly using eye-tracking techniques. For instance, White students attended more to the eyes of White compared to Black individuals, and this preferential visual attention to the eyes extended beyond racial groups and to novel ingroup and outgroup faces (Kawakami et al., 2014). This research offers even more evidence to suggest that visual attention can be flexibly and meaningfully influenced by motivational states, such that when given instructions to individuate a certain group, people oriented their attention to the eyes of members of that group. These findings support the notion that visual attention is sensitive to current social and motivational context, and specifically to social identities.

Tactile Perception

Tactile perception involves the interpretation of information provided by skin sensations and can be critical for spatial awareness and various motor tasks (Lederman & Klatzky, 2009). Existing work on how social identity shapes tactile perception has focused almost exclusively on pain perception and response (i.e., behavioral and physiological responses after experiencing pain or perceiving others experiencing pain). We distinguish here between mechanoreception (touch) and other parts of the somatosensory system (i.e., proprioception, thermoreception, and nociception). For instance, a large body[2] of research has found a strong social component associated with people's pain responses, including verbal reports of pain experiences, physiological responses, and other pain-related behaviors (e.g., tolerance).

Pain Perception

Perception of pain is subjective and susceptible to a wide range of top-down influences, including a person's mental state and attention, and even occurs when there is no external stimulation of the skin. Clinical research shows that expectation affects pain perception, such that many patients with pathological pain experienced relief from taking a placebo (Finniss & Benedetti, 2005; Weisenberg, 1977) and that burn patients experienced significant pain reduction from using virtual reality techniques (H. G. Hoffman, Patterson, & Carrougher, 2000). Emotional distraction has also been shown to be effective in reducing experienced pain. In one study, the length of time people could keep their hands in painfully cold water depended on the content of pictures they were exposed to in the meantime, with longer times associated with more positive pictures (de Wied & Verbaten, 2001). Because people's ratings of the pain intensity, made immediately after removing their hands from the cold water, were the same regardless of what pictures they saw, these authors concluded that the content of the pictures influenced the time it took to reach the same pain level

[2]No pun intended.

for each person (de Wied & Verbaten, 2001). Similar pain-reducing effects had been found by merely asking people to imagine a pleasant experience while their hands were immersed in cold water (Barber & Hahn, 1962). Similarly, social factors may also exert top-down influence on pain perception while keeping constant the pain-inducing stimulation.

Beliefs about pain expressions and tolerance differ across cultures, and as a function of other factors such as gender. For instance, female individuals generally believe that overt pain expression is more appropriate than do male, and people in some countries (e.g., India) have been found to be less accepting of overt pain expression than those in the United States (Nayak, Shiflett, Eshun, & Levine, 2000). Consistent with this belief, people from India showed higher pain tolerance than those in the United States, and male individuals showed higher pain tolerance than did female. In these studies, reported pain intensity accounted for 28% of the variance in pain tolerance and beliefs predicted an additional 5% (Nayak et al., 2000), further strengthening the argument that subjective feelings of pain are not driven entirely by the intensity of the pain-inducing stimulus.

Not only does pain perception differ due to explicit cultural beliefs and endorsement of gender stereotypes, but reactions to painful stimuli are influenced by subtle social cues. Cognitive dissonance research has shown that the higher the reward offered for participating in an experiment involving electric shocks, either monetary or psychological, the less shock people will tolerate (Zimbardo, Cohen, Weisenberg, Dworkin, & Firestone, 1966). Social pressure from experimental instructions also affects pain tolerance and the subjective experience of pain, such that people could be coaxed into taking more painful stimulation when simply asked to by the experimenter (Gelfand, 1964)—even after they indicated that they had reached their tolerance level for painful electric stimulation (Sternbach & Tursky, 1965). Explicit social information also modulates pain response. In one study, people were led to believe that the pain stimuli they would receive in the experiment was the minimum, a fixed amount, or the maximum of pain stimuli allowed to be delivered by another person—a manipulation of interpersonal social threat. As a result, as perceived social threat increased, self-reported pain increased (Peeters & Vlaeyen, 2011). Indeed, a host of different factors—group pressure, experimental instructions, and people's gender—have been found to affect pain tolerance in a complex interactive matter (Strassberg & Klinger, 1972).

This large body of research demonstrating a strong social component to people's pain experiences and pain-related behaviors has given rise to investigation of social group membership on pain perception. In one study, Jewish people were found to exhibit lower pain-tolerance thresholds than non-Jewish people, and Jewish Americans showed more exaggerated reactions and sensitivity to pain more than Americans of other religious or ethnic backgrounds (Zborowski, 1952). Researchers provided stronger evidence by experimentally manipulating beliefs and expectations among people regarding pain tolerance associated with their religious identities. When members of one religious group (e.g., Jewish) were informed that their group was less able to tolerate pain than members of another religious group (e.g., Protestant), there was an increase in pain tolerance (Lambert, Libman, & Poser, 1960). Thus, group beliefs about pain might directly alter pain perception. Recent research suggesting multiple group memberships as a source of resilience in the face of life challenges has inspired research on the role of social group memberships in physical challenges such as pain. Accordingly, it has been found that salience of multiple social group memberships led to greater pain endurance, suggesting that multiple social group memberships reflect an important psychological resource for group members (Jones & Jetten, 2011).

In addition to pain tolerance, researchers have found that even low-level physiological arousal is susceptible to social group categorization. By experimentally manipulating social group membership, researchers showed that physiological arousal associated with induced pain is lower following reassurance from an ingroup member, compared to when such reassurance came from an outgroup member or when there was no assurance (Platow et al., 2007). Of course, it is important to note that it is unclear whether pain is necessarily a part of touch, because it can occur in the absence of physical contact (Xu, Zuo, Wang, & Han, 2009). Nevertheless these findings motivate future research to examine the malleability of pain perception, as well as other tactile perception, to influences from social identity and the role of flexible tactile perception in affecting attitudinal and behavioral intergroup consequences.

Auditory Perception

Auditory perception results not only from bottom-up information provided by the acoustic signal but also from top-down information provided by the meaning of words and sentences, perceiver's knowledge of the rules of grammar, and information that the perceiver has about the speaker's voice (McGurk & MacDonald, 1976). A meaningful context can facilitate auditory perception, such that it enhances listeners' ability to recognize phonemes (Rubin, Turvey, & Van Gelder, 1976). And our perception of continuous speech is so powerful that people believe they hear a missing sound when the missing sound is replaced by an extraneous one (e.g., cough) but not when it is replaced by silence (Warren, 1970).

Another profound example of top-down influences on speech perception comes from the perceptual effects of sine-wave speech. Sine-wave replica of speech preserve the dynamic properties of speech but leave the speech-like properties, which normally would evoke impressions of consonants, vowels, words, and so on (e.g., the pop of "p"). Of interest, simply giving listeners the expectation of a synthesized sentence is sufficient to elicit hearing the phonetic structure and understanding the natural utterances on which the sine-wave replica were based (Remez, Rubin, Berns, Pardo, & Lang, 1994; Remez, Rubin, Pisoni, & Carrell, 1981). Such evidence suggests that auditory perception is highly susceptible to top-down influences.

The experience of noise has also been shown to be dependent upon the meaning it has been attributed and other top-down social constructs, including social identity. Existing work on the modulation of auditory perception by social factors is relatively scarce. In one study, loud noise was perceived to be more positive and pleasant when it was attributed to a religious

festival compared to a nonfestive source, particularly among those that self-identified as pilgrims (Shankar et al., 2013). Somewhat remotely related is Papousek and colleagues' work using an auditory task to induce affective states in studying affective flexibility (Papousek, Freudenthaler, & Schulter, 2011; Papousek, Reiser, Weber, Freudenthaler, & Schulter, 2012). These researchers used an auditory task to induce negative and positive affective states by having people listen to other people's vocal expressions of affective states such as anxiety, sadness, or cheerfulness. By measuring prefrontal electroencephalography asymmetry during and after the auditory stimulation, these researchers found that prefrontal asymmetry at rest was related to a flexible pattern of affective responding, which has been linked to adaptive emotional processing in the relevant literature. Even though this work does not test auditory perception per se, but rather affective flexibility, similar tasks can be adopted to study auditory perception. Future research should explore this relatively understudied area and assess whether the relationship between the input acoustic stimulus and the perceived outcome can be modulated by social identity.

Olfactory Perception

Olfactory perception emerges from the perception of an odor (also called smell, scent, or fragrance), which is made of chemical compounds. Even though humans can *discriminate* at least 1 trillion different odors (Bushdid, Magnasco, Vosshall, & Keller, 2014), they often find it difficult to accurately *identify* odors (Cain, 1979), even familiar ones (Lawless & Engen, 1977). When people are asked to identify the substance associated with the odor, they are successful only about half the time; however, when given feedback on the correct odors, accuracy increased up to 98% after some practice (Desor & Beauchamp, 1974). In addition, knowing the label for an odor can easily transform our perception of that odor. For instance, the same smell will be perceived very differently if it is labeled cheddar cheese versus body odor (de Araujo, Rolls, Velazco, Margot, & Cayeux, 2005; Engen & Pfaffmann, 1960). Thus, like other sensory modalities, olfactory perception is susceptible to top-down influences (Coppin & Sander, 2011).

Can social factors have a similar effect on olfaction? Cultural experiences have been repeatedly shown to influence olfactory perception (Ayabe-Kanamura et al., 1998; Distel et al., 1999; Ferdenzi et al., 2013; Ferdenzi et al., 2011). For instance, the smell of durian is liked more in Singapore than in Switzerland (Ferdenzi et al., 2011). But this does not mean that social identity is the underlying factor of these differences—they could be caused by differential exposure to different odors in different cultures. It seems reasonable to assume that Singaporeans have been more exposed than Swiss individuals to the smell of durian in their life. To the best of our knowledge, two studies have directly investigated the impact of social factors on olfaction. First, researchers have shown that suspicion can improve the detection sensitivity to metaphorically associated fishy smells (Lee & Schwarz, 2012). Second, social identity shaped olfactory perception of an identity-symbolizing smell (Coppin et al., 2016). Specifically, Swiss people primed with their Swiss identity experienced the smell of chocolate (a food item for which Switzerland is world famous) as more intense than both non-Swiss people and Swiss people who were primed with their individual identity or not primed. This work demonstrates that olfactory perception is malleable to modulation by social group membership.

Gustatory Perception

Gustatory perception emerges from the chemical reaction of substances with our taste buds. Unlike the large discrimination allowed by the olfactory system, there are six possible sensations elicited by taste: sweetness, sourness, saltiness, bitterness, umami, and fat. Although partially genetically determined (Keskitalo et al., 2007), gustatory perception is a malleable process and susceptible to the modulation of top-down influences. Just as olfactory perception, taste perception is sensitive to labeling (Grabenhorst, Rolls, & Bilderbeck, 2008). It has also been shown that gustatory perception is culturally dependent (Doty, 1986), which could be due to differential exposure or genetic factors. It is important to note that the precise causes of the sensitivity to particular tastes in different populations (Doty, 1986) have not yet been satisfactorily disentangled. Moreover, gustatory perception also varies in individuals with different beverage and food intake and adiposity (E. Green & Murphy, 2012).

To the best of our knowledge, no experiment has directly investigated the impact of social processes on simple gustatory perception (e.g., sweet, sour), although several have done so with the more complex multimodal perception of flavors and foods (see the following section). However, some work has found that social identities can shape the reported preference for certain tastes. In one study, researchers found that being nice can make candy taste sweeter. Specifically, candy tasted sweeter to people who believed it was accompanied by a nice message (Gray, 2012). Of interest, the reverse relationship has also been shown: bitter taste decreases the prevalence of prosocial behavior (Eskine, Kacinik, & Prinz, 2011; Sagioglou & Greitemeyer, 2014), and sweet taste increases it (Meier, Moeller, Riemer-Peltz, & Robinson, 2012), although these results were not replicated in a later study (Ashton, Pilkington, & Lee, 2014). Given the links between social identity, food preferences, and health, we believe this is a ripe area for future research.

Cross-Modal Perception

In addition to individual perceptual modalities, our perceptions almost always work in conjunction to provide us with an integrative experience (Calvert, 2001; Driver & Noesselt, 2008; Ghazanfar & Schroeder, 2006). As neuroimaging and electrophysiology techniques advance, there is now increasing information on not only how each sensory area maps out in the cortex but also the prominence of cross-modal perception as represented in both behavioral paradigms and cortical anatomy (see Figure 9 for a comparison of traditional scheme and modern scheme of the cortical anatomy of multisensory areas; Calvert, 2001; Driver & Noesselt, 2008; Ghazanfar & Schroeder, 2006).

Multimodal input often contributes to ease of processing compared to unimodal presentations. What people hear depends not only on the physical stimulus—in this case, the

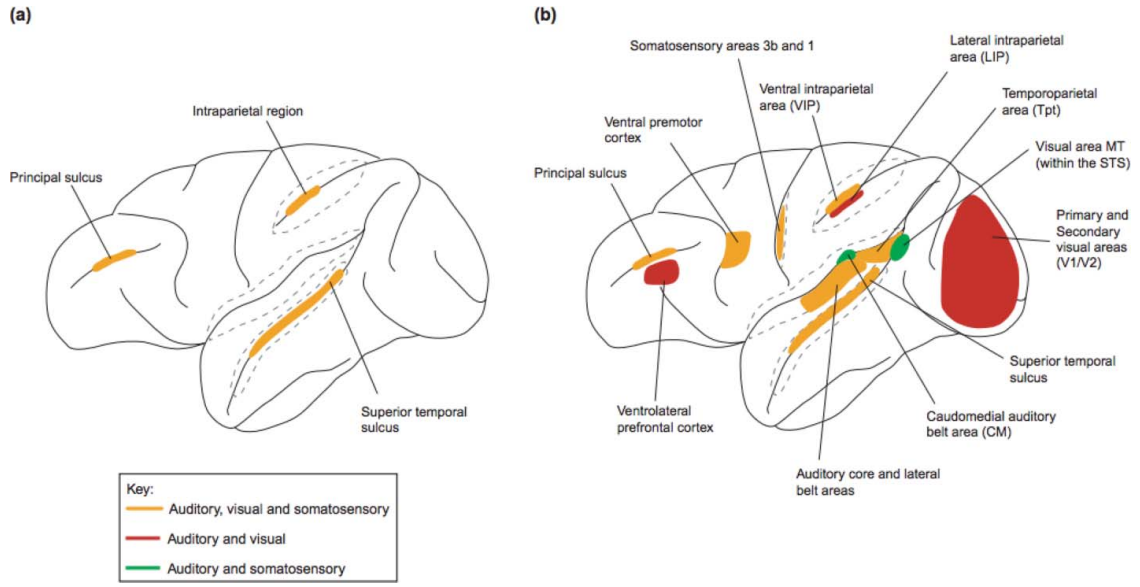

Figure 9. (a) Traditional scheme of the cortical anatomy of multisensory areas in the primate brain and (b) modern scheme of the cortical anatomy of multisensory areas. *Note*. Colored areas represent regions where there have been anatomical and/or electrophysiological data demonstrating multisensory interactions. Figure reproduced from Ghazanfar and Schroeder (2006). © Elsevier. Reproduced by permission of Elsevier. Permission to reuse must be obtained from the rightsholder.

acoustic signal—but also on information from a number of different sensory modalities. Although auditory information is the major source of information for speech perception, visual information can also exert a strong influence on what people hear—a phenomenon termed the McGurk Effect (McGurk & MacDonald, 1976). The McGurk Effect describes the phenomenon that the same auditory input is perceived differently depending on the movement of the lips, and even when perceivers are made aware of the phenomenon. When listeners hear "baba" and at the same time see a speaker articulating "gaga," they tend to combine the information from the two sources into "dada." The relationship between auditory and visual perception also occurs in the opposite direction, and researchers have demonstrated cross-modal influences from the auditory modality on visual perception (Vroomen & de Gelder, 2000). In the "double flash illusion," perceivers stared at a fixation point on the computer screen and a white circle briefly flashed on the edge of their vision. At the same time, either one or two beeps in quick succession played in their ear. As a result, when two beeps were played, people believed they saw two flashes on the screen, but only one flash when there was one or no beep (Shams, Kamitani, & Shimojo, 2000). As such, these discoveries gave us some of the first evidence that perception in a sensory modality is not entirely independent but can be shaped by input from a different sensory modality.

More recent work has investigated the integration of visual perception and auditory perception in the social domain. For instance, judgments about the sex of a face are influenced by the simultaneous sound of a voice. As a result, when deciding on the sex of a face, hand movement deviates toward the opposite sex when matched with a sex-atypical voice (Freeman & Ambady, 2011b), suggesting that the auditory perception continually affected the visual perception in this process. There is also evidence of cross-modal interaction in the spatial domain. For instance, according to the ventriloquist effect, sound can appear to come from somewhere other than the actual sound source (Connor, 2000). Consistently, research has demonstrated a strong effect of light flashes on people's detection of the location of synchronized sounds (de Gelder, Vroomen, & Bertelson, 1998), as well as a less strong but possible effect of sound attracting the location of the light flashes (Bertelson & Radeau, 1981). Cross-modal influences in perception have also been found in emotion perception. In one study, people were asked to judge targets' emotions in their voice while viewing faces (de Gelder & Vroomen, 2000; Massaro & Egan, 1996). Whether the face expressed the same or a different emotion affected how the voice was perceived. Conversely, when asked to judge the emotional expression from a face, whether the synchronized voice signaled a congruent or incongruent emotion also had an effect (de Gelder & Vroomen, 2000). Therefore visual and auditory perceptions are closely intertwined in the social world.

Flavor may be the most multimodal of all of our sensory experiences (Small, 2012). Flavor is the perception that results from the integration of retronasal olfactory,[3] gustatory, and oral-somatosensory signals, which naturally co-occur during beverage and food consumption. Flavor is consequently what is called "taste" in everyday language. Several experiments have directly investigated the impact of social processes on flavors and food items. For instance, Canadians primed with their Canadian identity preferred the taste of maple syrup—a taste that is part of the Canadian cultural identity—to the taste of honey (Hackel, Coppin, Wohl, & Van Bavel, in revision). The effect of *tastes* on prosocial behaviors (just discussed) extended to *foods*—with exposure to organic foods leading to increased prosocial behaviors (Eskine, 2013). Second, other work has found that social attitudes influence liking and willingness to pay for beverages (Sörqvist et al., 2013). More specifically,

[3]By contrast with orthonasal olfaction, that is, olfactory perception resulting from volatile compounds traveling through the nostrils, retronasal olfaction refers to olfaction arising from the volatile compounds present inside the mouth.

people scoring high in their attitudes toward sustainable consumer behavior judged an eco-friendly coffee as tasting better than the exact same coffee without this label, and were willing to pay more money for it.

Identity also influences the anticipated and experienced hedonic value of food items (Hackel et al., in revision). Among individuals who strongly identified with the Southern United States, the Southernness of certain foods (e.g., chicken fried steak) predicted tastiness ratings. In a second experiment, priming Canadians with their Canadian identity shaped the reported pleasantness of tasted maple syrup (an identity-relevant food), which in turn affected the willingness to pay for it. Taken together, this body of research suggests that understanding the effects of identity on valuation is important for understanding and motivating healthy food choices. We believe this is a promising avenue of research. For instance, one may want to investigate the relationship between identities, on one hand, and food perception and consumption in stress episodes, on the other (e.g., Pool, Delplanque, Coppin, & Sander, 2015). We predict that in such contexts, where excessive pursuit of high-calorie foods may be present, individuals may use food consumption as a strategy to restore their threatened identity. Overall, cross-modal perceptual experience provides another fruitful avenue for exploring the role of perception in social identity and intergroup relations, among other social processes.

General Discussion

In this article we proposed a perceptual model of intergroup relations to characterize the relationship between social and intergroup relations. According to our model, social group identification, as well as its related constructs and processes, can shape perception in each sensory modality, which can impact intergroup relations. We reviewed empirical support for the critical paths in this model. There is much more existing work on the path from social group identification to perception, and very little work on the link between perception and intergroup relations. It is important to further this investigation to fully test this model, which has implications for understanding group processes and perception, as well as clinical practices and policy making.

Implications for Group Processes

It is also worth noting that each perceptual modality is not evenly represented in social psychology, with far more research on visual and tactile perception and relatively little on auditory, olfactory, and gustatory perception. Nevertheless, these other modalities can have valuable implications for promoting positive intergroup relations. Malleable perception of pain as a function of social group membership can have potentially detrimental consequences for ethnic and cultural minority individuals. For example, evidence points to the racial and ethnic disparity for prescription of pain medication for Whites and racial minorities in emergency rooms, as well as other settings, such that racial minorities (Blacks, Latinos) are less aggressively treated for pain compared to Whites (Bonham, 2001; C. R. Green et al., 2003; Ng, Dimsdale, Rollnik, & Shapiro, 1996; Pletcher, Kertesz, Kohn, & Gonzales, 2008; Tamayo-Sarver, Hinze, Cydulka, & Baker, 2003). Other work finds that both patient gender and physician gender influence pain medication prescription (Weisse, Sorum, & Dominguez, 2003; Weisse, Sorum, Sanders, & Syat, 2001). In either case, perception of pain by a patient is susceptible to a host of unrelated social characteristics, such as race and gender of the person experiencing pain. Thus, understanding such influences on pain perception—as well as other perceptual modalities—is crucial particularly in interracial and intergroup contexts.

Implications for Understanding Perception

There has been considerable research in psychology on top-down influences in perception. Social psychologists may be interested in studying the top-down influence of social factors such as social group membership on perception. For instance, whereas auditory perception researchers might be interested in how putting a face to speech influences speech perception, social psychologists may investigate how putting an ingroup versus outgroup member's face differentially affects speech perception. Alternatively, researchers may be interested in studying how our identities could shape what people hear and to what extent people can detect subtle differences in speech. For instance, researchers can test whether priming bilingual or bicultural individuals with different identities could facilitate their ability to distinguish between certain sounds and phonemes. In this way, the research reviewed in this article, as well as research generated by the proposed perceptual model of intergroup relations, will corroborate research from perception researchers by bringing in social processes and constructs.

Having pointed out that each perceptual modality is not evenly represented in social psychological research, we hope to encourage more work to be done in the less represented perceptual modalities, such as olfactory, tactile, and gustatory perception. For instance, if smells can prime different social identities, then perhaps smells could be used to alter compliance with group norms or even discrimination. Another fascinating line of research has focused on the role of chemosensory signals (found in body odors and tears) in social communication (Frumin et al., 2015; Gelstein et al., 2011; Pause, 2012). It is currently assumed that chemosensory signals are processed by the olfactory system in humans. Unlike other social signals, they are generally processed below the threshold of consciousness. Much like smells, one may speculate that these chemosensory signals could perhaps be used to prime different identities in an implicit fashion, and one could study how this may influence group phenomena. Future work should test the prediction that olfactory perception is susceptible to influence from a host of social constructs and processes, such as social identity and other social group dynamics. The same reasoning should extend to predictions in other perceptual modalities.

Cognitive Penetrability

Perception has usually been defined and tested in different ways by different researchers (Balcetis & Dunning, 2010; Bruner & Goodman, 1947; Hochberg, 1956; Proffitt, 2006). Although these findings provide us with extremely useful information on

how high-level social factors and processes can shape perception, there are nevertheless potential weaknesses in terms of the measurement of basic perceptual processes and the ambiguity of the term *perception* (see Firestone & Scholl, 2015). Perception researchers have long been investigating top-down influences on perception, but these factors are usually studied at a different level than commonly studied by social scientists (Henderson, 2003; Hochberg, 1956). While testing hypotheses regarding top-down effects on perception, researchers will need to move in the direction of dissociating the component processes of perception, as well as differentiating influences from other processes such as judgment or recall. For instance, distance perception is often assessed by having people assign a numerical value proportional to the physical distance using a particular metric (e.g., in miles), or put a dot on a line that represents a given physical distance (Xiao & Van Bavel, 2012). These measurements were used partly because it is not possible to provide actual visual input for large distances beyond our visual field. Thus many researchers, including us, broadly discuss these findings in terms of distance *perception*, but these tests are not process pure and can indeed encompass a host of different processes, such as judgment, recall, or actual perception, of physical distance. It is thus important to realize that these measures may be tapping into memory or judgmental biases rather than online perceptions of distance. In fact, there are still researchers who deny top-down effects of cognition on perception, or "cognitive penetrability." These authors pointed out several potential pitfalls of studies on "cognitive penetrability" (Firestone & Scholl, 2015). Therefore, future research in this domain will need to examine where in the perceptual processing stream that social identity and other factors are exerting an influence. This work will benefit by moving beyond the sorts of self-report measures that have been widely employed in this literature in favor of the tasks and methods typically employed in classic perception research. Better understanding of social influences on perception will provide greater leverage for understanding human behavior in intergroup contexts.

Conclusion

According to the proposed perceptual model of intergroup relations, social group membership shapes perceptual processing, which in turn mediates intergroup relations. This work should serve as a starting point for social psychologists to utilize perception to understand intergroup relations, as well as for cognitive psychologists interested in how social processes might influence perception. Perception is not the only means through which social group membership affects intergroup attitudes and behaviors, but understanding the role of perception might nevertheless shed new light on an ancient issue. Examining the role of perception in intergroup relations may allow future researchers and policymakers to devise new and unique interventions targeted at the perceptual level.

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