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The Effect of Knowledge about a Group on Perceived Group Variability and Certainty about Stereotype-Based Inferences

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Abstract

People often learn about categories, particularly social categories, based on biased information. Unless people are able to correct for this, they may develop biased beliefs and inferences about these categories. The current research examines if potentially biased information about social groups makes groups appear more homogeneous, and makes people more confident in their inferences about group members. Two sources of biases are considered: due to lacking first-hand experience with a group, or due to having second-hand information from the media or other people. Both sources made groups appear more homogeneous, suggesting that information biases were present and not corrected for. However, only second-hand knowledge led to greater confidence about group members, because, when people lacked first-hand knowledge, their uncertainty about the group average counteracted this effect. This highlights the importance of understanding biases present in people's information, and corrective processes that may allow people to continue to make unbiased inferences.

Keywords: Categories; Inference; Stereotypes; Variability; Homogeneity; Certainty; Bias

People have an amazing ability to pick up on regularities in the world, and can use this to form beliefs about categories and make inferences based on them in ways that are often in line with statistical principles (Griffiths et al., 2008). This applies in general, and can also apply when people form beliefs about social groups (Jussim, 2017), i.e. 'stereotypes' (Ashmore & Del Boca, 1981). For example, people might learn from experience how tall men and women are on average, and how much variability there is in each group's height. In this case, people can likely form unbiased beliefs about these properties: beliefs that are accurate on average across people, rather than systematically deviating from the truth. This is in part because people most people have met enough men and women to have large amounts of good-quality information about men and women's heights. More specifically, this information is likely unbiased, so that the distribution of heights that people know about (the 'sample distribution'), does not systematically differ across people from the true distribution of each gender's heights (the 'population distribution').

However, in many cases, people form beliefs about groups based on biased information that systematically misrepresents the group. For example, most people have not met many transgender people, or, depending where someone lives, they might not meet many people from other countries. In these cases, people may lack information about these groups, especially first-hand information learned from personal experience with group members. The information people do have can then be biased, because their limited experience is less likely to reflect the full range of a group's variability (Konovalova & Le Mens, 2020; Linville et al., 1989). People might also learn about groups through second-hand information, such as from the media or what other people say. Second-hand information can be an important source of cultural transmission of knowledge, and has been found to lead to accurate category knowledge, at least in experiments with artificial categories and where people are motivated to pass on accurate information (Chopra et al., 2019). Yet with real-world social groups, communicators will often have other goals, which can lead to biases in the information they pass on. In particular, people often selectively convey stereotype-consistent information (Kashima, 2000), so that second-hand information could also fail to reflect a group's full variability. Thus, both a lack of first-hand information and the presence of second-hand information about a group can lead to biases that portray groups as less variable (more homogeneous) than they actually are.

Biased information could bias people's beliefs, so that groups are perceived as more homogeneous, which could in turn increase people's confidence when using stereotypes to make inferences about group members. This could increase the potential impact of these stereotypes, including their negative societal consequences. On the other hand, it is also possible that people's information could contain these biases without affecting their beliefs or inferences (Wegener et al., 1998; Whalen et al., 2018). If people realize (consciously or unconsciously) that these information biases exist, they might be able to correct for them, so that groups are not perceived as overly homogeneous. Even if groups are perceived as overly homogeneous, people could also counteract the consequences of this by reducing certainty in their inferences, so that they are not more confident when applying stereotypes to group members. Therefore, the main question this paper will address is whether or not these potential sources of information biases – due to the lack of first-hand information or the presence of second-hand information – make groups appear more homogeneous, and

make people more confident when applying stereotypes to group members.

Understanding when biased information will affect people's confidence or certainty in their stereotype-based inferences is important, because this is a powerful determinant of how impactful these stereotypes will be. In particular, we focus here on people's certainty that someone will have a particular degree of an inferred characteristic – for example, someone might guess that a man they have never met will be 1.7m tall (the average height of men), and they could be more or less certain that this man is exactly that height. If people are more certain when using stereotypes to infer what a group member is like, this should amplify the effects of the stereotype, as people should be more likely to act based on their inferences, and less likely to consider other information that might counteract the stereotype (Tormala, 2016).

People's confidence about what a group member is like depends on their beliefs about the group, and this can often occur in ways that suggest people are following principles of statistical inference. At least two different aspects of these beliefs should matter. The first is how homogeneous a group is thought to be (e.g. how similar men are in terms of their height). Several studies have found that when groups are seen as more homogeneous – that is, less variable on some characteristic – people are more certain about what members of that group are like (Figure 1a; Park & Hastie, 1987; Ryan et al., 1996). This makes sense statistically, because, if the group really is more homogeneous, group members are more likely to be similar to the group average. A second aspect of people's beliefs that likely matters is how certain people are about the group average (e.g. how certain someone is that the average height of men is 1.7m). When people are more certain about what a group is like on average, they should also be more certain that a particular group member will be similar to their estimate of the group average (Figure 1b). On the other hand, if someone has no idea what a group is like on average, they should have little confidence in inferring what that person is like solely based on their group membership. These two aspects of beliefs about groups are not fully independent. Instead, people tend to be more certain about the group average when a group is seen as more homogeneous (Figure 1c; Lambert et al., 2004). This also makes sense statistically, because if everyone in a group is the same, one can know for sure what the group is like on average even from just knowing about one person. This relationship means that seeing a group as more homogeneous can therefore increase certainty about group members through two paths: both directly, and indirectly through increasing certainty about the group average (Figure 1a-c). This is broadly consistent with work on the entitativity or coherence of categories (the degree they are seen as an entity, or to have features that 'fit together'). This work suggests that these types of categories, which tend to be seen as more homogeneous, are also used
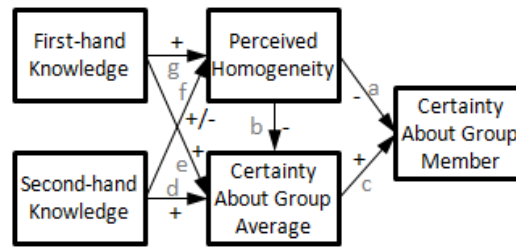

Figure 1: Hypothesized relationships. Directions of predicted relationships are indicated by a + or –.

more strongly to generalize to individual category members (Patalano et al., 2006; Yzerbyt et al., 2004).

This work suggests that people often use their beliefs about groups in statistically reasonable ways to determine their certainty about individual group members. However, these beliefs themselves could be biased, perhaps due to receiving biased information. In line with this, unfamiliarity with a group[1] has been proposed to make groups appear overly homogeneous, in part because of biases in people's information when they only have small amounts of information (Konovalova & Le Mens, 2020; Linville et al., 1989). This is based on the statistical fact that sample variance tends to be smaller than population variance, and this is especially true for small sample sizes. This means that if someone has only met a few people in a group, they are especially unlikely to have met anyone who is an extreme outlier, simply because those outliers are less common. If people then use the variability of the known group members directly to estimate the variability of the group, people should tend to think the group is overly homogeneous. This bias will get reduced as one meets more people, implying that when people are less familiar with a group, the group should appear more homogeneous than when they are more familiar with it (Figure 1g). This tendency may in part account for other known biases in perceived group homogeneity (Konovalova & Le Mens, 2020; Linville et al., 1989), as people may often be less familiar with outgroups, minority groups, and lower-status groups, and thus also perceive them as overly homogeneous (Boldry et al., 2007; Mullen & Hu, 1989; Ostrom & Sedikides, 1992).

Putting all this together, this work suggests that people tend to be more confident when applying stereotypes to members of unfamiliar groups, because those groups may seem overly homogeneous. This could occur when people lack either first-hand or second-hand knowledge, though it may be particularly relevant for unfamiliarity due to a lack of first-hand knowledge, because second-hand knowledge may contain additional biases that could overwhelm these

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[1] Though unfamiliarity is used to refer to lack of knowledge from any source of information (first-hand or second-hand; Linville et al., 1989), it has typically been operationalized as a lack of first-hand knowledge (e.g. Park et al., 1992).

effects. Therefore, hypothesis 1 is as follows: on average, when people lack first-hand knowledge about a group, the group will seem more homogenous, and people will be more confident about group members. Though previous research rarely states this hypothesis explicitly, it is implied when the consequences of perceived homogeneity, such as increased stereotyping, prejudice and discrimination, are used to explain the importance of studying the causes of biases in homogeneity (Linville et al., 1989; Ostrom & Sedikides, 1992).

Though unfamiliarity may lead to biased information, biases in people's information do not necessarily lead to downstream consequences. One possibility is that these biases could be corrected for, so that unfamiliar groups do not appear more homogeneous. In statistics, with a simple change to the formula for variance (using N-1 rather than N in the denominator), sample variance can be used to compute an unbiased estimate of population variance. There is no theoretical reason that people cannot make a similar correction (Konovalova & Le Mens, 2020). Furthermore, while some empirical research shows that unfamiliar groups are seen as more homogeneous (Linville et al., 1989; Ryan et al., 2001; Ryan & Bogart, 1997), there are several null results (e.g. Guinote, 2001; Ryan et al., 2001). These null results may indicate that people may be correcting for this biased information when forming their beliefs about a group's homogeneity. However, it is also possible that previous research simply lacked the power to reliably find effects. Therefore, it remains unclear whether unfamiliarity makes groups seem more homogeneous, or whether people can correct for any biased information due to unfamiliarity.

Even if unfamiliarity does bias homogeneity, people might be able to counteract its effects farther downstream, so that they are not more confident when making inferences about group members. The intuition here is that, if someone has never met anyone from a particular group, such as people from Madagascar, they should be less confident about what members of that group are like, not more confident. This could be accounted for in the current model if a lack of first-hand knowledge makes people less certain about what the group is like on average (Figure 1e). This could then counteract effects of seeing the group as overly homogeneous, so that, in total, a lack of first-hand knowledge may lead to little or no increase in certainty about group members. Existing research has not actually tested this, because it has only looked at either causes or consequences of perceived homogeneity in isolation (e.g. Park & Hastie, 1987; Rubin & Badea, 2012). Thus, even if the individual effects found in previous research hold (i.e. unfamiliarity increases perceived homogeneity, and perceived homogeneity increases certainty about group members), considering causes and consequences simultaneously, along with potential counteracting factors that could be affected by those same causes, could provide a very different picture than studying them in isolation.

Aside from personally interacting with group members, people may also learn about groups through second-hand information, for example, through the media, or from what other people say. Though these sources of second-hand information might function similarly to first-hand information, they can also contain their own set of biases. One bias that that second-hand knowledge may show is highlighted by research on stereotype communication. This research finds that, in serial reproduction tasks, where a story is retold and passed on through a chain of people, people tend to mostly pass on stereotype-consistent information (e.g. Kashima, 2000; but see e.g. Simpson & Kashima, 2013). This can serve various communication goals, such as finding common ground (Klein et al., 2010), or informing others about stereotypes (Lyons & Kashima, 2003). This tendency to pass on stereotype-consistent information suggests that second-hand information may be biased to not reflect the full variability of a group (Figure 1f). Therefore, hypothesis 2 suggests that, on average, having more second-hand knowledge about a group can make the group seem more homogeneous, which in turn can make people more confident in their inferences about group members.

It is also possible that more second-hand knowledge might not make groups seem more homogeneous. If people are aware that information from the media or other people tends to portray groups in overly homogeneous ways, they could mentally correct for this biased information so that their beliefs remain unbiased. Another reason this effect might not be observed is that unfamiliarity with a group, in terms of lacking second-hand information, could also bias groups to appear overly homogeneous. Depending on the relative size of these different possible biases, this could reduce or reverse any tendency for groups to seem more homogeneous when people have more second-hand knowledge about them.

Even if groups are seen as more homogeneous when people have more second-hand knowledge about them, what about the possibility of counteracting this so it does not increase certainty about group members? In this case, this seems unlikely to happen. This is because, unlike when people lack knowledge, having knowledge, even if second-hand, should make people more confident about the group average (Figure 1d). Both of these effects of second-hand knowledge should make people more confident about group members, so that, unlike with a lack of first-hand knowledge, there is no way that these effects can counteract each other.

The current research will test these hypotheses by examining the proposed path model (Figure 1). Within this, we focus on if these two potential sources of biased information – due to a lack of first-hand knowledge, or the presence of second-hand knowledge – make groups seem more homogeneous, and make people more certain when applying stereotypes to group members. Though these studies use cross-sectional observational data, and therefore cannot test the causal direction of these effects, the results can provide evidence for whether the proposed relationships

exist, or whether these information biases are instead corrected for or counteracted, leading to no relationships.

Preregistration and Online Materials

Hypotheses, sample size, and exclusion criteria were preregistered. Some minor modifications were made from the preregistered analysis plan. Details of these changes and results of the preregistered analyses are reported online; results here are consistent with those from the original plan. Note that preregistration on the Open Science Framework (OSF) website was intended to be done prior to data collection, but due to an error a blank preregistration was created at the time and the correct files were uploaded later. The preregistration, materials, raw data, analysis scripts, and additional results are available online at https://osf.io/kv7er/. Two follow up studies are also detailed online.

Methods

Overview

The hypothesized relationships were tested by investigating people's perceptions of various social groups that differed widely in the amount and type of knowledge participants were likely to have about them. For each group, participants made explicit ratings of each variable included in Figure 1.

Participants

103 participants (64 female, 36 male, 3 unspecified) from the Rotman School of Management participant pool participated for course credit. Three participants were excluded: two did not complete the experiment due to time constraints, one because the program crashed. Sample size was decided a priori of at least 100 participants with usable data. A power analysis based on pilot data showed that this lead to greater than 99% power to find all hypothesized effects, assuming the same effect sizes as in the pilot data.

Social Groups

Participants completed a computerized survey where they answered questions about various social groups. 24 groups were used that were intended to fall into three conditions: high on both first-hand and second-hand knowledge (e.g. high school teachers), low on both types of knowledge (e.g. people from Madagascar), or high on second-hand but low on first-hand knowledge (e.g. politicians). Participants' knowledge ratings were used in analyses, so the accuracy of the intended condition assignment for each group is not essential. Groups in each knowledge condition were evenly divided among different types of groups: careers, nationalities, subjects of university study, and hobbies. Participants also had the option to list their own nationality (if not included already) and up to 3 of their hobbies. These were used to attempt to find groups where participants would have more first-hand than second-hand knowledge.[2]

Certainty and Variability Ratings

For each group used in the study, participants answered several questions about the personality of members of that group. A single randomly-assigned personality trait was used for all ratings (extraversion, organization, adventurousness, or creativity)[3]. Participants rated the personality of a random member of this group and their certainty in this rating. They then rated the average personality of the group as a whole, their certainty in that rating, and how similar they thought members of this group were to each other on that personality trait. All questions were answered on continuous scales from 0 to 100, first for the 24 pre-generated groups (groups randomly ordered). After this participants could list their own groups, and then rated the personality of these groups.

Knowledge Ratings

Participants then reported how much knowledge they had about each group's personality. This was broken into three questions to measure different sources of knowledge: their amount of overall knowledge (i.e. based on any source of information), first-hand knowledge (i.e. based only on personal experience interacting with that group), and second-hand knowledge (i.e. based only on other sources of information, such as general knowledge, media, and what others have said about this group). Each question was rated on a 7-point Likert scale (1='None at all', 4='A moderate amount', 7='A great deal'). The 24 pre-generated groups were rated first in a randomized order, and any self-generated groups were rated after, in the order they had been listed. After this, participants reported if they did not understand the meaning of any of the pre-generated groups.

Analysis

Data Preparation

Responses to a particular social group were excluded for participants who reported that they did not understand what the group meant, or who did not answer all questions used in the analyses (5% of data excluded).

Path Analysis

Data were analyzed using multilevel modelling with random intercepts included for each participant. The primary path model is specified in Figure 2. Specifically, this involved three regression models: 1) predicting certainty about group members from perceived homogeneity, certainty about the group average, first-hand knowledge, and second-hand

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[2] All results held when analyzing effects within each group, so other differences between groups did not fully account for results.

[3] Note that this meant traits were not necessarily equally stereotype-relevant for all groups, which was done in part because people may not have strong stereotypes about unfamiliar groups. Two additional studies reported on OSF largely replicated the results here using stereotypical and counterstereotypical traits specific to each group.

knowledge; 2) predicting perceived homogeneity from first-hand knowledge and second-hand knowledge; 3) predicting certainty about the group average from first-hand knowledge and second-hand knowledge. Indirect effects were assessed via computing the product of path coefficients, and total effects as the sum of these. Confidence intervals for these were computed using bias-corrected & accelerated bootstrap intervals with stratified sampling based on participants as strata.
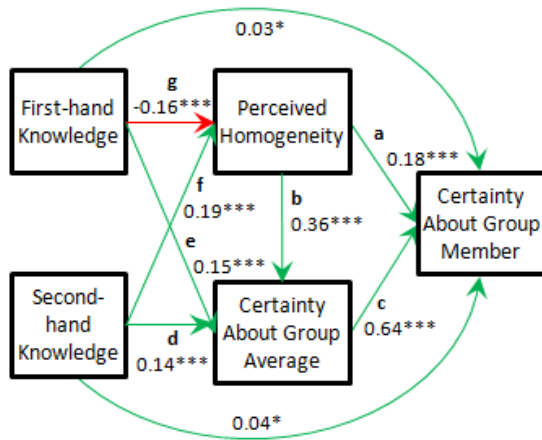
Results

Figure 2. Results. Standardized coefficients shown. *** indicates p < .001. * indicates p < 0.5. Green and red lines indicate positive and negative coefficients, respectively.

Effects of Homogeneity and Certainty about Group Average

Before examining potential sources of biases in people's information about groups, we examined whether the perceived homogeneity of a group, and one's certainty about the group average affected confidence in people's stereotype-based inferences in the expected ways. As expected, people were more certain about a group member's traits when the group was perceived as more homogeneous (Figure 2a: $\beta = 0.17$, $p < .001$), and when people were more certain about the average level of the group's traits (Figure 2c: $\beta = 0.65$, $p < .001$). Furthermore, when the group was seen as more homogeneous, people were more certain about the group average (Figure 2b: $\beta = 0.33$, $p < .001$), supporting the idea that homogeneity can increase certainty about group members both directly, and indirectly through increasing certainty about the group average. These results suggest that participants adjust their certainty about group members based on their beliefs about the group in ways that are consistent with statistical principles

Effects of a Lack of First-Hand Knowledge

These beliefs about groups – in particular, about a group's homogeneity – might in turn show biases based on the type and amount of information people have about the group. One potential source of bias in perceived homogeneity is due to a lack of first-hand knowledge. Consistent with previous theories of unfamiliarity (Linville et al., 1989), in this study, when people lacked first-hand knowledge about a group, they perceived it to be more homogeneous (Figure 2g: $\beta = -0.14$, $p < .001$).[4] This provides evidence that biases due to lack of first-hand information can increase perceived homogeneity, and are not immediately corrected for.

This increased perceived homogeneity could lead to greater certainty when applying stereotypes to group members; however, it might also get counteracted if people are also less certain about what the group is like on average. In line with this second possibility, when people lacked first-hand knowledge, they were less certain about the group average (Figure 2d: $\beta = 0.14$, $p < .001$). This should counteract any consequences of increased perceived homogeneity, so that a lack of first-hand knowledge should produce little or no increase in certainty about group members. In line with this, in total, when people had less first-hand knowledge about a group, they were not more certain about group members, and were in fact very slightly less certain ($\beta = 0.05$, 95% CI [0.01, 0.06]). Therefore, in contrast to hypothesis 1, lacking first-hand knowledge did not lead to greater confidence about group members, despite groups appearing more homogeneous.

Effects of Second-Hand Knowledge

Learning about groups through second-hand information could also potentially lead to biases that make groups seem more homogeneous, and make people more certain when applying stereotypes to members of those groups. To test this possibility, the effects of second-hand knowledge on perceived homogeneity were examined. As the work on stereotype communication suggests, when people had more second-hand knowledge about a group, the group seemed more homogeneous (Figure 2f: $\beta = 0.17$, $p < .001$). This supports the idea that biases in information people receive from others can portray groups as overly homogeneous, and that these biases are not immediately corrected for.

These biases were further expected to have downstream effects, in terms of increased confidence about group members. This is because second-hand knowledge should also increase certainty about the group average, rather than decreasing it as in when people lack first-hand knowledge, so there is nothing to counteract the effects of biases in homogeneity. In line with this, when people had more second-hand knowledge about a group, they were more certain about the group average (Figure 2d: $\beta = 0.14$, $p < .001$). These two effects should work together to make people more certain about what group members are like. Consistent with this, in total, people were more certain

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[4] This did not reliably replicate in follow up studies (see OSF).

about group members when they had more second-hand knowledge about a group ($\beta = 0.18$, 95% CI [0.11, 0.18]). These results support hypothesis 2: biases in second-hand knowledge can make groups seem more homogeneous, which can lead to greater certainty when using stereotypes to make inferences about members of those groups.

Mediation

Providing further support that the proposed path model accounts for these effects, all indirect effects were significant and nearly fully mediated the relationship between both types of knowledge and certainty about group members. (See details on OSF.)

Discussion

This paper investigated if potential biases in the information people have about social groups affect people's beliefs about those groups and inferences about group members, or if instead these biases can be corrected for or counteracted. Specifically, it focused on whether two potential sources of biased information – lacking first-hand knowledge or having second-hand knowledge – could make groups appear more homogeneous, and if this in turn would lead to downstream increases in how certain people were when applying stereotypes to group members. A lack of first-hand knowledge was found to make groups appear more homogeneous; however, this did not replicate reliably in follow up studies. Furthermore, even though homogeneity was increased, a lack of first-hand knowledge was not associated with greater certainty about group members, because this was in part counteracted by their greater uncertainty about the group average. On the other hand, second-hand knowledge was consistently linked to seeing groups as more homogeneous and being more confident when applying stereotypes to group members. This suggests that biases in the information people get from second-hand sources are not being corrected for, therefore biasing beliefs about a group's homogeneity. Furthermore, downstream consequences on certainty about group members were not counteracted, as second-hand knowledge also made people more certain about the group average, further increasing certainty about group members.

Turning again to first-hand knowledge, the inconsistent effect of first-hand knowledge on homogeneity in the present set of studies parallels the inconsistent results of previous research on this topic. The current study may have been especially able to find this effect by choosing groups that covered a wide range of first-hand knowledge, leading to larger effect sizes. In line with this. at least one study reported a lack of variation in how familiar participants were with the groups involved (Guinote, 2001), an issue which could have plagued other studies and led to overall smaller or less reliable effects. The current results suggest then that at biases due to unfamiliarity at least sometimes can affect beliefs without being immediately corrected for.

However, even if a lack of first-hand knowledge makes groups appear overly homogeneous, the current research highlights a way that people reduce the impact of this bias. When people lack first-hand knowledge about a group, they can counteract any increased certainty about group members through their corresponding uncertainty about the group average. In other words, the same conditions that may lead to biases in perceived homogeneity also allow people to counteract its consequences, perhaps because they recognize that their stereotype is based on unreliable or biased information. The fact that the same situations that cause biases can also enable people to avoid their consequences is an important point, and could apply to many other biases. This shows the importance of not just identifying biases in isolation, but studying them within their broader context, simultaneously considering their causes, consequences, and potential counteracting factors that may also be affected.

While the current results imply that biases due to unfamiliarity may be less impactful than previously suggested, they also imply that second-hand knowledge may be a much greater source of bias, one which has not been considered much in research on perceived homogeneity. The current results provide the first evidence that second-hand knowledge is associated with social groups appearing more homogeneous, and with people having greater certainty when applying stereotypes, across a range of real-world. This extends previous research using serial reproduction tasks which showed that people tend to communicate primarily stereotype-consistent information (e.g. Kashima, 2000): the current work directly tests the consequences for perceived homogeneity and certainty, and also shows that these biases are not constrained to serial reproduction tasks, but occur across the range of ways that people can learn from others in the real-world. Though the current research considered effects of second-hand knowledge broadly construed, future research could continue to explore exactly when and why second-hand knowledge has these effects (as in Simpson & Kashima, 2013), and when people might be able to correct for biases in second-hand information (as in Whalen et al., 2018).

Future research can also examine if these results extend similarly to non-social categories. While unfamiliarity may function similarly in both cases, biases due to second-hand information may depend on people's communication goals, which could differ for social versus non-social categories. People often learn about categories, particularly social categories, in conditions of less-than-ideal information, such as when they lack first-hand experience with a group, or when they learn about a group through second-hand information sources. These conditions can lead to biases in the information people receive. The current results show that biases in people's information can lead to biases in how homogeneous groups are believed to be, and this in turn can make people more confident when applying stereotypes to individuals. However, these results also show that this may not always occur. Thus, rather than assuming that biases in information or beliefs will have important consequences, we must study when they are more or less impactful, in full consideration of people's potential for self-correction.

> **Comment [U1]:** I cut out large chunks of the discussion if you want to do a quick skim and see if what I kept seems reasonable.

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