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A Cognitive-Ecological Explanation of Intergroup Biases

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Abstract
People often hold negative attitudes toward out-groups and minority groups. We argue that such intergroup biases may result from an interaction of basic cognitive processes and the structure of the information ecology. This cognitive-ecological model assumes that groups such as minorities and out-groups are often novel to a perceiver. At the level of cognition, novel groups are primarily associated with their unique attributes, that is, attributes that differentiate them from other groups. In the information ecology, however, unique attributes are likely to be negative. Thus, novel groups, and by proxy minorities and out-groups, tend to be associated with negative attributes, leading to an evaluative disadvantage. We demonstrated this disadvantage in three experiments in which participants successively formed impressions about two fictional groups associated with the same number of positive and negative attributes. Participants preferred the first group over the novel group as long as the groups' unique attributes were negative.

Keywords
learning, minority groups, preferences, prejudice, stereotyped attitudes, open data, open materials

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Intergroup conflict is ubiquitous and manifests itself at almost every level of society. Group conflicts begin at the subtle level of perception and cognition, by a division of the world into "us" and "them" and a preference for "us" over "them." This tendency is known as intergroup bias and manifests itself on the level of attitudes (prejudice), cognition (stereotypes), and behavior (discrimination). Social psychological research has identified two almost universal tendencies. First, people hold more negative attitudes toward out-groups (e.g., rival universities, sport teams, foreign countries) compared with in-groups. Second, people hold more negative attitudes toward minority groups (e.g., refugees, Muslims, African Americans) compared with majority groups. Most existing explanations for these intergroup biases refer to some kind of motivated information processing within the social perceiver (Hewstone, Rubin, & Willis, 2002). For example, intergroup biases may reflect the human motivation to achieve or maintain a positive social identity (Tajfel & Turner, 1979), optimal distinctiveness (Brewer, 1991), social dominance (Pratto, Sidanius, & Levin, 2006), or self-preservation (Greenberg et al., 1990).

Alternatively, we present a cognitive-ecological model that predicts intergroup biases without perceivers' motivations, but based on the interaction of basic cognitive principles of learning and the structure of the information ecology (Fiedler, 2000). The model starts with the observation that negatively evaluated groups such as minorities and out-groups are often novel groups (Halberstadt, Sherman, & Sherman, 2011; Sherman et al., 2009). That is, people usually come in contact with, and form impressions about, out-groups (e.g., foreign nations) and minorities (e.g., African Americans, Muslims) only after they have already formed impressions about in-groups (e.g., family, fellow citizens) and majorities (e.g., Whites, Christians). The model then combines well-established cognitive principles of learning with recently formulated theories about the structure of the information ecology. The cognitive part assumes that novel groups are associated

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with attributes that differentiate them from other groups (i.e., unique attributes). The ecological part assumes that because of structure of the information ecology, unique attributes are more likely to be negative than positive (Alves, Koch, & Unkelbach, 2017a). Consequently, because novel groups are associated with their unique attributes, they suffer an evaluative disadvantage. We delineate these assumptions in more detail in the following sections.

The Cognitive Principle of Differentiation

The model's cognitive part relies on well-established research showing that learning, categorization, and comparison processes primarily rely on unique attributes, that is, attributes that differentiate between persons, groups, or objects. For example, when people form associations between categories (e.g., groups) and their attributes, more attention and weight is given to attributes that heighten between-category differences rather than between-category similarities (Krueger & Clement, 1994; Krueger, Rothbart, & Sriram, 1989). Hence, during category formation, unique attributes receive more attention and weight and ultimately define a category (Tversky & Gati, 1978).

Whether attributes are unique or not depends on the attributes already associated with existing categories. This implies that learning, categorization, and comparison processes are sensitive to temporal order. Kruschke (1996, 2001, 2003) delineated this principle in his attentional-learning framework. People flexibly shift their attention from already-known (shared) attributes to novel (unique) attributes and form associations accordingly. Sherman and colleagues (2009) applied this principle to stereotype formation and showed that when a frequent and an infrequent group share an attribute, this attribute is more strongly associated with the frequent group. The authors suggested that this happens because the frequent group occurs earlier in the learning sequence, and they concluded that "once a trait is taken by one group, the association of the trait with other groups may be inhibited" (p. 321). Crucially, research on comparison processes found that such order effects also apply to evaluations, as recently encountered options are evaluated on the basis of how they differ from earlier encountered options (Hodges, 2005; Houston, Sherman, & Baker, 1989; Tversky, 1977).

We can thus expect novel groups to be associated with and to be evaluated on the basis of their unique attributes. Next, we introduce the ecological perspective and argue that unique attributes are usually negative attributes, as a statistical necessity. Our reasoning follows from two well-established asymmetries in the information ecology. Negative attributes (and behaviors) are more diverse than positive attributes, and positive attributes (and behaviors) occur more frequently than negative attributes.

Ecological Diversity and Frequency of Positive and Negative Attributes

Negative attributes are more diverse than positive attributes—that is, there are more ways to be bad than to be good (Alves, Koch, & Unkelbach, 2017b; Alves et al., 2015; Gräf & Unkelbach, 2016; Koch, Alves, Krüger, & Unkelbach, 2016; Unkelbach, 2012; Unkelbach, Fiedler, Bayer, Stegmüller, & Danner, 2008). For example, while faces can be unattractive in many different ways, there are only a few ways to be attractive (Langlois & Roggman, 1990; Potter, Corneille, Ruys, & Rhodes, 2007). This principle also applies more generally to individuals', groups', and objects' attributes (e.g., traits, behaviors, features; Alves, Koch, & Unkelbach, 2016; Koch, Imhoff, Dotsch, Unkelbach, & Alves, 2016).

While negative attributes are more diverse, positive attributes occur more frequently. Most people behave positively most of the time and usually display positive attributes (Edwards, 1953; Hamilton & Gifford, 1976; Wood & Furr, 2016). Consequently, people typically evaluate others positively (Greenberg, Saxe, & Bar-Tal, 1978; Rothbart & Park, 1986), and people expect others to behave positively (Sears, 1983).

Both asymmetries are also mirrored in language. While the vocabulary for negative words, such as trait words, is more diverse (Leising, Ostrovski, & Borkenau, 2012; Schrauf & Sanchez, 2004), positive words are used more frequently (Augustine, Mehl, & Larsen, 2011; Dodds et al., 2015).

Unique Attributes Are Negative

If negative attributes are more diverse and less frequent than positive attributes, it follows that a given person's or group's unique attributes are more likely to be negative than positive, a consequence that has been overlooked so far. To illustrate this reasoning, we implemented our assumptions in a simple feature model with present/absent attributes (Tversky, 1977).

Let us assume two groups, A and B, that display positive and negative attributes. Figure 1 illustrates the groups' attribute profiles with simplified attribute vectors. Some attributes are present (filled squares), and some are absent (unfilled squares). Figure 1a illustrates the effect of differential diversity while holding frequency constant: Both groups display two positive and two negative attributes. Implementing the greater diversity of negative attributes, the attribute vectors include

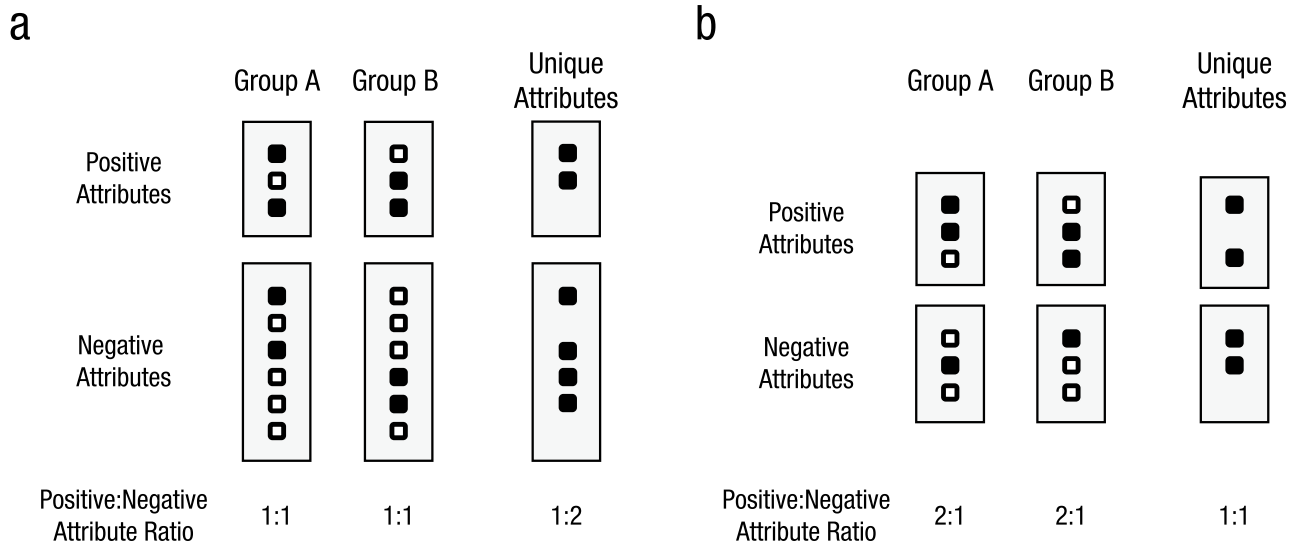

Fig. 1. Schematic illustrating a feature-based attribute model that depicts the greater diversity of negative attributes (a), the greater frequency of positive attributes (b), and the resulting overrepresentation of negative attributes among unique attributes. Filled squares indicate attributes that are present; unfilled squares indicate attributes that are absent.

twice as many negative attributes (three positive, six negative). Consequently, although the frequency of positive and negative attributes is the same (1:1 positive:negative ratio), the group's unique attributes are more likely to be negative (1:2 positive:negative ratio). This effect follows probabilistically as long as negative attributes are more diverse.

Figure 1b illustrates the effect of differential frequency while holding diversity constant: There are three positive and three negative attributes within the groups' attribute vectors, but both groups have more positive (two) than negative (one) attributes. This prevalence of positive attributes (2:1) is likely attenuated among unique attributes (1:1). Alves and colleagues (2017a) provide a detailed mathematical formulation and simulations of this principle.

The larger diversity and lower frequency of negative attributes thus independently contribute to the overrepresentation of negative attributes among unique attributes, although both principles should apply simultaneously. Hence, if (a) novel groups are associated with and evaluated on the basis of their unique attributes and (b) unique attributes are likely to be negative, then people can be expected to form negative impressions about novel groups and thereby derogate outgroups and minorities.

Overview of Empirical Tests

To test the present cognitive-ecological model, we showed participants two different fictional groups ("alien tribes") and received information about their members' attributes. This paradigm provides a simplified experimental analog to associating attributes with groups. Participants learn about one group first and then learn about a novel group before they indicate which group they prefer.

Within this attribute-learning paradigm, we manipulated the structure of the information ecology, the main causal factor in our model. Experiment 1 directly manipulated the valence of the alien groups' unique and shared attributes. We expected preferences for the first group when unique traits were negative and shared attributes were positive. We expected the reverse when unique attributes were positive and shared attributes were negative. Experiments 2 and 3 manipulated the valence of unique and shared attributes indirectly by varying the diversity (Experiment 2) and frequency (Experiment 3) of positive and negative attributes (see Fig. 1) within the groups' information ecology.

Trait-Learning Paradigm

In all three experiments, we asked participants to imagine traveling to a remote planet where they encounter an alien tribe. On each trial, they would encounter one member of the tribe along with a trait describing the alien. After participants had encountered all members of the alien tribe, they were presented with a summary list of the alien tribe's traits. Then participants were instructed to imagine that they would travel on and encounter another alien tribe. Participants were told that they would again encounter several members of this tribe along with information about their traits. After participants encountered all members of this novel tribe, they were presented with a summary list of the tribe's traits. At the end, participants saw the pictures of both alien tribes next to each other and were asked "If you had to decide, which of the two tribes do you prefer?" Participants indicated their preferences by clicking one of two buttons. Detailed information about the experimental procedures in all three experiments can be found in the Supplemental Material available online.

Experiment 1

Method

We recruited 210 participants via Amazon Mechanical Turk in order to obtain sufficient statistical power (> .80) to detect small-to-medium-sized effects in a between-participants design with two conditions. Each participant was randomly assigned to one of two learning scenarios: Each of the two alien tribes displayed either three shared positive and three unique negative traits or three shared negative and three unique positive traits.

Results

As predicted, when shared traits were positive and unique traits were negative, most participants preferred the first tribe over the second tribe (first: n = 68; second: n = 36). In contrast, when shared traits were negative and unique traits were positive, most participants preferred the second tribe over the first tribe (first: n = 44; second: n = 62), $\chi^2(1, N = 210) = 12.02$, $p < .001$; $\varphi = -.24$.

Experiment 2

Method

Experiment 2 manipulated the diversity of positive and negative traits. As outlined above, this differential diversity probabilistically determines the valence of shared and unique traits (see Fig. 1a). Hence, we indirectly manipulated the valence of shared and unique traits via the differential diversity of positive and negative attributes within the information ecology. That is, two conditions varied whether the positive or negative traits were drawn from sets of high or low diversity (see Fig. 1). Specifically, in the *negative-diverse* condition, each alien tribe's 3 positive traits were drawn from a set of 4 traits, while 3 negative traits were drawn from a set of 16 traits. The positive traits were therefore more likely to be shared by both tribes, while the negative traits were likely to be unique. In the *positive-diverse* condition, the trait set sizes were reversed. The positive traits were therefore more likely to be unique, while the negative traits were likely to be shared.

On the basis of our model (see Fig. 1), we predicted a preference for the first group in the negative-diverse condition and a preference for the second group in the positive-diverse condition. We aimed to collect data from 210 participants but ultimately collected data from 223 participants who were students at the University of Cologne. Participants were randomly assigned to conditions.

Results

As predicted, most participants preferred the first over the second tribe (first: n = 80; second: n = 32) when negative traits were diverse. When positive traits were more diverse, only about half of participants preferred the first over the second tribe (first: n = 58; second: n = 53). While participants' preferences did not reverse in the positive-diverse condition, the association between condition and preference was nevertheless significant, $\chi^2(1, N = 223) = 8.69$, $p = .003$; $\varphi = -.20$.

The diversity manipulation is not a deterministic manipulation of the differential valence of shared and unique traits but a probabilistic one. Because of the random sampling of traits, the valence difference among shared and unique traits in the two conditions varied in magnitude between participants. It is entirely possible that participants observed a set of learning trials that fully contradict the intended manipulation. Yet the data for all factual observations were recorded. The strength of the factually realized association between shared traits and valence and unique traits and valence can be expressed by a phi coefficient for each participant. We coded each observed trial such that a positive phi coefficient indicated that unique traits were more negative than shared traits, while a negative phi coefficient indicated that unique traits were more positive than shared traits. The sign and the size of the phi parameter thereby expresses the factual direction and strength of our central manipulation. We therefore tested whether participants' phi parameters could account for the effect of condition. Among phi+ participants, most preferred the first alien tribe (first: n = 78; second: n = 29), while slightly fewer than half of the participants preferred the first tribe among phi– participants (first: n = 50, second: n = 53). This association between phi and tribe preferences was significant, $\chi^2(1, N = 210) = 13.08$, $p < .001$; $\varphi = -.25$.

We then conducted a logistic regression analysis to test whether phi as a continuous subject-level parameter could account for the effect of condition on preference. We used the *lavaan* package in R (Rosseel, 2012) to specify a corresponding mediation model. Note that the mediator phi does not represent a causal cognitive process but merely a precise proxy for our central manipulation. This analysis yielded the significant total effect of condition on preference, $b = 0.20$, $SE = 0.06$, $Z = 3.01$, $p = .003$. In addition, the model found the predicted effect of phi on preference, $b = 0.50$, $SE = 0.15$, $Z = 3.40$, $p = .001$. There was no significant direct effect of condition on preference beyond the mediator phi, $b = -0.26$, $SE = 0.15$, $Z = -1.68$, $p = .090$, while the indirect effect of condition on preference via phi was significant, $b = 0.45$, $SE = 0.13$, $Z = 3.39$, $p = .001$. We can therefore conclude that the stronger preference for the first alien tribe in the negative-diverse condition compared with the positive-diverse condition emerged because of the differential valence of shared and unique traits in the two conditions. When negative traits were more diverse than positive traits, shared traits were likely to be positive and unique traits were likely to be negative, leading to a strong preference for the first group. When positive traits were more diverse than negative traits, shared traits were more likely to be negative while unique traits were more likely to be positive, which erases the preference for the first group.

Experiment 3

Method

Experiment 3 manipulated the frequency of positive and negative traits. Again, this frequency asymmetry also statistically influences the valence of shared and unique traits (see Fig. 1). When positive traits are more frequent than negative traits, shared traits are likely to be positive and unique traits are likely to be negative. When negative traits are more frequent, on the other hand, shared traits are more likely to be negative while unique traits are more likely to be positive. In the *positive-frequent* condition, both alien groups displayed four positive traits and one negative trait. In the *negative-frequent* condition, they displayed four negative traits and one positive trait. Positive and negative traits were both drawn from a set of six traits, thereby holding the diversity of positive and negative traits constant. All other procedural aspects in Experiment 3 were similar to those in Experiment 2. We expected a preference for the first tribe in the positive-frequent condition and a preference for the second tribe in the negative-frequent condition. We again aimed at collecting data from 210 participants but ultimately collected data from 208 participants who were students at the University of Cologne. Participants were randomly assigned to conditions.

Results

As predicted, most participants preferred the first over the second tribe (first: $n = 65$; second: $n = 39$) when positive traits were frequent. When negative traits were more frequent, only half of participants preferred the first over the second tribe (first: $n = 52$; second: $n = 52$). The association between condition and preference was, however, weaker than in Experiment 2 and not significant at a standard alpha level in this overall analysis, $\chi^2(1, N = 208) = 3.30$, $p = .069$; $\varphi = -.13$.

For a more fine-grained analysis, we again calculated participants' factual phi coefficient from their observed learning trials. The preference difference should again be a function of participants' individual phi coefficients that expresses the valence difference between shared and unique traits (i.e., on the basis of the observed samples from the underlying ecology). Among phi+ participants, most preferred the first alien tribe (first: $n = 64$; second: $n = 33$), while fewer participants preferred the first tribe among phi– participants (first: $n = 51$; second: $n = 56$). This association between phi and tribe preferences was significant, $\chi^2(1, N = 204) = 6.94$, $p = .008$; $\varphi = -.18$.

We again conducted a logistic regression analysis to test whether phi as a continuous subject-level parameter accounted for the effect of condition on preference. Similar to the chi-square test, the analysis yielded a total effect of condition on preference that was not significant at a standard alpha level, $b = 0.13$, $SE = 0.07$, $Z = 1.83$, $p = .067$. However, the effect of phi on preference was significant, $b = 0.27$, $SE = 0.11$, $Z = 2.52$, $p = .012$. There was no direct effect of condition on preference beyond the mediator phi, $b = -0.11$, $SE = 0.11$, $Z = -0.95$, $p = .345$, while the indirect effect of condition on preference via phi was significant, $b = 0.23$, $SE = 0.09$, $Z = 2.50$, $p = .012$. We can therefore conclude that the stronger preference for the first alien tribe in the positive-frequent condition compared with the negative-frequent condition emerged because of the differential valence of shared and unique traits in the two conditions.

General Discussion

We delineated and tested a cognitive-ecological model of intergroup biases. Assuming that out-groups and minorities are often novel groups, they should suffer an evaluative disadvantage. Our model predicts this disadvantage on the basis of the cognitive principle of differentiation (e.g., Kruschke, 2003; Sherman et al., 2009) and the structure of the information ecology (Alves et al., 2017a, 2017b). Novel groups are primarily associated with and evaluated on the basis of their unique attributes, that is, attributes that differentiate them from already-known groups. In the information ecology, negative attributes are more diverse and less frequent than positive attributes, and thus negative attributes are overrepresented among attributes unique to a group. Social perceivers are therefore likely to form negative impressions about novel groups. We tested this idea in three learning experiments. Experiment 1 found that preferences for groups are driven by the valence of novel groups' unique attributes. Experiments 2 and 3 found (a) that the valence of novel groups' unique attributes is a function of the two ecological assumptions about diversity and prevalence of positive and negative attributes and (b) that group preferences change accordingly.

The present model thereby renews the understanding of well-known evaluative biases in social perception. For example, when novel groups such as refugees enter a society, the members of this society have already formed associations between existing groups and their attributes. Hence, novel groups will be associated with those attributes that are unique to them, resulting in an "innocent" evaluative bias, because these unique attributes are more likely to be negative than positive.

The model has a predecessor in Hamilton and Gifford's (1976) illusory correlation explanation of stereotype formation. The authors described how associations between minority groups and negative behavior may form because both are rare in the information ecology and because human memory is sensitive to frequency-based distinctiveness. The present predictions do not follow from this explanation, however (i.e., both alien tribes appeared with equal frequency). The present model solely builds on the assumptions that categories are defined by their unique attributes (Kruschke, 2003; Sherman et al., 2009), and ecologically these attributes are likely to be negative.

On the basis of these distinctions, the present model provides a novel and integrative explanation for the two most prominent intergroup biases. People show a tendency to prefer their in-groups over out-groups and to prefer majority groups over minority groups. Crucially, out-groups as well as minority groups often constitute relative novel groups and are therefore associated with attributes that distinguish them from in-groups and majority groups (Halberstadt et al., 2011; Sherman et al., 2009). Thus, when people form impressions about out-groups and minority groups, they associate these groups with attributes that distinguish them from already-known in-groups and majority groups. Because such unique attributes are likely to be negative, people's impressions about out-groups and minority groups will be as well.

More generally, the present work shows the potential of integrating cognitive theories with theories about the information environment (Fiedler & Juslin, 2006). By acknowledging that information in the environment is rarely symmetric, one can see that unlike in most experimental settings, cognitive principles such as differentiation can have dramatic implications, such as general disadvantages for novel groups, minorities, and out-groups. We suggest that the interface between mind and environment provides a novel explanatory level to arrive at a more complete understanding of evaluative biases.

Conclusion

Given their ubiquity, it is likely that intergroup biases are multicausal phenomena. While humans are certainly motivated to favor their own group, intergroup biases may also arise beyond people's self-interests. To fully understand intergroup biases, it is important to understand that novel groups, such as refugees, minorities, or out-groups in general, may suffer a natural evaluative disadvantage.

Action Editor

Wendy Berry Mendes served as action editor for this article.

Author Contributions

H. Alves and C. Unkelbach developed the research idea. H. Alves and A. Koch designed the experiments. H. Alves and A. Koch supervised the research assistants carrying out the experiments. All authors analyzed the data. H. Alves drafted the first version of the manuscript. A. Koch and C. Unkelbach contributed to the final version of the manuscript.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

Supplemental Material

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Open Practices

All data and materials have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/qenhu/?view_only=a214ad4886e64dcf8a57048fbde1dfbb. The design and analysis plans for the experiments were not preregistered. The complete Open Practices Disclosure for this article can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797618756862. This article has received badges for Open Data and Open Materials. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges.

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