Wondering is Enough: Uncertainty about Category Information Undermines Face Recognition

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Abstract

Some social categories are almost always identifiable in face-to-face interaction (e.g. race and gender). Information about many other category memberships (e.g., religion, sexual orientation) can be uncertain, however. This work explores the influence of uncertainty about category information on face recognition. Current accounts of intergroup bias in face recognition (specifically, the feature selection model and categorization-individuation model) are extended to predict that uncertainty about category information would undermine later recognition of another person. Experiment 1 provided an initial test of the hypothesis by comparing recognition of faces for which category membership was uncertain to recognition of faces belonging to certain ingroup and outgroup members. Experiment 2 used a different comparison group (a threatening outgroup) in order to rule out two alternative interpretations of Experiment 1. Finally, Experiment 3 manipulated category uncertainty without direct reference to outgroup membership in order to address the possibility that uncertain group memberships might be redefined as an entitative outgroup. Across experiments, results converged to indicate that uncertainty about category information undermined face recognition. These results buttress current accounts of facial recognition bias by successfully extending them to a new domain, extend theoretical treatments of motivation as an antecedent variable in face recognition, apply a boundary condition to the influence of threatening stimuli on bias in face recognition, call into question recent findings about the cognitive system's treatment of uncategorized individuals, and identify uncertainty as a determinant of person perception.

Key words: face recognition; social categorization; own-group effect; own-race effect; cross-race effect; person perception

Encountering unfamiliar people involves uncertainty. Upon introduction (or indeed, through the early phases of acquaintance) the things we do not know about another person usually outnumber the things we do know. Depending on context, such uncertainties sometimes matter (e.g. unknown political beliefs when telling an off-color partisan joke), and are sometimes irrelevant (e.g. unknown political beliefs when choosing a restaurant). The present paper explores the consequences of uncertainty about social category memberships for one of the fundamentals of human cognition and interaction, face recognition.

Uncertainty about social category memberships is important. Social category memberships define shard and unshared group membership (i.e., ingroup and outgroup members; Tajfel & Turner, 1979). From shared or unshared group membership, a variety of cognitive and interpersonal consequences follow, including perceptual distortion, differential memory, and favoritism, (Sporer, 2001; Taylor, Fiske, Ectoff, & Ruderman, 1978; Turner, Hogg, Oakes, & Reicher, 1987).

Although many important categories, such as race, age, and gender, appear to be easily ascertained, categorization according to such dimensions is actually a dynamic and probabilistic process (Freeman & Ambady, 2011). Categorization of faces by sex, for example, is ultimately fast and accurate but involves the accumulation of evidence in favor of both male and female categorization before a decision is made (Freeman, Ambady, Rule, and Johnson, 2008). Moreover, difficulty with categorization has consequences (Johnson, Lick, & Carpinella, 2014). Targets that present conflicting category cues (e.g., relatively feminine heterosexual men) prompt disfluency during categorization. Such disfluency in turn translates to negative evaluations (Lick & Johnson, 2013).

Additionally, not all important group memberships have visual markers. Religion, sexual orientation, and political beliefs, for example, do not involve invariant external markers and can be difficult to determine conclusively without discourtesy. People can extract information about such category memberships based on facial features (Rule et al., 2010a; Rule, Macrae, & Ambady, 2009), but such information is less certain and less ubiquitously extracted than is information about age, race, and gender (Martin & Macrae, 2007; Tskhay & Rule, 2013; see also Todorov & Porter, 2014).

The impact of known category memberships on the encoding of and memory for new faces is well established. The largest body of work in this area concerns the effects of racial categories. This work documents that people reliably recognize members of their own race better than members of other races (Malpass & Kravitz, 1969; Meissner & Brigham, 2001), an effect termed the cross-race effect or the own-race effect. More recently, it has become apparent that the own-race effect overlaps substantially with a larger class of biases in facial recognition – Own-group bias. Work on own-group bias makes clear that intergroup bias in face recognition can arise from virtually any meaningful category distinction (Hugenberg, Wilson, See, & Young, 2013). Own-group bias has been observed as a result of categorization according to sexual orientation, religion, politics, university affiliation, and even arbitrary experimentally created teams (Bernstein, Young, & Hugenberg, 2007; Ray, Way, & Hamilton, 2010; Rule, Ambady, Adams, & Macrae, 2007; Rule, Garrett, & Ambady, 2010a; Van Bavel & Cunningham, 2012). In fact, the general phenomenon of bias in identity recognition appears to extend beyond the domain of faces entirely. Own-group bias is also apparent in memory for non-face representations of human identity (Ray & Matschke, 2012).

One of the interesting properties of categories without physiognomic markers is that they highlight the potential for uncertainty about at target's category membership during face-to-face interaction. The extension of the own-race effect to such categories thus raises the question - how might uncertainty about category membership affect memory for human faces?

When people are uncertain about something, they tend to pay attention to things that can reduce their uncertainty (Feldman & Fristen, 2010). In the present context, that would mean paying attention to information or features diagnostic of category membership. The impact of such attention on face memory is not necessarily obvious, however.

It does not appear to be the case that more attention is always better for face recognition. Explicit instruction to attend closely to faces, for example, does not reduce the cross-race effect (Hugenberg, Miller, & Claypool, 2007). Rather, attention to different types of information results in very different outcomes. For example, examining obvious surface characteristics of faces, such as nose length or gender, leads to worse memory for faces than does attempting to extract more individual information, such as personality (Bower & Karlin, 1974; Patterson & Baddeley, 1977).

In fact, attention to category diagnostic (as opposed to individuating) features is at the heart of recent theoretical accounts of bias in face recognition (both racial and otherwise). The feature selection model suggests that better recognition of same-race faces compared to other-race faces stems from noticing race-category diagnostic features instead of distinctive characteristics when encoding other-race faces (Levin, 1996; Levin, 2000). The categorization-individuation model (Hugenberg, et al., 2013; Hugenberg, Young, Bernstein, & Sacco, 2010) then builds on this insight in three ways. First, it extends the mechanism of category search to categories with no veridical visual referent. Presumably, lay theories about the appearance of ingroup and outgroup members are sufficient to guide encoding under these circumstances. Indeed, the construction of prototypical outgroup faces through reverse correlation gives some suggestion of what these features might be (Ratner, Dotsch, Wigboldus, van Knippenberg, & Amodio, 2014). Second, the categorization-individuation model links the distinction between searching for category diagnostic features and uniquely identifying features to the more general concepts of categorization (processing people according to category membership) and individuation (processing people according to individual characteristics; Fiske & Neuberg, 1999). Third, the categorization-individuation model notes that, although intergroup dynamics usually motivate people to rely on categorical information when encoding other people who do not share salient social categories (i.e., outgroup members), this is not always the case. Some circumstances, such as outgroup power (Ackerman et al., 2006; Ratcliff, Hugenberg, Shriver, & Bernstein, 2011; Shriver & Hugenberg, 2010), can eliminate category usage in the encoding of outgroup members.

Both of these models suggest that uncertainty about category information would lead to processing and outcomes similar to those present for outgroup members. Uncertainty about category membership is likely to induce a focus on category diagnostic features. Such a focus is in turn likely to impair later recognition relative to other types of encoding. Uncertainty about category information might result in greater attention overall, but such attention is likely to be directed at facial elements that will not result in effective memory.

The present investigation presents an important test of the feature selection model and the categorization-individuation model. These models can explain known moderators of cross-group recognition bias well through attention to categorical or personal information at face encoding and through the process of categorization and individuation. Uncertainty about category information presents a novel antecedent condition form both models, however. If the above predictions about face recognition under category uncertainty are supported, that would thus speak strongly to the models' generativity and continued efficacy (Popper, 2005).

Overview

Current theoretical perspectives on cross-group bias in face recognition suggest that uncertainty about a target's category membership will undermine memory for faces in the same way that unshared social category memberships typically undermine recognition of outgroup members relative to ingroup members. The research reported here investigated this hypothesis in in three experiments. Experiment 1 provided an initial test of the hypothesis by comparing recognition of faces for which category membership was uncertain to recognition for faces belonging to ingroup and outgroup members. Experiment 2 used a different comparison group in order to rule out two alternative interpretations of Experiment 1. Finally, Experiment 3 used an alternative manipulation of category uncertainty in order to address the possibility that uncertain group memberships might be redefined as an entitative outgroup.

Sample Size and Other Practical Considerations

The present research utilized moderately sized samples in repeated measures designs (average N = 36). Power analysis suggests that these sample sizes were appropriate given the powerful nature of repeated measures designs. Meta-analysis of the cross-race effect indicates a large effect size (f = .41; Meissner & Brigham, 2001). Sample sizes as low as N = 15 would be sufficient to detect such an effect with 80% power. Downward adjustment to a smaller effect of f = .25 on the assumption that the cross-group effect would not be as strong as the cross-race effect yielded a recommended sample size of N = 33. Sensitivity analysis using the correlations between observations actually observed in the reported experiments (average r = .397, weighted by sample size) confirmed these power estimates. With 80% confidence, Experiment 1 was able to detect effects of f = .252 or larger, Experiment 2 was able to detect effects of f = .237 or larger, and Experiment 3 was able to detect effects of f = .201 or larger. All measures, manipulations, and exclusions are reported. At no point was data collection continued after initial analysis because preliminary results were unsatisfactory.

An additional practical consideration in the present work was contamination of absent and concealable category membership by visible social categories, namely race, age, and gender. Race, age, and gender are extracted quickly and automatically and have documented effects on face encoding (Ito & Urland, 2003; Meissner & Brigham, 2001; Rhodes & Anastasi, 2012; Wright & Sladden, 2003). The salient presence of such a competing category has the potential to govern face encoding at the expense of less visible or absent category memberships (Ray et al., 2010). Strong contextual cues can overcome such competing influences (Hehman et al., 2010; Shriver & Hugenberg, 2010), but laboratory paradigms examining the influence of concealable social category memberships on face recognition are vulnerable to contamination by competition from visible category memberships.

Most existing work on facial recognition bias with concealable categories matches stimuli to participant race and age (i.e., uses only white stimuli and white participants and young faces with young subject populations) and skirts the issue of stimulus gender by only using male stimulus faces (e.g., Bernstein et al., 2007; Hehman et al., 2011; Ray et al., 2010; Rule et al., 2009; Shriver et al., 2008; Shriver & Hugenberg, 2010); see also (MacLin & Malpass, 2001; Pauker et al., 2009). Using race and age matched male stimuli avoids contamination by gender categorization because stimulus gender is unlikely to become salient without variation in exemplar genders (Young et al., 2009), even among female participants (Hamilton, 1991; Merritt

& Kok, 1995). In turn, without category salience, shared or unshared gender would be unlikely to influence face encoding (Hugenberg et al., 2010). In this investigation stimuli were matched to race and age through demographic screening (i.e., eligible participants were under 30 and white). Stimulus images of both genders were utilized, but stimulus gender was matched to participant gender at analysis (Experiment 1) or at exposure (all other experiments).[1]

Experiment 1

Experiment 1 compared recognition for faces about which category information was uncertain to recognition for definite ingroup and outgroup members.

Methods

Thirty-five participants were recruited for a 3 condition (category information: ingroup, outgroup, or uncertain) within-subjects design. Participants were recruited in a university cafeteria using chocolate bars as an incentive to participate. The actual experiment was completed in a quieter nearby area on a laptop computer. Because of the non-traditional recruitment venue, participants were asked to rate how seriously they took the experiment on a seven-point scale after they completed the experiment. Participants whose ratings were below the scale midpoint (*N* = 2) were excluded from analysis. The final sample consisted of 33 German university students (16 men, 17 women, *M* age = 23.80, *SD* = 2.65).

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[1] This work did not include participant gender as a factor in analysis. The current designs do not lend themselves to such analysis because the majority of participants in all experiments were female and sample sizes were based on the assumption of a repeated measures design. Including participant gender anyway does not qualify any of the results reported in the main manuscript or in the appendix, *F*'s < 2.186, *p*'s > .149, η_p^2*'s* < 066.

During an exposure phase, participants saw 30 target same gender faces for 3 seconds each interspersed with an equal number of extraneous opposite gender faces. In order to match participant and stimulus gender, only responses from same gender faces were retained for analysis (see Appendix for analysis of recognition and face gender in this experiment). The face images were cropped around the chin and forehead to remove most of the targets' hair. The faces were preceded by written information, present for 2 seconds, indicating that a face's nationality was German, French, or unknown. The true nationality of the faces was unknown, although the faces belonged to people attending university in the US at the time that the images were created. The order of exposure was random and the category membership assigned to particular faces was counterbalanced across participants. These exposure conditions were expected to induce uncertainty by (a) calling attention to the missing nationality information immediately preceding exposure to the face, and (b) juxtaposing categorized faces with faces missing category information in the same recognition block.

After the exposure phase, participants completed a distracter task in which they listed as many cities in Germany as they could in three minutes. Participants then completed a recognition test in which they saw the same faces they had seen at exposure intermixed with an equal number of foils and in which participants indicated whether a particular face was old or new. Written information indicating either national category membership or unknown category membership was presented in the same way as at exposure.

Recognition levels were computed for each participant in the metric of *d'* in which higher numbers indicate better recognition and which accounts for performance on both familiar stimuli and foils. Recognition estimates controlled for the variance associated with counterbalancing stimulus nationality, which consumed 6 degrees of freedom. All scores were adjusted according to the log-linear approach to accommodate instances of perfect performance (Macmillan & Creelman, 2005; Snodgrass & Corwin, 1988).

Results

Extension of the feature selection model and the categorization-individuation model predicts that uncertain nationality would undermine memory for faces comparably to known national outgroup membership. Recognition levels are presented in Figure 1. A repeated measures one-way ANOVA revealed a significant effect of condition, $F(2,52) = 4.180$, $p = .021$, $\eta_p^2 = .138$. Pairwise comparisons indicated that ingroup faces ($M = 1.579$, $SE = 0.142$) were better recognized than both outgroup faces ($M = 1.242$, $SE = 0.154$), $F(1,26) = 7.259$, $p = .012$, $\eta_p^2 = .218$, and faces with unknown category membership ($M = 1.155$, $SE = 0.155$), $F(1,26) = 6.612$, $p = .016$, $\eta_p^2 = .203$. Outgroup faces and faces with unknown category membership were recognized comparably, $F(1,26) = 0.258$, $p = .616$, $\eta_p^2 = .010$. These results conform to the predictions derived from the feature selection model and the categorization-individuation model of categorical bias in face recognition.

Additionally, exploratory analyses examined participants' response criterion in the form of *C*. Negative values of *C* would indicate that participants were biased towards characterizing faces as old (i.e., a liberal response bias). Positive values of *C* would indicate that participants were biased towards characterizing faces as new (i.e., a conservative response bias). The experimental manipulations had no effect on response criterion, $F(2, 52) = .099$, $p = 906$, $\eta_p^2 = .008$. Overall, participants appeared neither liberal nor conservative in their responses ($M = .023$, $SE = .063$), $t(32) = .358$, $p = .722$, $d = .064$.

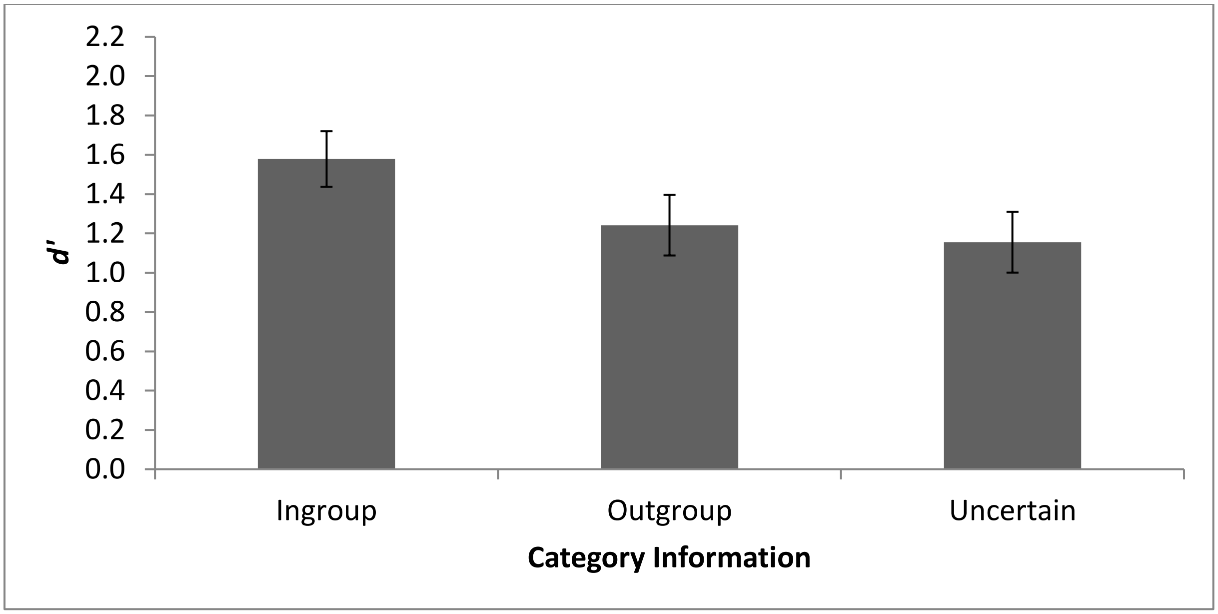

Figure 1. *Recognition levels in Experiment 1. Error bars represent cell standard errors. Faces were labeled as ingroup members, outgroup members, or category information was uncertain. Both outgroup categorization and uncertain category information led to poor recognition relative to ingroup categorization.*

Discussion

Although the results from Experiment 1 were consisted with extension of the feature selection and categorization-individuation models, two alternative theoretical perspectives could also account for the results. One possibility is that that differences in recognition between ingroup and outgroup members was driven by enhanced recognition of ingroup faces. The recognition levels observed in response to outgroup faces and faces for which category information was absent would thus be default and require no special explanation. Indeed, this position has been advanced (Van Bavel, Packer, & Cunningham, 2011).

The findings presented in Experiment 1 could also be interpreted to reflect ingroup over-exclusion. People tend to be conservative in assigning uncertain exemplars to ingroup categories

(Leyens & Yzerbyt, 1992; Pauker et al., 2009). In the face of ambiguity, the default assumption is often that someone is an outgroup member. Poor recognition of faces without category information might thus have resulted from those faces being assigned to the outgroup.

An additional experiment was thus required to provide a second demonstration that uncertainty about category information undermines recognition and in order to rule out these alternative accounts of Experiment 1.

Experiment 2

Experiment 2 used a manipulation similar to that employed in Experiment 1. Faces for which category information was unknown were intermixed with faces labeled as ingroup and outgroup members and participants' task was to remember those faces. The key difference between Experiment 1 and Experiment 2 was the outgroup used for comparison. Experiment 2 used criminals, a threatening outgroup.

Outgroups that present a threat or that affect important outcomes are remembered as well as or better than ingroup members (Ackerman et al., 2006; Ratcliff, Hugenberg, Shriver, & Bernstein, 2011; Shriver & Hugenberg, 2010). Because members of such outgroups are personally relevant, people are motivated to process those outgroup members in the same way that they process ingroup members. Specifically, people focus on the uniquely individuating features of particular outgroup members rather than on their category diagnostic features.

In the case of uncertain category information, dangerous or threatening outgroup membership presents an interesting case. A person's first priority when presented with an unknown individual who might or might not belong to a threatening outgroup is probably to determine that person's group membership (i.e., is this person a potential threat?). Ironically, this assessment would require focusing on the categorical features that might be ignored were the person definitely known to be a threatening outgroup member. Because focusing on categorical features undermines recognition, extension of both the feature selection model and the categorization-individuation model would predict that uncertainty about a potentially threatening outgroup membership would undermine face recognition even when certain membership in a threatening outgroup would lead to recognition comparable to ingroup membership. Critically, this prediction diverges from both an ingroup enhancement account and an ingroup over-exclusion account of Experiment 1.

An ingroup enhancement account of Experiment 1 suggests that uncertainty about category membership had no effect on processing at all. Rather, enhanced processing of ingroup members drove the observed differences. If uncertainty about membership in a normal outgroup has no effect on processing, then it is difficult to see why uncertainty about membership in a dangerous outgroup category might be expected to suppress recognition. That is, in the context of a well-recognized outgroup, an ingroup enhancement account would predict that recognition for ingroup, outgroup, and uncertain category exemplars would be the same.

An ingroup over-exclusion account of Experiment 1 posits that uncertain category membership led to implicit outgroup categorization. If uncertainty about category information leads to implicit outgroup categorization, then uncertainty about membership is a well-recognized threatening outgroup would also be expected to lead to relatively good recognition. The uncertain exemplar would be just as much of a threat as a certain exemplar. Like the ingroup enhancement account, an ingroup over-exclusion account would thus predict that recognition for ingroup, outgroup, and uncertain category exemplars would be the same.

In sum, an uncertainty account of Experiment 1 would predict that saliently absent category information would suppress recognition even in the context of threatening outgroup membership. In contrast, both ingroup enhancement and ingroup over-exclusion would predict comparable recognition between saliently absent category information and definitive membership in a threatening outgroup.

Method

Thirty-six Scottish university students (28 women, 8 men, *M* age = 19.58, *SD* = 2.23) participated in a 3 condition (category information: ingroup, outgroup, or uncertain) within-subjects design in exchange for partial course credit. The testing venue was a dedicated psychological laboratory. Procedures were otherwise identical to Experiment 1 with the following exceptions: All stimuli were matched to participants' gender; the number of both exposure and foil stimuli was increased from 30 to 45; no filler task was used. Participants were told that the faces they were viewing belonged either to other students (the ingroup) or to criminals convicted of a serious offense (the threatening outgroup) and participants were warned that the specific membership of some of the faces (either student or criminal) was unknown. The stimulus faces were labeled accordingly ('student', 'criminal', and 'unknown').

Results

Extension of the feature selection model and categorization-individuation model predicts that uncertain category information would undermine memory for faces relative to both student labeled (ingroup) and criminal labeled (dangerous outgroup) faces. Recognition levels are presented in Figure 2. A repeated measures one-way ANOVA revealed a significant effect of condition, $F(2,60) = 4.058$, $p = .022$, $\eta_p^2 = .119$. Pairwise comparisons indicated that both student faces ($M = 1.404$, $SE = 0.139$), $F(1,30) = 7.677$, $p = .010$, $\eta_p^2 = .204$, and criminal faces ($M = 1.342$, $SE = 0.154$), $F(1,30) = 4.377$, $p = .045$, $\eta_p^2 = .126$, were better recognized than faces without category information ($M = 0.949$, $SE = 0.163$). Recognition did not significantly differ between student and criminal faces, $F(1,30) = 0.141$, $p = .710$, $\eta_p^2 = .005$. These results indicate that saliently absent category information undermined recognition even in circumstances in which definitive membership in an outgroup did not interfere with recognition.

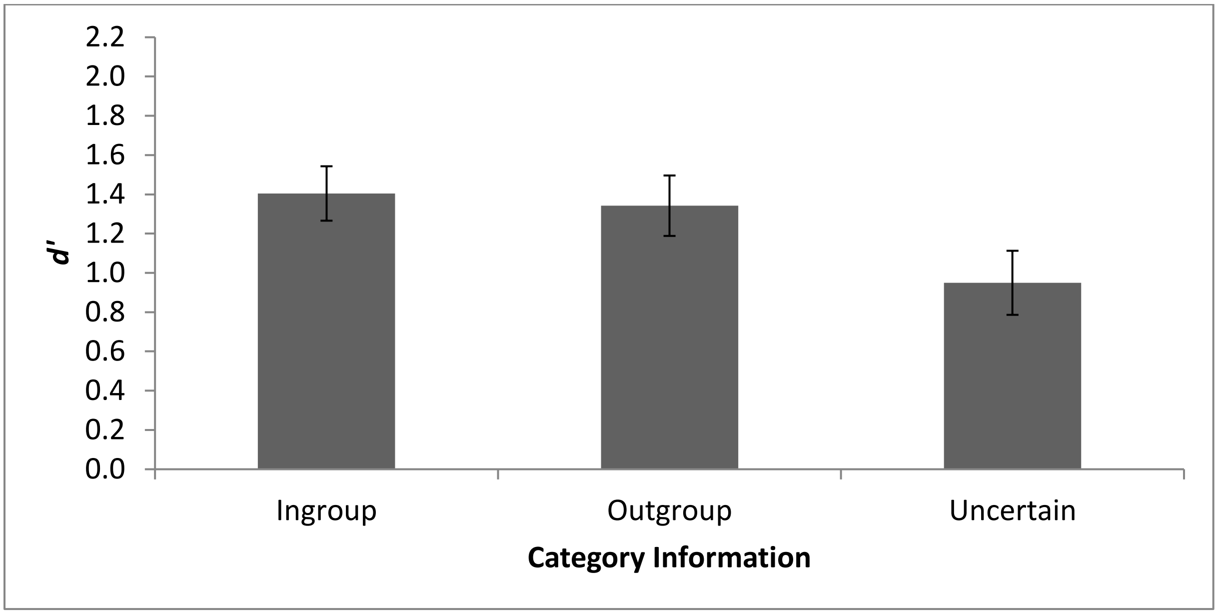

Figure 2. Recognition levels in Experiment 2. Error bars represent cell standard errors. Faces were labeled as ingroup members, threatening outgroup members, or category information was uncertain. Membership in a threatening outgroup did not reduce recognition relative to ingroup membership but uncertain category membership reduced recognition relative to both ingroup and outgroup membership.

Additional exploratory analysis again examined participants' response criterion (*C*). In contrast to Experiment 1, participants were relatively liberal in their response criterion (M = -0.513, SE = .106), $t(35)$, = -4.828 p = < .001, d = .803, although the extent of this bias varied by experimental condition, $F(2, 60) = .099$, p = 906, $\eta_p^2 = .008$. Pairwise comparisons indicated that participants' response criterion was especially liberal for faces of uncertain category membership

(*M* = -0.768, *SE* = .174) relative to student faces (*M* = -0.301, *SE* = 0.182), $F(1, 30) = 9.349$, $p = .005$, $\eta_p^2 = .238$. Responses to faces of uncertain category membership also tended to be more liberal than criminal faces (*M* = -0.496, *SE* = 0.176), $F(1, 30) = 2.975$, $p = .095$, $\eta_p^2 = .090$. Response criteria for student and criminal faces did not measurably differ from one another, $F(1, 30) = 1.582$, $p = .218$, $\eta_p^2 = .050$.

Discussion

Experiment 2 provided a second demonstration that uncertain category information undermines facial recognition. Experiment 2 thus provided a replication of the key conditions under study in Experiment 1. At the same time, the use of a well-recognized outgroup for comparison (criminals) ruled out ingroup enhancement and ingroup over-exclusion as alternative accounts.

Participants in Experiment 2 showed a relatively liberal response criterion relative to participants in Experiment 1, especially in response to faces of unknown category membership. The overall tendency towards liberal responding might reflect the threatening nature of criminal targets. In threat recognition, false positives are probably less costly than false negatives. Participants might thus have adjusted their overall mindset in response to potentially threatening stimuli. Why this would be particularly exaggerated for faces of unknown category membership is less obvious. One possibility is that the ambiguity of uncertain category membership might have enhanced participants existing response bias. That is, an already liberal response bias became more extreme because of the uncertain categorization.

Although the combined results of Experiments 1 and 2 are consistent with extension of the feature selection and categorization-individuation models rather than with ingroup enhancement and ingroup over-exclusion, the results could still be explained by one additional alternative account. It is possible that, rather than being implicitly assigned to the existing outgroup, uncertain category membership created an entirely new outgroup with properties independent of the outgroup already introduced. An additional experiment with a different manipulation of uncertainty was required to rule out this final alternative account.

Experiment 3

In order to manipulate uncertainty about ingroup membership without reference to outgroup membership, Experiment 3 drew on a paradigm used in early depth of processing work on face recognition. In this classic paradigm, participants' attention was explicitly directed to either visible category memberships or to unknown personal characteristics at encoding (Bower & Karlin, 1974; Patterson & Baddeley, 1977). Attention to visible category membership led to "shallower" processing and worse memory than did attention to unknown personal characteristics.

Experiment 3 replicated this work but directed attention implicitly through uncertainty. In the key manipulation of uncertainty, German participants guessed if target faces were German or not. In this manipulation, uncertain group membership could not be treated as a potentially separate category (as in Experiments 1 and 2). Rather, participants had to speculate about the specific membership of uncategorized faces (ingroup or not ingroup). According to the predictions derived from the feature selection model and the categorization-individuation model, uncertainty about the category membership of these faces would lead them to be recognized relatively poorly regardless of whether they were ultimately categorized as ingroup members (Germans) or not.

Experiment 3 is also relevant to ingroup over-exclusion accounts of Experiment 1. In Experiment 3, participants explicitly decided if they thought uncertain exemplars were members of an ingroup. Because ingroup over-exclusion identifies the ultimate categorization of exemplars as the driving influence on recognition, an ingroup over-exclusion account would predict that exemplars assigned to the ingroup would be better recognized than exemplars not assigned to the ingroup. In contrast, an uncertainty account of Experiment 1 identifies the decision process itself rather than the outcome of the decision as the driving influence on recognition. An uncertainty account thus predicts that the eventual classification of exemplars would not affect recognition.

Three comparison groups were useful to evaluate these predictions. First, to account for the possibility that asking questions about faces might generally reduce recognition, participants were also asked to guess personal information about a different set of faces. Specifically, participants were asked to guess if different faces would make a good friend or not. Answering questions about friendship quality and answering questions about nationality both require attempting to resolve uncertainty about unknown information. The questions differ, however, in the degree to which the uncertainty concerns category diagnostic features. Guessing if a target is German requires evaluating features diagnostic of the established and commonly used social category, German. In contrast, guessing if a target would make a good friend requires searching for personally diagnostic (i.e., individuating) information like personality characteristics (Fiske & Neuberg, 1990). If simply asking questions about faces affected recognition, then the effect of asking questions should be evident after both types of questions. In contrast, extension of both the features selection model and the categorization-individuation model would predict that these different questions would lead to different recognition outcomes.

Additionally, in order to compare the effects of uncertainty to certainty about ingroup and outgroup membership, Experiment 3 also included faces that were explicitly labeled as belonging to an ingroup (German) or to an outgroup (French).

Methods

Forty-three participants were recruited for participation. As in Experiment 1, participants were recruited in a university cafeteria with chocolate provided as an incentive and, after completing the experiment, were asked to rate how seriously they took the experiment on a seven-point scale. Participants whose ratings were below the scale midpoint (N = 2) were excluded from analysis. The final sample consisted of forty-one German university students (12 men, 29 women, M age = 23.55, SD = 2.51).

The experiment utilized a four cell repeated-measures design. In two cells, participants were asked questions about uncategorized faces (German? Good Friend?). In the remaining two cells, participants saw explicitly labeled faces (German, French). The four different encoding conditions were divided into two blocks, one block of faces with questions at encoding and one block of faces with labels at encoding. The “labels block” used a format identical to Experiment 1 with two exceptions. Faces were labelled only as “German” or “French,” and the filler task consisted of listing either pieces of furniture or animals. The specific filler task was randomized between blocks.

In the “questions block,” each face was preceded by the cue, “German?” or by the cue, “Good friend?” Instructions indicated that participants were to determine if the face on the screen was German or if the face on the screen would make a good friend according to the cue presented before each face. Participants answered each question, “yes,” or, “no,” with a key press. Following encoding participants completed the randomized filler task and took a recognition test. The cues present at encoding (i.e., the questions) were also provided during the recognition trial. The instructions and presentation format for each recognition trial were careful to differentiate between the questions asked at encoding and the decision being made during the recognition task, however. No participants indicated confusion about the intended procedures.

Both blocks contained 40 gender matched faces for a total of 80 faces. Order of stimuli within blocks was randomized and the stimuli assigned to particular encoding cues were counterbalanced. Block order was counter balanced.

Recognition levels were again computed in the metric of *d'* using the same procedures as previous experiments. Controlling for stimulus counterbalancing consumed 8 degrees of freedom.

Results and Discussion

Extension of both the feature selection and the categorization-individuation model predicts (a) that uncertainty about category information would undermine recognition relative to uncertainty about personal information, and (b) that this comparison would parallel differences in recognition between ingroup and outgroup membership. Recognition levels are presented in Figure 3.

A repeated measures one-way ANOVA revealed a significant effect of the manipulations, $F(3,99) = 4.11$, $p = .009$, $\eta_p^2 = .11$. Recognition was poor when participants tried to determine whether the person pictured was German ($M = 1.457$, $SE = 0.136$) relative to when participants tried to determine whether the person pictured would make a good friend ($M = 1.816$, $SE = 0.121$), $F(1,33) = 8.112$, $p = .008$, $\eta_p^2 = .197$. Similarly, recognition was poor when faces were labeled as outgroup members ($M = 1.574$, $SE = 0.120$) relative to when faces were labeled as ingroup members ($M = 1.842$, $SE = 0.108$), $F(1,33) = 4.310$, $p = .046$, $\eta_p^2 = .116$. Recognition when participants tried to determine if a face was German did not differ from faces labelled as French, $F(1,33) = 0.63$, $p = .435$, $\eta_p^2 = .02$. These results indicate that uncertainty about ingroup membership reduced recognition relative to uncertainty about personal information. Moreover, this difference mirrored the difference in recognition of certain ingroup and outgroup members with uncertainty about ingroup membership reducing recognition to outgroup levels.

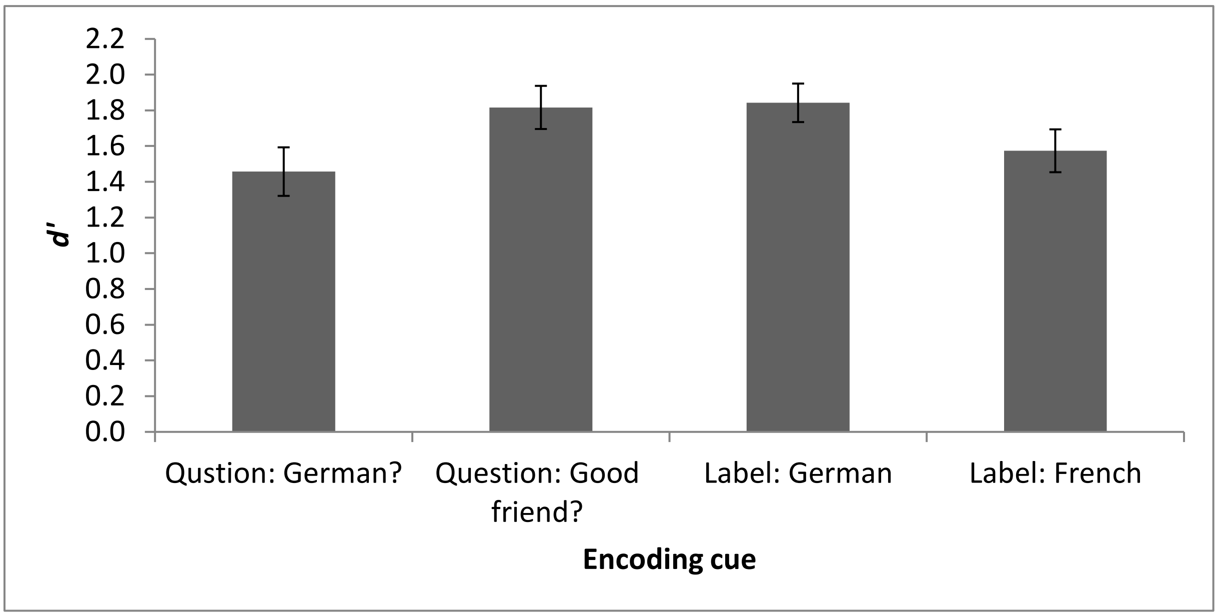

Figure 3. *Recognition levels in Experiment 3. Error bars represent cell standard errors. Questions prompting uncertainty about ingroup membership (German?) were compared to questions prompting uncertainty about personal information (Good friend?) as well as to certain ingroup membership (German) and certain outgroup membership (French). Uncertainty about ingroup membership led to relatively poor recognition comparable to certain outgroup membership. Questions about personal information led to relatively good recognition comparable to certain ingroup membership.*

In order to determine if it was the decision process itself (i.e., asking the question, is this person German?) or the decision outcomes (i.e., deciding that a person is or is not German) that drove the observed effects, accuracy was examined according to whether a particular face had been classified positively or negatively as an ingroup member or as a good friend. On average, participants guessed that 52.1% of the presented faces were ingroup members (Germans). The proportion of faces that participants correctly recognized did not differ between faces assigned to the ingroup (M = .720, SE = .036)) and faces assigned to the outgroup (M = .762, SE = .036), $t(30) = 0.933$, $p = .358$, $\eta_p^2 = .028$. In fact, the descriptive trend was for faces assigned to the outgroup to be better recognized than faces assigned to the ingroup. On average, participants guessed 40.8% of the presented faces would make good friends. Once again, the proportion of faces that participants correctly recognized did not differ between faces expected to be good friends (M = .831, SE = .036)) and faces not expected to be good friends (M = .877, SE = .029), $t(30) = 1.095$, $p = .282$, $\eta_p^2 = .038$.[2] These results indicate that initial uncertainty rather than reassignment to an outgroup drove the effects observed in Experiment 3.

Exploratory analysis again examined participants' response criterion (C). As in Experiment 1, participants appeared neither liberal nor conservative in their responses, (M = .065, SE = .086), $t(40) = .756$, $p = .454$, $d = .118$, and the experimental manipulations had no effect on response criterion, $F(3, 99) = 1.99$, $p = .120$, $\eta_p^2 = .057$.

General Discussion

[2] Three participants had no variance in one of the two decisions made about stimulus faces, for example, thinking that either all or none of the stimulus faces would make a good friend. This resulted in a frequency of zero for one of the response categories analyzed here and thus prevented any meaningful computation of a proportion of correct answers. These participants were excluded from this analysis.

Three experiments explored the potential for uncertainty about category information to influence memory for human faces. Experiment 1 demonstrated that uncertain category membership can suppress face recognition. Experiment 2 replicated this finding in the context of a dangerous outgroup. Finally, Experiment 3 replicated this finding without reference to outgroup membership. Consistent with extension of the feature selection and categorization-individuation models of intergroup bias in face recognition (Hugenberg et al., 2013; Hugenberg et al., 2010; Levin, 1996; Levin, 2000), uncertainty about category information consistently undermined recognition.

In combination, these experiments rule out several alternative accounts of the data presented here. By itself, the finding that uncertainty about category information leads to relatively poor face recognition could be accounted for by an ingroup enhancement account of intergroup bias in face recognition. This is the idea that recognition at outgroup levels is default and ingroup membership elevates recognition from that baseline (Van Bavel et al., 2011). This explanation does not easily account for the findings of Experiments 2. In Experiment 2, a threatening outgroup was recognized at ingroup levels but the attempt to determine if a target was a member of that threatening outgroup led to relatively poor recognition. Because this context produced relatively good recognition for both ingroup and outgroup members, it is difficult for an ingroup enhancement to explain why uncertainty about ingroup or outgroup membership would lead to relatively poor recognition.

Alternatively, the finding that uncertainty about category information leads to relatively poor recognition could be accounted for by ingroup over-exclusion - the idea that people tend to be conservative in assigning uncertain exemplars to ingroup categories (Leyens & Yzerbyt, 1992; Pauker et al., 2009). This explanation does not easily account for the results of either

Experiments 2 or 3. Experiment 2 used an outgroup that was as well-recognized as the ingroup. In the context of a well-recognized outgroup, assigning uncertain exemplars to that outgroup would be expected to lead to relatively good recognition. In fact, uncertain category information undermined recognition. Experiment 3 used a task in which participants explicitly decided if they thought uncertain exemplars were members of an ingroup. Because ingroup over-exclusion identifies the ultimate categorization of exemplars as the driving influence on recognition, exemplars assigned to the ingroup would be expected to be better recognized than exemplars not assigned to the ingroup. In fact, recognition was not influenced by the eventual decision about exemplar membership.

It is also possible that uncertainty about any sort of information (categorical or non-categorical) leads to relatively poor recognition. This explanation cannot account for the results of Experiment 3, however. In this experiment, uncertainty about personal information led to better recognition that did uncertainty about category information.

Finally, the finding of both Experiments 1 and 2 might be explained by the implicit assignment of uncertain category exemplars to a new outgroup, unrelated to the ingroups and outgroups explicitly defined in experimental context. Experiment 3 addressed this possibility by asking participants to classify uncertain exemplars with respect to ingroup membership. This manipulation lead to relatively poor recognition without reference to an outgroup and regardless of eventual classification. The implicit redefinition of a new outgroup thus appears to provide a poor account of Experiment 3.

One limitation of this work is that it includes no direct measurement of uncertainty. Appropriate measurement of uncertainty in the current context is by no means obvious, however. Conscious and reportable experiences of uncertainty, curiosity, or interest would not necessarily index the processes involved in early face categorization. Measurement of computer mouse trajectory presents a more subtle possibility but such techniques capture the influence of competing evidence on categorization decisions rather than the initial absence of evidence (e.g., Freeman, et al., 2008). This weakness is compensated for by relatively clear manipulations in Experiments 1 and 2 (explicit labeling and contrast with certain information) and by direct manipulation through explicit questions in Experiment 3. The claim that uncertainty drives the effects reported here does, however, ultimately rest on the assumption that these manipulations were effective in creating uncertainty and that plausible alternative antecedents (i.e., ingroup enhancement, ingroup over-exclusion, implicit reassignment to novel outgroups) cannot explain the observed results as effectively as uncertainty.

Recent work related to the phenomenon under study here examined the categorization of and memory for multiracial individuals - people whose ancestry blends two or more distinct ethnic groups. Most of this work has focused on which of the available parent categories are applied to biracial targets of perception. The perception of biracial people appears to follow the rule of hypodescent, the tendency to assign people of mixed ancestry to the lower status of the applicable parent categories (Halberstadt, Sherman, & Sherman, 2011; Ho, Sidanius, Levin, & Banaji, 2011; Peery & Bodenhausen, 2008; but see Chen & Hamilton, 2012). That is, in contrast to the results reported here, the perception of multiracial people appears to be governed by the outcome of categorization under ingroup over-exclusion rather than by uncertainty (Pauker et al., 2009).

Additional work on beliefs about the diagnosticity of visual cues to category memberships suggests a potential moderator of the effects reported here. Lick & Johnson (2014) found that beliefs about the differential diagnosticity of visual cues to different category membership (e.g., visibility of race vs sexual orientation) varied between individuals. In turn, lower belief in cue diagnosticity for a particular category membership affected participants' response criterion in favor of non-stigmatized social defaults (e.g., straight). It is possible that such beliefs might moderate the effects observed here by undermining category search. On the other hand, such beliefs clearly don't prevent category search upon prompting. In Lick and Johnson (2014), participants' overall accuracy was not affected by their diagnosticity beliefs. Participants were thus able to extract category information from faces even when they did not expect to be able to. Similarly, it is not clear if such beliefs operate early enough in processing to affect face memory.

Conversely, contextual or dispositional reactions to uncertainty might influence people's likelihood of engaging in category search. People have different baseline tolerances for ambiguity and uncertainty (e.g., causal uncertainty beliefs, need for cognitive closure; Weary & Edwards, 1994; Webster & Kruglanski, 1994) and people also sometimes actively manage uncertainty through intrapersonal processes (e.g., Hogg, 2007). In cases, where people are motivated to avoid uncertainty, they might more frequently assume socially a normative category membership at the expense of entertaining uncertainty about a category membership.

In fact, causal uncertainty beliefs might present additional means to link the kinds of effects reported here to uncertainty. People with high causal uncertainty beliefs doubt their ability to accurately assign causation and thus tend to engage in more extensive searches for causal information (Weary & Edwards, 1994). In the context of impression formation, high causal uncertainty usually reduces reliance on stereotypes because uncertainty prompts consideration of multiple different potential causes for behavior in addition to membership in a stereotyped group (Weary, Jacobson, Edwards, & Tobin, 2001). In the context of uncertain category membership, high causal uncertainty might instead lead to increased consideration of potentially category diagnostic behaviors or characteristics and thus to an increase in the influence of uncertainty.

The theoretical implications of these findings are broad. First, these findings buttress the feature selection and categorization-individuation models of facial recognition bias (Hugenberg et al., 2013; Hugenberg et al., 2010; Levin, 1996; Levin, 2000). These models correctly predicted face recognition performance under the novel antecedent circumstance of uncertainty. Such predictive ability supports the importance and efficacy of these models for understanding facial recognition bias.

At the same time, these findings suggest a refinement of theoretical treatments of motivation as an antecedent of intergroup bias in face recognition. Motivation has almost always been linked to individuation. To the extent that a target is perceived as relevant, people are willing to individuate. If a target is not viewed as relevant people rely on categorical information. Cognitive (as opposed to perceptual) bias in face recognition thus occurs because people are motivated to individuate ingroup members but not outgroup members (Hugenberg et al., 2013; Rodin, 1987; Sporer, 2001). The original articulation of the categorization-individuation model (Hugenberg et al., 2010) did emphasize one important example of people being motivated to categorize rather than individuate ingroup members (Wilson & Hugenberg, 2010), but that example is treated as a theoretically informative exception rather than an important characterization of motivation in general.

In contrast, the research reported here focuses on one everyday circumstance, uncertainty about another person's group memberships, in which active interest in another person prompts attention to category information. The current findings make clear that motivation to attend carefully to someone else and attention to categorical information are not necessarily at odds in everyday life. A full understanding of the role of motivation in facial recognition bias thus requires a more nuanced treatment of the relationship between motivation, individuation, and categorization.

Experiment 2 drew on work demonstrating an important set of circumstances in which intergroup bias in face recognition is eliminated, the case of powerful or dangerous outgroups and outgroup members (Ackerman et al., 2006; Ratcliff et al., 2011; Shriver & Hugenberg, 2010). Although Experiment 2's main purpose was to challenge alternative theoretical accounts of the main phenomenon under study here, it also suggests a boundary condition on the influence of powerful and dangerous outgroups on face recognition. Such group memberships might moderate the own-group and own-race effect only when they are certain. When powerful or dangerous group memberships are a potential rather than a certainty, cognitive effort might be expended on determining appropriate categorization rather than on individuation.

The current findings also raise important questions about the most appropriate interpretation of evidence in favor of ingroup enhancement accounts of bias in face recognition. The ingroup enhancement perspective is based on an experiment (Van Bavel et al., 2011) in which participants memorized faces belonging to the members of two teams, thus creating an ingroup and an outgroup. Participants later saw the faces they had memorized twice. On one occasion, participants had to indicate which of the faces were ingroup members. On the other, participants had to indicate which of the faces were outgroup members. Novel faces were introduced during these categorization tasks without being identified as novel. Fusiform Face Area (FFA) activity was recorded by FMRI during this task. FFA activity was greater in response to ingroup faces than in response to outgroup faces. Moreover, FFA activity in response to novel faces was similar to that present for outgroup members. These results were interpreted to mean that the processing of ingroup faces is enhanced relative to both outgroup and uncategorized faces.

In fact, introducing novel faces into a task involving the classification of recently learned faces might very well have prompted participants to wonder which team the novel face was affiliated with. That is, the procedure used to obtain evidence of ingroup enhancement could plausibly reflect uncertainty about category membership rather than baseline processing of unaffiliated faces. Because both uncertainty about group membership and outgroup membership appear to prompt similar recognition outcomes, the observed similarities in brain FAA activity does not necessarily reflect ingroup enhancement from a neutral baseline. Indeed, ingroup enhancement appears to be at odds with recent cognitive accounts of racial bias in face recognition. Sporer (2001), Levin (1996, 2000) and Hugenberg et al. (2010, 2013) all assert that unshared category membership is a feature detected by the perceptual system and the detection of unshared membership is what modifies processing. These models suggest that default processing is modified by the detection of outgroup membership rather than by the detection of ingroup membership. Note that ingroup enhancement was only one of several conclusions drawn in Van Bavel et al. (2011). The current findings do not suggest reinterpretation of any additional points.

More broadly, the current investigation expands the scientific treatment of uncertainty during person categorization. With the exception of recent work on the perception of multiracial individuals, traditional approaches to understanding categorization in person perception (Duncan, 1976; Dunning & Sherman, 1997; Fiske & Neuberg, 1990; Kunda & Thagard, 1996; Macrae et al., 1994; Sagar & Schofield, 1980) leave little room for uncertainty. The consequences of categorization occur because a category was ultimately either present or absent, applied or not applied. In fact, the work reported here suggests that uncertainty about category information can be as or more influential than the outcome of person categorization.

Indeed, the principles explored in this work most likely apply to outcomes beyond face recognition. The concept of categorization and individuation were developed in order to better understand the likelihood of and reasons for stereotyping (Fiske & Neuberg, 1990; D. L. Hamilton & Trolier, 1986; Macrae et al., 1994). Less directly, a search for category diagnostic cues shares much with characterizations of stereotypes as biasing expectancies. Just as encoding a face based on categorical features hinders later recognition, encoding behavior through the lens of categorical expectancies distorts behavior in category consistent ways (Duncan, 1976; Dunning & Sherman, 1997; Sagar & Schofield, 1980). As with face recognition, uncertainty about category information might thus emphasize category relevant information in the perception of personality and behavior at the expense of uniquely identifying information.

The practical implications of the findings reported here are succinct and straightforward. Intergroup bias in facial recognition might not require outgroup membership. Instead, simply wondering about another person's political beliefs, sexual orientation, religion, or other such category membership appears to have the potential to bias processing.

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Appendix: Analysis of Face Gender and Recognition in Experiment 1

Analysis of recognition including both same and other gender faces yields results that are difficult to interpret. A significant effect of condition (ingroup, outgroup, or uncertain) still emerges, $F(2,52) = 4.051$, $p = .023$, $\eta_p^2 = .135$, but pairwise comparisons suggest that ingroup ($M = 1.291$, $SE = .115$) and outgroup ($M = 1.230$, $SE = .116$) faces were recognized comparably well, $F(1,26) = 0.626$, $p = .436$, $\eta_p^2 = .024$, whereas faces without category information ($M = 1.058$, $SE = .123$) were recognized worse than ingroup faces, $F(1,26) = 7.029$, $p = .013$, $\eta_p^2 = .213$, and marginally worse than outgroup faces, $F(1,26) = 3.687$, $p = .063$, $\eta_p^2 = .066$. These results are thus consistent with the prediction that absent category information suppresses face recognition but fail to produce intergroup bias in face recognition based on national labels.

However, analysis of the effects of stimulus gender on the own-group effect suggests that own-gender bias distorted own-group bias based on nationality. A focused examination of group labels (ingroup or outgroup) and stimulus gender (same or other) yielded a significant interaction, $F(1,26) = 6.600$, $p = .016$, $\eta_p^2 = .202$. In this interaction, simple main effects showed differences between national ingroup faces ($M = 1.579$, $SE = .142$) and national outgroup faces ($M = 1.242$, $SE = .133$) for same-gender targets, $F(1,26) = 7.259$, $p = .012$, $\eta_p^2 = .218$, but not for opposite gender targets (national ingroup $M = 1.004$, $SE = .154$; national outgroup $M = 1.219$, $SE = .134$), $F(1,26) = 2.415$, $p = .132$, $\eta_p^2 = .085$. Similarly, comparison of recognition for same and other gender faces showed significant cross-gender bias among national ingroup members, $F(1,26) = 14.867$, $p = .001$, $\eta_p^2 = .364$, but not among national outgroup members, $F(1,26) = 0.029$, $p = .866$, $\eta_p^2 = .001$. These results are consistent with past evidence indicating that multiple category distinctions do not necessarily combine additively to influence face recognition (Ray et al., 2010; see also Chiroro, Tredoux, Radaelli, & Meissner, 2008; Shriver, et al., 2008). Rather, the presence of a single outgroup membership appears to have the potential to cause relatively poor recognition.

What is the most appropriate analysis strategy in light of the dependency between own-group national bias and own-gender bias? Own-group effects have been documented with a large variety of ingroup-outgroup distinctions (Bernstein et al., 2007; Ray et al., 2010; Rule et al., 2007; Rule et al., 2010a; Van Bavel & Cunningham, 2012), including German and French nationality among German participants (Ray & Matschke, 2012). Similarly, own-sex effects have been widely replicated, particularly among female perceivers (Herlitz & Loven, 2013). As both the own-group and own-sex effects are observable in the data reported here only when competing outgroup memberships are absent, and as competing outgroup memberships have documented potential to contaminate the effect on face recognition of a focal category distinction, consideration of only same gender faces provides appears to be the most appropriate approach to understanding the influence of stimulus nationality in Experiment 1. In light of this conclusion, all later experiments adopted gender-matched stimulus faces (i.e., female participants saw only female faces and male participants saw only male faces).

Note that this decision was not meant to imply that the influence of gender on face recognition was uninteresting. To the contrary, the influence on face recognition of category combinations involving not only gender but also age, race, and additional concealable category memberships is an important and relatively unexplored area of research. It is, however, an area perhaps best addressed through dedicated investigation.