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The target article, "A Perceptual Model of Intergroup Relations" (Xiao, Coppin, & Van Bavel, this issue), provides a thoughtful and integrative review of research linking perceptual processes to interpersonal outcomes. By synthesizing literatures spanning multiple scientific disciplines into a cohesive framework, the authors have done a great service to the field of social vision (Adams, Ambady, Nakayama, & Shimojo, 2010; Balcetis & Lassiter, 2010). Particularly compelling is the possibility of a reciprocal relationship between perceptual processes and intergroup relations. It seems that sometimes, perceptual factors impinge on social life; other times, social life influences basic percepts. On these points, we are in agreement.

Although the authors provide evidence supporting both halves of the reciprocal relation between perception and social judgment, their review is noticeably imbalanced. Most of the cited work describes associations between social identity and perception. This imbalance is both intentional and defensible, as the authors contend that studies linking social factors to perception are relatively more common than studies showing effects of perception on intergroup relations.

Indeed, we agree that more evidence exists in support of the former. We disagree, however, with the notion there is scant evidence in support of the latter. A quickly accumulating literature has revealed links between perception and intergroup relations, indicated by Paths D and F of the current model (Xiao et al., this issue, Figure 1). We describe this work below to more fully substantiate the reciprocal association between perception and social judgment.

The target article summarizes intergroup relations as an interrelated set of attitudes, judgments, and behaviors involving social groups. Thinking broadly about the association between perception and intergroup relations, it is already well established that perceptual factors influence these factors. For example, the *mere exposure effect* demonstrates that repeated experience with a given stimulus enhances attitudes toward that stimulus (Zajonc, 1968). Classic studies showed that repeated exposure increases likeability judgments of uncommon foods (Pliner, 1982), vocabulary words (Johnson, Thomson, & Frincke, 1960), and Chinese pictographs (Zajonc, 1968). Critically, however, early work in this area was limited to nonsocial stimuli, raising questions about whether perceptual exposure also impacts high-level social evaluations of others. Early studies also utilized the same stimuli during the

exposure and test phases, making it unclear whether exposure to a generalized class of stimuli (e.g., people belonging to a particular social group) enhances attitudes toward novel members of that class.

Contemporary researchers have responded to these limitations by extending research on mere exposure to a decidedly social domain. We review evidence from our own and others' work that makes two important points relevant to the current review. First, perceptual exposure provides a broad and generalizable account of how social attitudes are calibrated over the life span. Research on sensory adaptation has revealed that repeated exposure to members of a particular social group instills preferences for members of that group and prejudices against members of other groups. This process also works in reverse, such that intergroup attitudes affect the direction of visual attention toward, and thus perception of, social targets. Second, metacognitive features of perceptual experience guide downstream social evaluations. Processing fluency—the ease with which one perceives members of a group—can impact social evaluations, such that people who are easy to process tend to be evaluated relatively positively, whereas people who are difficult to process tend to be evaluated relatively negatively. In reviewing the literatures on sensory adaptation and processing fluency, we aim to contribute additional evidence for the proposed relationship between perception and intergroup relations.

Sensory Adaptation

Intergroup relations do not emerge from a knowledge vacuum. Instead, prior experience provides a conceptual framework from which perceivers derive their attitudes, judgments, and behaviors directed toward members of social groups. The target article acknowledges the social impact of prior experience by noting that exposure to faces belonging to different racial groups determines the dimensionality of the cognitive space in which race is represented. Specifically, racial groups with which a perceiver has more experience are represented more densely in a highly dimensional "face space" where each dimension represents a facial feature that varies in the population (Valentine, 1991). The center of the space represents the prototypical face, which takes on average values for all dimensions based on perceptual experiences accumulated over the life span. Faces falling

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close to the prototype are processed more holistically, identified more efficiently, and perceived as more normative than faces falling farther from it (Xiao et al., this issue).

These findings reveal that, in the long term, intergroup exposure guides the processes and outcomes of social judgments involving race. Still, exactly how and to what end these exposures accrue in the short term have only recently become apparent. Cutting-edge research has revealed that even fleeting exposure can systematically alter social evaluations of many different groups based on cues in multiple sensory modalities. The dominant paradigm in this line of work is sensory adaptation. Initially discovered in vision science, adaptation is the process by which perceptual systems habituate to features in the surrounding environment, resulting in aftereffects that alter subsequent perception (Clifford & Rhodes, 2005). For example, after viewing a downward-moving object for a brief time, shifting one's gaze to a stationary object causes that object to appear to drift in the direction opposite that of the initial motion (Anstis, Verstraten, & Mather, 1998). This aftereffect occurs because adaptation decreases the activity of neural populations dedicated to processing a given feature. When a novel stimulus appears in the visual field, the neurons coding for downward motion remain selectively inactive, causing stationary objects to appear as if they are drifting upward (Blakemore & Campbell, 1969). Sensory adaptation is ubiquitous in human perception, affecting many different aspects of low-level vision (e.g., color, motion, brightness; Webster, 2012) and audition (e.g., volume, pitch; D'Alessandro & Norwich, 2009; Phillips, Scovil, Carmichael, & Hall, 2007).

Exciting new discoveries have revealed that similar adaptations occur for higher level cues, including socially relevant cues contained in the human face. Preliminary work on face adaptation revealed that brief exposure alters the perceptual threshold for categorizing others as members of social groups. For example, adaptation to masculine male faces causes observes to categorize an androgynous face as female, and adaptation to Asian faces causes observes to categorize a racially ambiguous face as White (Webster, Kaping, Mizokami, & Duhamel, 2004). Adaptation also impacts categorical judgments of facial identity, such that repeated exposure to a particular identity ("Dan") causes a novel face to look like that identity's phenotypic opposite ("anti-Dan"; Rhodes & Jeffery, 2006). Adaptation even alters the threshold for categorizing others as members of social groups that seem perceptually ambiguous. In recent studies, brief exposure to hypermasculine male faces shifted the point of subjective equality for sexual orientation categorization, causing perceivers to categorize unknown men as gay at a lower level of gender atypicality than they did originally (Lick & Johnson, 2016). Each of these aftereffects emerges because perceptual exposure shifts the location of the prototype for a given social category in face space toward the adapting stimuli. Novel targets are coded in relation to the new prototype, which explains why targets that were coded as belonging to one social category preadaptation can appear to belong to a different category postadaptation (Webster, 2012).

The fact that sensory adaptation alters category prototypes raises the possibility it might also alter evaluative reactions to individual members of social groups. Indeed, classic research revealed that perceivers tend to evaluate stimuli based on their fit with a category prototype (Posner & Keele, 1964). Across diverse stimulus sets (Halberstadt & Rhodes, 2000), developmental periods (Vingilis-Jaremko & Maurer, 2013), and cultural contexts (Apicella, Little, & Marlowe, 2007), perceivers respond more favorably to prototypical category members than to nonprototypical category members. Consequently, adaptation's impact on category prototypes suggests that it is likely to shift evaluative judgments. Researchers have only begun to explore these possibilities, but available data look promising. For example, recent studies revealed that visual adaptation to extremely gendered faces enhanced social evaluations of similarly gendered faces (Lick & Johnson, 2014a), adaptation to physically distorted faces improved attractiveness ratings of similarly distorted faces (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003), and adaptation to human/chimpanzee facial morphs increased positive affective responses to similarly morphed faces (Principe & Langlois, 2012). As expected, these outcomes are closely linked to shifts in prototypicality, insofar as adaptation results in a correlated increase in perceived normativity and evaluative valence for targets that share features with the adapting stimuli (Lick & Johnson, 2014a). As such, sensory adaptation serves as a perceptual factor that helps to explain intergroup biases. To the extent that we are exposed most often to people who share our social group memberships, we may come to view features associated with those groups as normative, resulting in preferences for ingroup members and prejudices against outgroup members.

Evidence for the effect of sensory adaptation on intergroup relations extends beyond faces to include social category information conveyed through other channels. For example, similar effects emerge following visual adaptation to targets varying in body mass index. Adaptation to thin bodies lowered the threshold for labeling others as fat, whereas adaptation to fat bodies heightened that threshold. These perceptual changes also had evaluative implications, such that lowering the threshold for fat categorization via exposure to thin bodies exacerbated weight bias, but whereas raising the threshold for fat categorization via exposure to fat bodies mitigated weight bias, both explicitly and implicitly (Lick, Hunger, Tomiyama, & Johnson, 2016). Thus, just as it does for faces, sensory adaptation alters category judgments and evaluative biases related to body weight. These findings provide a mechanistic account for why parents whose children became overweight nevertheless perceived them as looking "just right" both before and after weight gain (Duncan, Hansen, Wang, Yan, & Zhang, 2015).

Several studies have extended preliminary findings about the evaluative impacts of sensory adaptation from faces and bodies to other sensory modalities. For example, we recently found that attractiveness ratings of female voices were calibrated on the basis of recent perceptual experience. Perceivers adapted to voice stimuli that were manipulated to vary in fundamental frequency to be gender typical or gender atypical for women. They then evaluated unaltered female test voices with regard to their typicality and attractiveness. Exposure to gender-atypical voices caused test voices to seem more typical and therefore more attractive than exposure to gender-typical voices (Lick, Bryant, & Johnson, 2016). Other work has revealed cross-modal effects of sensory adaptation. In one series of studies, adapting to hypermasculine female faces increased the perceived typicality

of masculine female faces as well as masculine female voices (and vice versa; Little, Feinberg, DeBruine, & Jones, 2013). The importance of sensory adaptation for social judgment is therefore robust to changes in sensory modality, suggesting that repeated exposure alters category prototypes at a relatively high level of representation.

Thus, whether they involve visual perception of faces, visual perception of bodies, or auditory perception of voices, social judgments are strongly guided by perceptual experience.

Social targets tend to be evaluated favorably when they are prototypical for their group, with prototypicality determined at least in part by prior experience. These conclusions provide additional evidence in support of Path D in the perceptual model of intergroup relations (Xiao et al., this issue, Figure 1). Of course, the controlled nature of the laboratory studies on which these conclusions are based might raise questions about the process by which sensory adaptation emerges under more natural viewing conditions. We recently began addressing these questions, as well as the reciprocal nature of the perceptual model of intergroup relations, in a series of studies involving body weight (Lick et al., 2016). Using eye-tracking technology, we found that perceivers spontaneously look at thin bodies more than fat bodies when gazing freely at social scenes in which both body types were presented simultaneously. The magnitude of this gaze tendency predicted change in weight bias from pretest to posttest, such that perceivers who were more likely to preferentially fixate on thin bodies exhibited stronger weight bias against fat bodies after viewing than before. These findings suggest how the association between social groups, perception, and intergroup relations may become cyclical. In the case of body weight, perceivers preferentially attend to social targets they prefer to begin with (e.g., thin bodies), instilling evaluative preferences for similar targets and prejudices against dissimilar targets, which restarts the cycle by creating even stronger preferential attention effects.

Aforementioned findings notwithstanding, the news is not all bad. Because visual attention is subject to conscious control, we reasoned it might be possible to overcome preferential gaze tendencies in order to mitigate intergroup biases associated with unequal allocation of visual attention. In a follow-up study, we trained participants to gaze primarily at either thin or fat bodies in an array. The training altered weight bias as expected, with participants whose gaze was experimentally directed toward fat bodies showing less weight bias after training than before.

These findings underscore the largely untapped promise of perceptual interventions to improve intergroup relations. The promise becomes even more appealing in light of recent studies showing that face aftereffects can last up to 7 days postadaptation, even with drastic changes in experimental setting (Carbon & Ditye, 2012). By deliberately altering individuals' perceptual experiences via sensory adaptation, psychologists may be poised to develop a relatively simple and cost-effective means of combating intergroup bias.

Perceptual Fluency

As research on sensory adaptation reveals, when it comes to the link between perception and social judgment, the past very much guides the present. Although perceptual history certainly impacts attitudes and judgments related to social groups, it is not the only factor at play. Mounting evidence suggests that metacognitive sensations arising from perceptual acts themselves can also guide social evaluation. In particular, the subjective experience of *fluency* associated with a judgment has consequences for intergroup relations.

Broadly defined, fluency indicates the relative ease with which perceivers are able to process a stimulus (Alter & Oppenheimer, 2009). Fluent processing is "easy on the mind," marked by swift and seamless progress toward stimulus judgment, whereas disfluent processing is "hard on the mind," marked by slow and effortful progress toward stimulus judgment (Winkielman, Halberstadt, & Fazendeiro, 2006). This definition is intentionally broad because processing ease is known to be multiply determined. Indeed, fluency is influenced by diverse aspects of a stimulus (e.g., visual contrast, font readability, prior exposure) that become salient at various stages of processing (e.g., perception, categorization, recognition; Oppenheimer, 2008). Despite its myriad instantiations, fluency is consistently linked with stimulus evaluation across multiple domains of judgment. For example, relative to disfluent processing, fluent processing leads perceivers to rate works of art as more aesthetically pleasing (Belke, Leder, Strobach, & Carbon, 2010), deem instructions simpler to complete (Song & Schwarz, 2008), rate food additives as less risky (Song & Schwarz, 2009), and believe currencies to be more valuable (Alter & Oppenheimer, 2008). In recent years, researchers have extended these early findings about the evaluative implications of fluency to include evaluations of social targets. The findings are clear and consistent, indicating that fluent processing tends to compel relatively positive social evaluations whereas disfluent processing tends to compel relatively negative social evaluations (for a review, see Lick & Johnson, 2015).

Early work in this area examined how the fluency of imagined experiences guides social evaluation. Participants received descriptions of two hypothetical groups—described simply as Group A and Group B—and were asked to imagine the experiences of individuals who did or did not migrate from one group to another. Participants provided less positive evaluations of the targets who migrated compared to those who did not migrate, and this evaluative bias was partially explained by the greater difficulty participants experienced trying to imagine migrants' experiences (Rubin, Paolini, & Crisp, 2010). Other work examined the impact of fluency on trustworthiness judgments made about vocal recordings. Perceivers tended to rate heavily accented speech as less trustworthy than mildly or unaccented speech, and the bias against accented speech was associated with the difficulty perceivers experienced while deciphering the stimulus (Lev-Ari & Keysar, 2010). Subsequent work examined the social impact of fluency more generally as a function of semantics. In a series of studies, researchers found that hypothetical targets whose surnames were difficult to pronounce (e.g., Colquhoun) were rated as less likeable and received fewer votes in a mock ballot than those whose surnames were easy to pronounce (e.g., Smith). These findings extended beyond the laboratory, insofar as attorneys in real U.S. law firms tended to hold superior positions when their names were easy to pronounce rather than hard to pronounce (Laham, Koval, & Alter, 2012).

Although the aforementioned findings provided preliminary evidence for social implications of perceptual fluency, they

involved imagined experiences, auditory cues, and semantic information, which depart sharply from visual perceptual mechanisms at the heart of the target article. Thankfully, other work addresses these topics. We recently completed a series of studies showing that the fluency of social categorizations relying on facial features also guides evaluative judgments. In one study, perceivers judged as series of faces for their sexual orientation (*gay, straight*), gendered characteristics (*masculine, feminine*), and social traits (e.g., *intelligence, warmth, competence*). Targets categorized as gay were evaluated less favorably than targets categorized as straight, in part because their gender-atypical appearances made their social category memberships difficult to process, as indicated by slower response times (Lick & Johnson, 2013). A subsequent study replicated these findings, showing that targets categorized as bisexual were evaluated less favorably than targets not categorized as bisexual, in part because the former were processed more slowly in terms of their sexual orientation and gendered appearance (Lick, Johnson, & Rule, 2015).

Notably, the social impacts of fluency that we observed occurred over and above the act of categorization itself. Although both studies just described found that targets categorized as sexual minorities were evaluated less favorably than targets categorized as straight, disfluent processing nevertheless explained evaluative differences *within* the majority category. That is, even among targets who were categorized as straight, relatively slow processing corresponded to more negative evaluations. Thus, fluency does not override well-established effects of social categorization on evaluation, but instead operates in concert with them, providing an independent way in which perception influences social evaluation.

Thus far, our review of the fluency literature might give the impression that intergroup relations hinge on relatively fleeting sensations of perceptual ease. However, perceivers do not indiscriminately incorporate metacognitive cues into social judgments; instead, fluency varies in its heuristic value, becoming most powerful for judgments that are unclear or ambiguous (Oppenheimer, 2008). Evidence for this conclusion comes from a study that extended our original findings from sexual minority to racial minority individuals. Unlike findings for sexual minorities, the fluency of race categorizations (*Black, White*) had no reliable impact on evaluative judgments (Lick & Johnson, 2013). One reason that processing ease did not impact race-linked evaluations may be that race categorizations rely on cues that are perceptually obvious (see Lick & Johnson, 2014b). In fact, race categorizations are so efficient that perceivers achieve near-perfect accuracy following split-second exposures to stimuli (Martin & Macrae, 2007), suggesting a ceiling effect in which there is little need to draw upon less reliable heuristic cues such as fluency to render an evaluative judgment. This point was nicely illustrated in recent studies involving biracial face composites formed by morphing two monoracial faces. The biracial faces were rated as slightly more attractive than monoracial faces when participants received no additional information about them, but significantly less attractive than monoracial faces when participants were instructed to consider the race of the targets' parents (Halberstadt & Winkielman, 2014). It therefore appears that fluency is most likely to guide social judgments under conditions of perceptual uncertainty.

The fluency findings we have described are directly relevant to the target article. They indicate that the ease of perceptual processing directly predicts the valence of social evaluations. They also have broader implications for the study of prejudicial biases in intergroup relations, suggesting that some groups experience prejudice simply because features inherent in their group pose processing challenges for perceivers. For example, gender-atypical facial features common among sexual minorities make them somewhat difficult to process in the early moments of social categorization, resulting in prejudiced evaluations beyond those associated with their perceived sexual orientation (Lick & Johnson, 2013). In addition, disfluent experiences with one member of a group can generalize more broadly to affect attitudes toward the group at large. For example, Pearson (2011) presented White participants with the classic "Donald vignette," in which a Black target displayed ambiguously aggressive behavior under fluent conditions (easy-to-read font) or disfluent conditions (hard-to-read font). Participants evaluated Donald less favorably in the disfluent condition relative to the fluent condition, and these effects extended to the group as a whole: Participants evaluated Black individuals less favorably overall following exposure to a single Black target who was incidentally difficult to process. The link between the ease of processing for one target and valenced evaluations of the entire group highlight fluency as a critical component of theory linking perceptual processes to intergroup outcomes.

In summary, recent findings have linked perceptual fluency to social evaluation. Overall, targets processed fluently tend to be met with positive evaluations, whereas targets processed disfluently tend to be met with negative evaluations. This pattern emerges across diverse target groups, operationalizations of fluency, and levels of analysis. Taken together, these findings paint a clear picture of the social implications of processing ease. It may seem surprising that a metacognitive cue as seemingly inconsequential as fluency guides perceivers' judgments across such important domains, but fluency's potency likely derives from its ability to simplify the otherwise infinitely complex tasks of judgment and decision making. Specifically, fluent processing indicates familiarity and predictability, suggesting that prior interactions with similar stimuli had been successful (Alter & Oppenheimer, 2009; Winkielman, Schwarz, Fazendeiro, & Reber, 2003). In this way, fluency acts as a valuable heuristic differentiating familiar objects that are unlikely to cause harm from novel objects that could prove dangerous, compelling either comfort or caution that can protect one's interests early in the perceptual process (Kelley & Rhodes, 2002). Unchecked, however, fluency can lead to pronounced intergroup biases, bridging the gap between fleeting perceptual processes and downstream social consequences that affect millions of people.

Summary and Conclusion

In this commentary, we have augmented the research described in the perceptual model of intergroup relations by describing two additional perceptual mechanisms that impact intergroup relations. First, we discussed sensory adaptation as the process by which perceptual experience alters the perceived normativity of a target's features. Shifting norms impinge on social evaluations, resulting in positive evaluations of targets whose features

align with the perceptual norm but negative evaluations of targets whose features misalign with that norm. Second, we discussed perceptual fluency as the ease with which a social target can be processed. Social targets who are easy to process tend to enjoy more favorable evaluations than those who are difficult to process, resulting in pronounced biases against groups whose features are atypical or non-normative. Both of these processes replicate across multiple sensory modalities, numerous target groups, and diverse levels of analysis, providing clear and consistent evidence that perceptual factors impact social judgments.

It is worth noting that both sensory adaptation and processing fluency reflect relatively low-level aspects of human perception. Thus, we are not suggesting that these processes are uniquely social or that they evolved specifically for social purposes. Instead, we suspect they have been exapted to ease the otherwise arduous process of social judgment. Human perceivers are confronted with hundreds of novel faces every day, so it is necessary to develop strategies and shortcuts that ease the burden of social perception. Sensory adaptation and processing fluency do just that, providing human perceivers with quick heuristics that indicate the overall likeability of a target based on their fit with category prototypes derived from prior experience. Recognizing that both of these processes are at play in many other domains of judgment, including nonsocial judgments of size, brightness, pitch, aesthetic beauty, and monetary value, provides an impetus for the development of metatheories that unite various areas of research in psychology. This sort of integration will be necessary to provide a full and parsimonious account of the ways in which perception helps to fulfill our needs—or, in Gibson's (1979) words, of the ways in which perception aids action.

That sensory adaptation and processing fluency reflect low-level aspects of human perception also makes them strong candidates for intervention tools. The authors of the target article expressed interest in interventions explicitly. We propose that the generalized nature of these two processes make them particularly relevant. Indeed, research is already moving in this direction, with recent studies demonstrating that eye-gaze training can reduce evaluative biases against stigmatized individuals (Lick et al., 2016) and improve emotion regulation and positive mood among older adults (Isaacowitz & Choi, 2011). Interventions that take advantage of such basic aspects of human perception are exciting not only because they have the potential to reduce intergroup bias but also because they promise do to so in a relatively cost-effective and efficient manner. If research on these topics continues advancing at the rate it has over the past decade, we may soon be able to harness human perception to reduce long-standing social ills.

Funding

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