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Unequal resource division occurs in the absence of group division and identity

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Based on the seminal minimal group experiment, the widely influential social identity theory has, in the last 45 y, led to the belief that discrimination follows from intergroup relations and social identity. A large body of research evidenced that people discriminate against members of their out versus ingroup, even if groups and identities were assigned on the basis of a quantity estimate, aesthetic judgment, or a chance outcome. But to what extent may unequal resource division be accounted for by ad hoc difference versus sameness, outside of any group division? We show via Bayesian regression analyses in seven preregistered experiments (>1,400 subjects) that unequal resource division strategies persist against a single person that demonstrates a different versus the same quantity estimate, painting preference, or even coin flip (Experiments 1, 2, and 3ab), with 43.1% more money awarded for sameness relative to difference conditions (Experiments 4, 5, and 6). These findings open up the possibility that one key driver of discrimination may exist in a mechanism of interindividual comparison that treats ad hoc difference more negatively than ad hoc sameness. If unequal resource division readily emerges against a single person even after a mere chance difference, discrimination may be more widespread and occur for partly different reasons than is currently assumed. Theoretical implications for understanding cognitive and brain systems of discrimination are discussed.

social identity theory | discrimination | minimal group | relational mentalizing

Significance

In the seminal "minimal group" experiment, participants tend to financially benefit members of their own group versus another group, even when group allocation is based on minimal conditions, such as seemingly irrelevant features (e.g., a quantity estimate or painting preference) or a random event (e.g., a coin flip). Accordingly, an influential theory has argued that discrimination follows from intergroup relations and social identity. In contrast, here we show via seven experiments that discriminatory tendencies also emerge when participants are not divided into groups and only interact with a single person that demonstrates a different versus the same quantity estimate, painting preference, or even coin flip. Unequal resource division that follows a random difference with an individual may make discrimination more prevalent and occur for partly different reasons than is commonly assumed.

Discrimination is understood as an unequal treatment of people on the basis of the societal category they belong to, such as their race, ethnicity, nationality, age, or gender. Five decades of seminal research in the field of social psychology correspondingly described the origins of discrimination in terms of social identity and intergroup processes. The most influential theory, social identity theory (1–3), emphasized that we categorize people into "us" (the ingroup) and "them" (the outgroup) and favor the former to elevate our self-image (4–6). Discrimination researchers have thus generally focused on intergroup or social identity processes, more so than individual processes, to understand why unequal resource division is targeted toward individuals of a certain group or identity. Less-influential intergroup theories explored the function of expected reciprocity from ingroup members (7, 8), a desire to harm or derogate the outgroup (9), or ideological attitudes toward intergroup relations (10). More generally, social identity theory is one of psychological science's leading works, with its influence apparent in many other disciplines as well (11–16).

The core evidence for the social identity theory of discrimination emerged out of the well-established empirical finding that humans favor their own group (the ingroup) at the expense of a group that they do not belong to (the outgroup). This preference for the ingroup is so strong that it can be triggered by the most trivial of group boundaries. In the now classic "minimal group" paradigm (3), participants are assigned to one of two groups and given a social identity based on seemingly irrelevant, arbitrary, and meaningless features, or even random events. Such manipulations include being an over- versus underestimator of the number of dots that they had seen (3, 17), being part of a Klee versus Kandinsky group after having a preference for certain paintings (17), or belonging to a heads versus tails group after flipping a coin (18, 19). The use of such features has been crucial for pinpointing the core psychological mechanisms that spark discriminatory tendencies, stripped from any wider social factors such as race, personality characteristics, beliefs, values, or attitudes. Via carefully designed money allocation matrices (3, 20), Tajfel and colleagues evidenced the use of two discriminatory strategies. First, participants maximize the income of ingroup members (maximal ingroup profit; MIP); and second, they maximize the difference between the ingroup and the outgroup member even if this means they must sacrifice ingroup profit for it (maximal differentiation or "winning"; MD). Aspiring for the ingroup to "win" against the outgroup is considered a vital sign of the nonutilitarian character of discrimination because it inflicts a cost on the ingroup (17).

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Billig and Tajfel (18) made it clear that in order to attribute these effects to social categorization (i.e., the manipulation of group division and social identity assignment), one crucial confound needed to be addressed: They had to rule out similarity on an individual level, for instance in aesthetic preferences, as a viable explanation for the effects of social categorization. Indeed, many researchers, including Tajfel himself, have implied that in order for the paradigm's effects to be conceptually tied to this experimental manipulation and not the confound of interindividual similarity, the latter alone should not lead to the discriminatory behavior (8, 18, 21, 22). Moreover, social identity theory (1–3) states that: "explicit references to group membership are logically necessary for operationalizing in these minimal situations the major independent variable—that is, social categorization per se. This requires not merely that the subjects perceive themselves as similar to or different from others as individuals, but that they are members of discrete and discontinuous categories—that is, 'groups.' (p.39)." Social identity theory further explains that this process is different from comparisons with an individual [e.g., as described by Festinger (23)]. Empirically testing this potential confound using a small sample of participants, Billig and Tajfel (18) found that social categorization was a sufficient condition for intergroup discrimination. An interpersonal dissimilarity manipulation alone led to trending discrimination effects only in the painting preferences version, and to no discrimination effects in the coin toss version. They wrote that: "It was as if that, just by inserting the word 'group' into the experimental instructions, the s's definition of the situation was radically altered. (p.48)" Overall, it was argued that discriminatory effects occur in the minimal group paradigm because of the "critical role" of social categorization, that is, following an explicit group division manipulation.

Yet, the minimal group paradigm involves by design a dual manipulation of difference versus sameness in any of its tasks, including in the coin toss version: 1) the participant *individually differs* with an outgroup member in terms of a feature of interest, such as a quantity estimate, preferences for abstract pictures or a random outcome, and; 2) the participant is also assigned to a *different group that is associated with a social identity* (i.e., being a member of a group connected with a social category). For example, in a fictional experiment, participant 1 flips a coin, which shows "heads," and they are assigned to one of two groups that is categorized as the "green team." In contrast, participant 2's coin toss shows "tails," and they are assigned to the other group that is categorized as the "yellow team." Following the logic of researchers in the field (18, 21, 22), individual similarity alone leading to typical discriminatory strategies would be an issue for the interpretation of the minimal group paradigm in terms of (mainly) intergroup processes, including for social identity theory. Previous designs that tried to disentangle similarity from categorization manipulated difference versus sameness between the participants and multiple other individuals (18, 21, 22). Social identity theory would predict no discrimination in the latter case, nor in a case with one similar versus different individual, due to a lack of explicit group categorization. Therefore, if a difference versus sameness with a single individual in quantity estimates, aesthetic preferences, and coin flips would already lead to the use of discriminatory strategies, this would have broad conceptual consequences. Typical discriminatory tendencies may then hinge, in part, on the processing of individual difference.

Scope of the Study

In the field of cognitive neuroscience, Deschrijver and Palmer (24, 25) recently argued that a particular system in the human brain may track the extent to which another individual's mental state is the same or different to one's own. Four decades of research into the so-called false belief paradigm (26) have measured participants' responses to another person that has a different belief than one's own about the location of an object. Deschrijver and Palmer concluded via a systematic review of neuroimaging findings that a difference versus sameness with another person, be it in views about an object's location or based on other social information, may come with a conflict signal in the brain. Neural conflict more generally may lead us to change our social behavior, and is widely argued to be an unwelcome event in the brain that comes with negative emotions, such as anxiety or anger (27–32). Though speculative at this point, this view from cognitive neuroscience motivates the prediction that unequal resource division may occur against the same individual *when an ad hoc difference versus sameness is present*, even in the complete absence of any group categorization or social identity. A person with a different (false) belief or other social difference is conceptually comparable with one showing a different view about aesthetic preferences/quantity estimates or a different coin toss outcome.

Aside from research in cognitive neuroscience, the field of social psychology has shown that self-serving, self-enhancing, optimistic, and egotistical biases of the self are separable from any group serving biases. For instance, there is a large literature (33–38) on the effects on liking, persuasion, or cooperative behavior based on incidental similarity to another person (e.g., sharing one's name or birthday). Yet, none of the main discrimination theories have, to our knowledge, adopted the view that incidental similarity or self-positivity biases should lead to the specific strategies that are key to understanding discrimination (e.g., maximum differentiation). In fact, the field has settled on the view that dissimilarity in a random coin flip alone (outside of group division) is *not* sufficient to evoke such strategies (18, 22). To provide empirical support for the idea that important parts of unequal resource division can be accounted for by individual difference versus sameness, it is crucial to show that the latter can lead to discriminatory strategies. Moreover, the incidental similarity mechanism has often involved features that are chronically related to the self, such as sharing their birthday, the form of one's earlobes, the letters of one's name, etc, and this association with the self-concept has been named an integral part of the phenomenon (33–38). While it is easy to imagine that one's self-concept could have impact in a wider array of social circumstances, it remains to be seen whether a random coin toss generated by a computer on a trial-by-trial level is indicative of the same processes.

Since transient and ad hoc individual differences with a single individual do not hold much societal relevance, we will be referring to them under the term "sheer difference." In other words, we use sheer difference to refer to an ad hoc difference with a single individual that relates only to one specific feature and not any wider social factors, such as race, personality characteristics, beliefs, values, or attitudes. Such an interpretation is thus distinct from studies that have investigated the role of "similarity" in the minimal group paradigm via an *assumed* similarity in beliefs for ingroup members in the minimal group paradigm [e.g., in attitudes, worldly opinions, and values (39–41); for a review, see ref. 8]. The present research also goes further than existing research on the attraction or preferability of similarity in chronically existing features such as demographics, worldly opinions, values, or (religious) beliefs. Individually receiving the same coin flip is not usually considered similarity in these theories (8, 18, 22). For this reason, we introduce this novel term here.

In the current series of seven experiments, we set out to address whether sheer difference versus sheer sameness with another individual triggers unequal resource division mechanisms that may

underlie discriminatory behavior. While we are aware that discrimination is defined as disadvantaging certain social categories (e.g., racial ones), we follow the same methodological logic with which the minimal group paradigm was developed initially (3, 17): We experimentally strip elements that may be of relevance to explain societal group discrimination—including in this case any mention of group assignment or division by group (3) or multiple similar versus different individuals (18)—until we reach the very minimal conditions sufficient to generate unequal resource division processes.

We first ran three versions of the classic Tajfel minimal group paradigm (using dots, paintings, and coin tosses) with the dependent measures designed to capture key discriminatory tendencies, such as maximal differentiation. Yet, we implemented a major change: We made no group assignment, nor introduced social identities. We instead introduced only a single other actor that could show a difference or sameness in their quantity estimation, aesthetic preference, or chance outcome. The central hypothesis tested was always the same: The other person showing a difference versus similarity would lead to unequal resource division, even in the complete absence of group assignment. The tasks' "group" version was included after the "individual" version in Experiments 1 to 3a such that a replication of core minimal group discrimination effects would provide confidence in our design. The direct comparison of "individual" and "group" pull scores is indeed less theoretically relevant for our purposes: Both social identity theory and sheer difference can in principle predict for "group" discriminatory tendencies to be stronger than "individual" ones, albeit for different reasons. Sheer difference theory can assume that an added layer of difference (in this case: the group membership) will increase discrimination (see also ref. 21, whose authors theoretically argued against social identity theory by saying that in essence, the minimal group paradigm manipulated "similarity" twice). Social identity theory would, in contrast, expect discrimination to be driven *primarily* by explicit group division/social categorization (and *therefore* for it to be larger). Nevertheless, in Experiment 3b, we test the coin toss experiment with a between- instead of a within-subjects factor of task to more directly compare the strength of effects in "individual" and "group" versions. Subsequently, we wanted to quantify *how much more money* humans are willing to assign if the other person demonstrates sheer sameness relative to sheer difference. We therefore ran a further three congruency experiments (Experiments 4 to 6) inspired from well-established designs in the field of cognitive neuroscience (24, 27, 42–46). In the present congruency designs, the other person's dots estimation, painting preference, or coin toss outcome was in each trial communicated as either incongruent or congruent with one's own, after which the participant would decide on a reward for the other out of a certain maximum. Across all seven experiments, we preregistered the sample size, hypotheses, and Bayesian regression approach in advance. For comparison reasons, however, we did also include in our supplementary materials the frequentist analyses that are more conventional in the field. These frequentist analyses consistently showed the same patterns of results as outlined below and thus support the same conclusions.

Methods and Results

Experiments Based on Social Psychology's Minimal Group Paradigms. The experiments were approved by the ethical board of the Faculty of Psychology and Educational Sciences at Ghent University (reference: 2022-050) and of the School of Psychology at the University of Sydney (2024/83). All participants provided informed consent before the start of the experiment. Experiments 1, 2, and 3a (experimental design: see *SI Appendix*, Figs. S2 and S3) first introduced an "individual" version of the dots estimation, painting preference, and coin toss experiments, respectively. In each trial, the participant would indicate their estimation of a cloud of dots as being more or less than a certain reference number, their preference out of two paintings, or they would receive a head or a tail after a coin toss. Each participant was told that exactly one other participant had already completed the identical trials and that they would assign points to the other participant, which would be converted into a monetary reward. We captured discriminatory tendencies via Tajfel's money allocation matrices (20) that we adjusted for measuring discrimination against a single individual for choosing a different versus the same outcome. As an example, a participant in the dots estimation version would in each trial guess whether a cloud of dots was more or less than a reference number (which was unbeknownst to the participant always the exact number of dots presented). Without telling them what the other person had chosen, they were then asked how many points they would like to offer in this trial if the person had estimated the amount of dots as more versus less than the reference number. In the painting version, the participant chose between two paintings. We then asked via the matrices how much the participant wanted to allocate if the person had chosen the left versus the right painting in this trial. The coin version queried money allocation for the other in each trial when they would have received an Australian tail versus an Australian head, after the participant was shown a coin flip outcome themselves first.

After the "individual" part of Experiments 1, 2, and 3a, we implemented the respective classical "group" design. The participant was assigned to one of the two relevant groups and social identities based on their dots estimations, painting preferences, or coin tosses. They then assigned points to members of their ingroup and outgroup using the original Tajfel's matrices. In the dots estimation version, the participant completed a series of 13 dots estimation trials. They were then allocated to a group of "more-" or "less-estimators." The matrices then each asked how many points they would like to offer to member <Y> of the "less-estimators group" versus member <Z> of the "more-estimators group" (with <Y> and <Z> indicating a random number). In the painting version, the participant was allocated to a Klee or Kandinsky group based on a series of painting preference trials, after which they allocated money to members of the respective groups. In the coin version, we used head and tail groups. The experiment ended with a series of questionnaires that were used to perform exploratory bivariate correlational analyses (reported in *SI Appendix*).

We measured the strength of key discriminatory tendencies (including maximum differentiation) in three preregistered and online experiments with 238 UK-based participants per experiment (a total of 714: see *SI Appendix*, Table S1 for demographics). We computed from the allocation matrices data for both the "individual" and the "group" blocks 3 so-called "discriminatory pull scores," which measure the relative strength of two opposing allocation strategies (*SI Appendix*). Two of the pull scores captured the relative strength of the aforementioned discriminatory strategies MD and MIP combined (referred to as favoritism; FAV), against respectively prosocial strategies Parity (P; an equal division between the two options) and Maximum Joint Profit (MJP; assigning as many points as possible across the two options). The third one quantified the strength of the MD strategy against MJP/MIP. A score of 0 indicates no discrimination tendencies, a score of 12 indicates maximum discrimination against the other with a different outcome/outgroup, and a score of –12 indicates maximum discrimination against the other with the same outcome/ingroup.

To evaluate our preregistered hypotheses, we used a Bayesian parameter estimation approach as our analytical strategy (47, 48). The models estimated key parameters of interest (e.g., the pull scores) and their precision. Specifically, we used the lower bound of the 95% quantile interval of key parameters of interest, and evaluated it against a relevant reference value. For instance, if a discriminatory bias exist in the individual condition, the lower bound of the 95% quantile interval of discriminatory pull scores in the individual condition should exclude zero (i.e., 95% of the values in the posterior distribution are positive). If discriminatory pull scores are absent in the individual condition, the majority of the posterior distribution should be expected to overlap with zero. We would conclude that values close to zero were the best estimates of the pull score. As such, a Bayesian parameter estimation approach allows inferences to be made in favor of the experimental hypothesis, as well as the null hypothesis, thus making it unnecessary to additionally calculate Bayes factors (or *P*-values in frequentist statistics) to evaluate hypotheses (49).

The experimental data yielded the same pattern of results (Figs. 1–3). When inspecting the descriptive summary data visually for the "individual blocks," we saw that participants showed a substantial degree of equal resource division (i.e., many choices around the zero-mark). In addition, some participants used extreme unequal resource division strategies towards the different versus same other (i.e., choices around the twelve-mark). With the minimum and maximum ranging from −12 to 12, across all three experiments, average pull scores were between 2 and 4 points for the FAV versus MJP and FAV versus P matrices. The average pull scores for the MD versus MJP/MIP matrices were approximately 0.5 points across the three experiments. If we turn to our inferential statistical analyses, a Bayesian regression model for the "individual" block of Experiment 1 (dots estimations) showed that the estimates for the three pull scores were indeed above zero: None of the 95% quantile intervals included the number 0 (FAV versus MJP: estimate = 2.38; interval = 1.89 to 2.85; MD versus MJP/MIP: estimate = 0.43, interval = 0.09 to 0.78; FAV versus P: estimate = 2.81, interval = 2.30 to 3.31). The pull scores in Experiment 2 (painting preferences) were similarly estimated as well above 0, and this was also confirmed in the 95% quantile intervals (FAV versus MJP: estimate = 3.16; interval = 2.69 to 3.63; MD versus MJP/MIP: estimate = 1.40, interval = 1.03 to 1.77; FAV versus P: estimate = 3.30, interval = 2.79 to 3.78). The same was true for Experiment 3a (coin tosses; FAV versus MJP: estimate = 2.55; interval = 1.98 to 3.10; MD versus MJP/MIP: estimate = 0.35, interval = 0.06 to 0.65; FAV versus P: estimate = 2.60, interval = 2.04 versus 3.17). The results of all the "individual" pull scores suggest that participants indeed used the discriminatory strategies MIP/MD against the other when they had a different versus the same outcome. The specific evidence for the use of maximum differentiation strategy (via the MD versus MJP/MIP type of matrix) is in particular important because it shows that participants maximally *distinguished* in their point allocations between the situation where the other had demonstrated the same versus a different outcome—at the expense of maximally attributing points to the other when they had the same outcome. This gives key evidence for the presence of aspects of unequal resource division traditionally associated with discrimination: This strategy hampers the absolute gain for the other that demonstrates sameness.

Second, the "group" pull scores were estimated as above 0 as well (*SI Appendix, Materials and Methods*) and were similar in size to those seminal in the field (18). As per our preregistrations, we only exploratively assessed whether a difference existed between "individual" and "group" pull scores via an exploratory Bayesian regression model for each experiment, as both a mechanism in terms of individual difference and one in terms of group identity could in principle predict larger "group" than "individual" pull

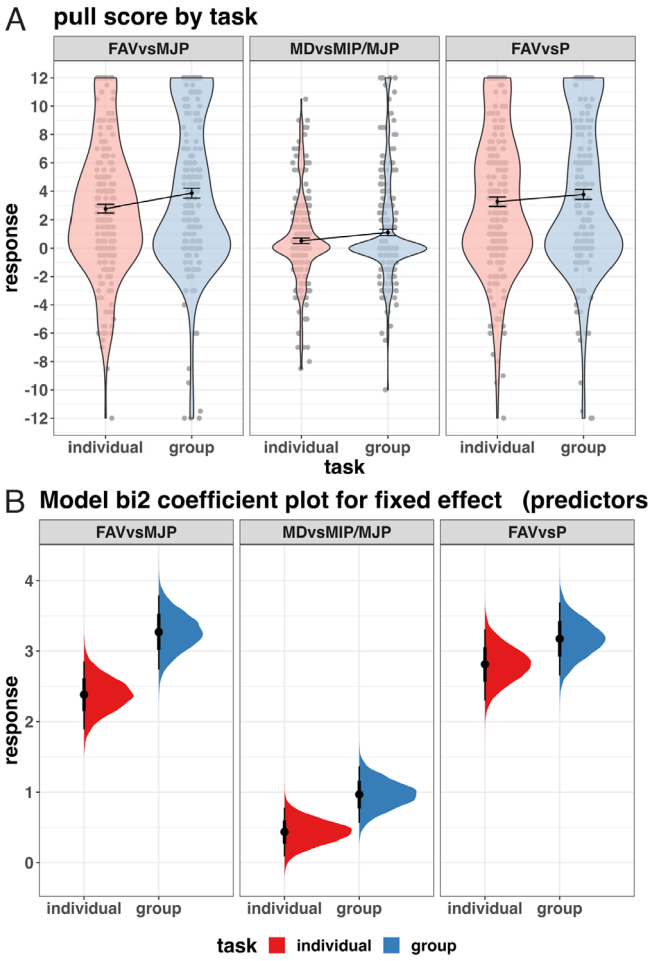

Fig. 1. Behavioral results and Bayesian model of Experiment 1 (dots estimations). Note. (*A*) violin plots of the 3 pull scores for each task (red = individual task; blue = group task). Higher scores represent more discrimination. Error bars denote the SEM. A score of −12 indicates maximum discrimination against the other with the same outcome/the ingroup. A score of 0 indicates no discrimination tendencies. A score of 12 shows maximum discrimination against the other with a different outcome/the outgroup. All of the average pull scores in the "individual" versions are above 0, which is indicative of unequal resource division tendencies on average across the sample against the individual other after a difference in a dots estimation. (*B*) Predictor estimates of the Bayesian interval model (bi2). Error bars denote the 66 and 95% quantile intervals in the coefficient plot. The 95% quantile intervals in the "individual" versions all exclude the value zero, which shows discriminatory behavior was observed in all measures against the individual.

scores (see the Introduction section). The models revealed that the "group" pull scores predictors were somewhat larger than the "individual" ones (Approx 0.5 to 1 point on a scale from −12 to 12), as reflected in the model estimates for the effect of task [Exp. 1 (dots estimations): estimate = 0.66, interval = 0.19 to 1.13; Exp. 2 (painting preferences): estimate = 0.95, interval = 0.52 to 1.37; Exp. 3 (coin tosses): estimate = 0.63, interval 0.12 to 1.13]. There were no interaction effects of task and pull scores (see *SI Appendix*, Figs. S5–S7). In other words, unequal resource division strategies typical for discriminatory tendencies strongly prevailed in the "individual" versions (in the absence of group division and identity). In these experiments, the increase in discriminatory tendencies for the "group" versions was consistently small (i. e., around 0.5 to 1 point), relative to how strong individual pull scores were (up to 3.3. points)—though these results should be considered with caution due to a potential order effect.

Even though the comparison between individual and group tasks was not central to our main aim, since we were primarily

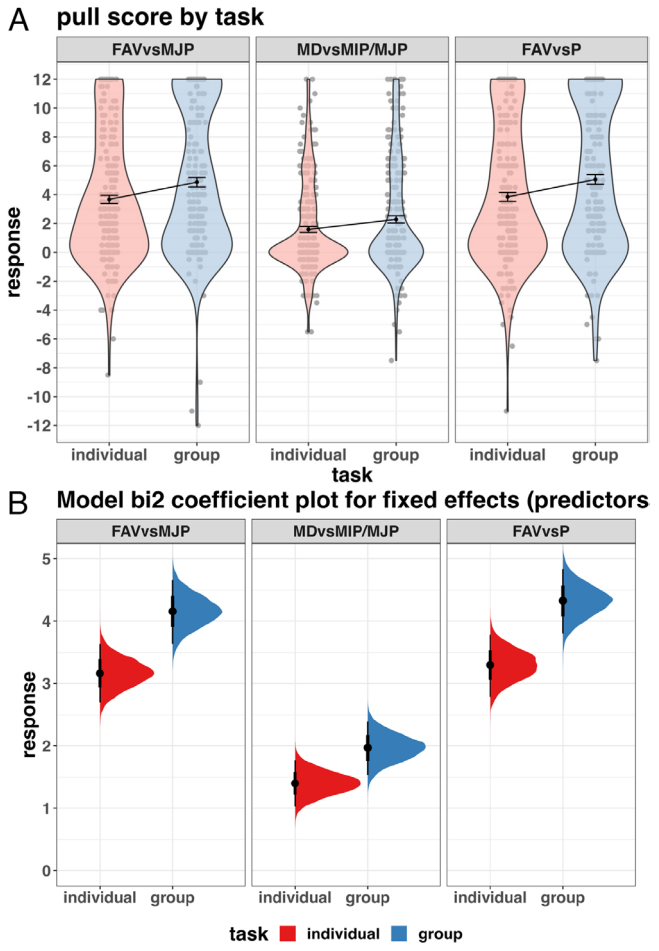

Fig. 2. Behavioral results and Bayesian model of Experiment 2 (painting preferences). Note. (*A*) violin plots of the 3 pull scores for each task (red = individual task; blue = group task). (*B*) Predictor estimates of the Bayesian interval model (bi2). See the legend of Fig. 1 for further information. Also here, all of the average pull scores in the "individual" versions are above 0, which is indicative of discriminative tendencies on average across the sample against the individual other that demonstrates a different versus the same painting preference. The 95% quantile intervals in the "individual" versions all exclude the value zero, which shows that discriminatory behavior was observed against the individual after a different versus the same painting preference.

interested in the individual task condition alone, we also decided to run experiment 3a again with a between-subjects manipulation of the task instead of the within-subjects manipulation. The aim of doing so was to account for a potential order effect in the within-subjects design and thereby provide a more unbiased estimate of the difference between individual and group task settings. As such, in Exp. 3b, we ran the coin toss experiment again in two groups of 238 participants, with one group completing the "individual" version of the task and one group completing the "group" version of the task. Our results showed a clear replication of all our previously reported effects, though the group pull scores were somewhat larger than reported in Exp. 3a (Fig. 4). A Bayesian regression model for the "individual" Task of Experiment 3b (coin tosses) showed that the estimates for the three pull scores were indeed above zero: None of the 95% quantile intervals included the number 0 (FAV versus MJP: estimate = 2.6; interval = 2.06 to 3.16; MD versus MJP/MIP: estimate = 0.33, interval = 0.03 to 0.64; FAV versus P: estimate = 2.58, interval = 2.03 to 3.14). The models revealed that the "group" pull scores predictors were larger than the "individual" ones (approx. 1.5 points on a scale from −12 to 12), as reflected in the model estimates for the effect of task [Exp. 3b (coin tosses): estimate = 1.70, interval = 1.06 to 2.33]. Altogether, this shows that the results of Exp. 3b are qualitatively the same than those of Exp. 3a, and that the larger group effect in Exps. 1 to 3a is unlikely to entirely reflect an order effect.

Experiments Based on Cognitive Neuroscience's Congruency Paradigms. How much *more* money are participants willing to allocate to the other person if they demonstrate sheer sameness relative to sheer difference? We applied in Experiments 4 to 6 an experimental congruency design (experimental design: see *SI Appendix*, Fig. S4). To determine sample sizes, we used the effect sizes that were reported in our prior experiments to guide a priori power analyses. We then preregistered three online experiments with 75 UK-based participants each (a total of 225: see *SI Appendix*, Table S1 for demographics), which gave us 95% power to detect the lower bound of our previously reported effects (Cohen's d_z = 0.51). Participants first estimated the number of dots, judged the paintings, or received a coin toss outcome. In half of the trials, they were told that the other person had experienced the same outcome (congruent condition). In the other half of the trials, they were told that the other person had experienced

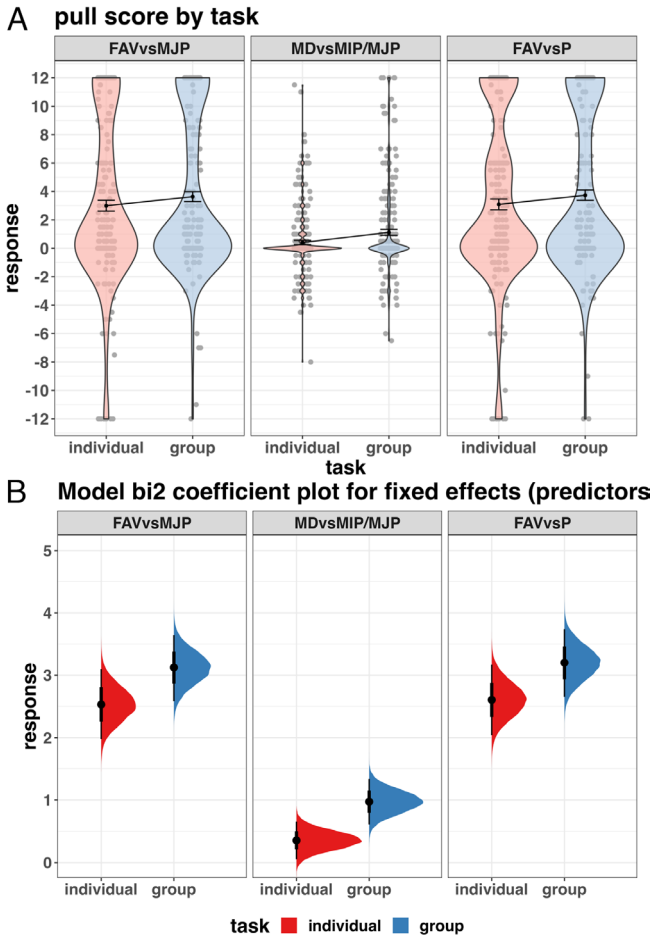

Fig. 3. Behavioral results and Bayesian model of Experiment 3a (coin tosses—within-subjects). Note. (*A*) violin plots of the 3 pull scores for each task (red = individual task; blue = group task). (*B*) Predictor estimates of the Bayesian interval model (bi2). See the legend of Fig. 1 for further information. Also here, all of the average pull scores in the "individual" versions are above 0, which is indicative of discriminative tendencies on average across the sample against the individual other that demonstrates a different versus the same coin toss outcome. The 95% quantile intervals in the "individual" versions all exclude the value zero, which shows that discriminatory behavior was observed against the individual after a different versus the same coin toss outcome. Participants thus used unequal resource division strategies against a single other even when the sheer difference versus sameness was based on explicit randomness.

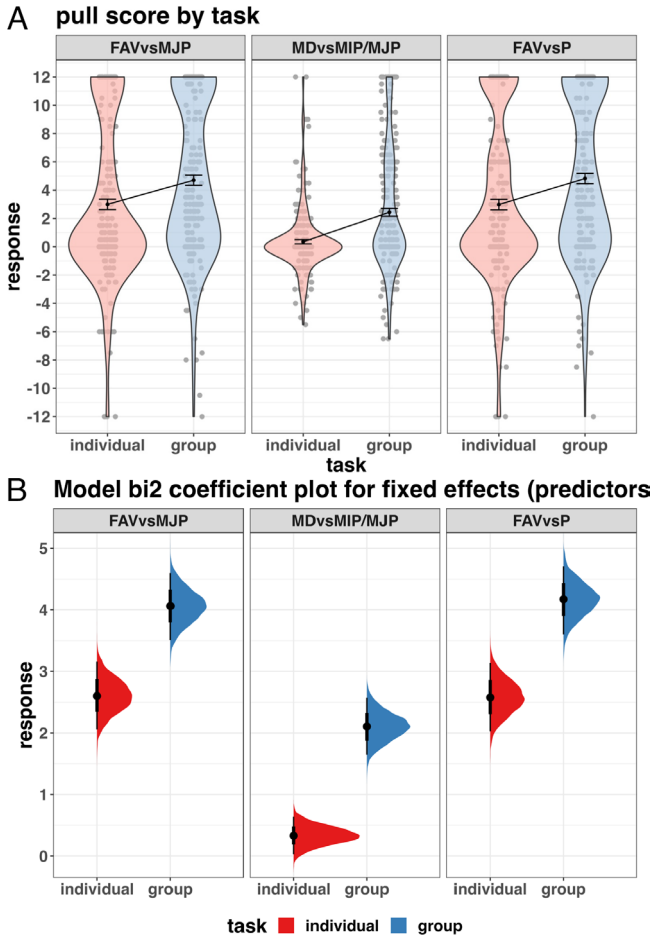

Fig. 4. Behavioral results and Bayesian model of Experiment 3b (coin tosses—between-subjects). (*A*) violin plots of the 3 pull scores for each task (red = individual task; blue = group task). (*B*) Predictor estimates of the Bayesian interval model (bi2). See the legend of Fig. 1 for further information. Also here, all of the average pull scores in the "individual" versions are above 0, which is indicative of discriminative tendencies on average across the sample against the individual other. The 95% quantile intervals in the "individual" versions all exclude the value zero, which shows that discriminatory behavior was observed against the individual after a different versus the same coin toss outcome. Participants thus used unequal resource division strategies against a single other even when the sheer difference versus sameness was based on explicit randomness. In the between-subjects version of this paradigm, the group pull scores are slightly larger than in the within-subjects paradigm.

the opposite outcome (incongruent condition). The participant was then asked to assign a certain number out of a maximum set of points. This maximum varied randomly from 10 to 100 in increments of 10, with 550 in total points available per condition. We then computed that percentage of points participants were willing to assign in congruent versus incongruent conditions.

We observed a clear effect of congruency in each of the three experiments (Fig. 5). In Experiment 4, participants were willing to give out 81.8% of the points to the other when they agreed with their dots estimation and 57.0% when they disagreed ($M_{difference}$ = 24.8%; σ = 24.8%; or 43.7% more money for congruent relative to incongruent answers). In Experiment 5, they assigned 76.7% of the points to the other when they agreed with their painting preference and 50.8% when they disagreed ($M_{difference}$ = 25.9%; σ = 29.0%; or 51.0% more money for congruent relative to incongruent estimations). In Experiment 6, they assigned 72.7% to the other when they had the same coin toss outcome, and 53.8% when they had a different one ($M_{difference}$ = 18.9%; σ = 29.4%; or 35.1% more money for congruent relative to incongruent outcomes). Participants were willing to give, on average across the three experiments, 43.1% *more money* in the congruent condition than in the incongruent condition. Our Bayesian model confirmed that in each of the three experiments, the percentage of points assigned to the other person is higher in the congruent than incongruent condition as the posterior distribution for the average effect of condition was positive (Exp. 4, dots estimations: estimate = 23.71, interval = 18.9 to 29.37; Exp. 5, painting preferences: estimate = 24.69, interval = 18.18 to 30.72; Exp. 6, coin tosses: estimate = 17.87, interval = 11.56 to 24.14). These results convincingly show that humans can financially treat another person preferentially when they show likeness on an individual level, even when based on a chance outcome.

Discussion

Our experiments evidence that in the three main versions of the minimal group paradigm, interpersonal difference versus sameness

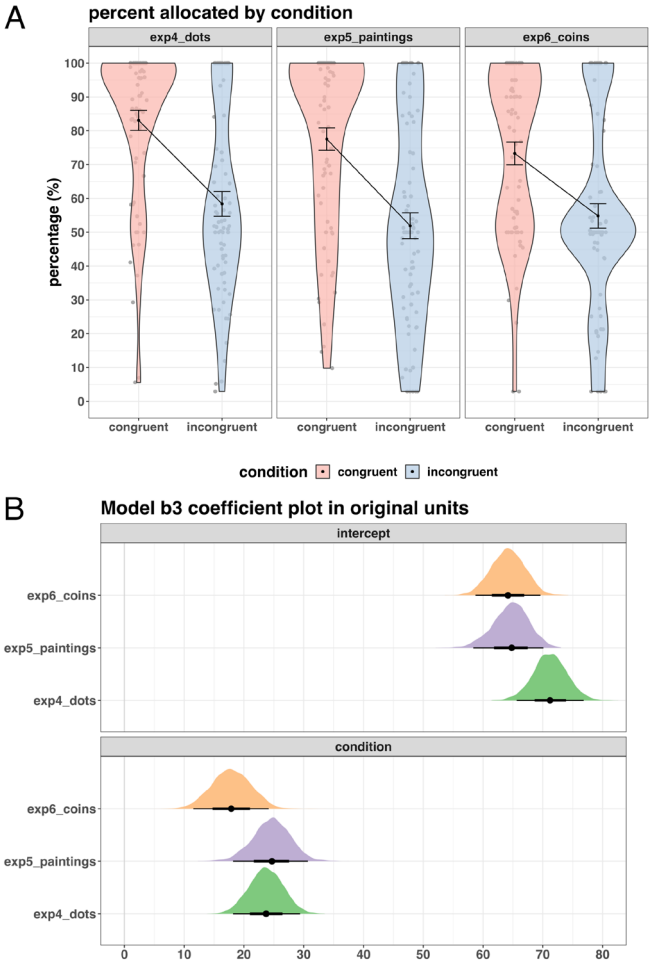

Fig. 5. Behavioral results and Bayesian models for Experiments 4 to 6 (dots estimations, painting preference, and coin tosses congruency experiments, respectively). Note. A greater congruency effect (i.e., the difference between the percentage of money allocations in congruent versus incongruent conditions) represents more discrimination. This is indicative of discriminative tendencies against the single individual on average across the sample. Error bars denote the 66 and 95% quantile intervals in the coefficient plot. (*A*) Violin plots of the percentage of assigned points for each condition (red = congruent; blue = incongruent). Error bars denote the SEM. (*B*) *Bottom*: parameter estimates for the effect of condition (i.e., the difference in assigned money in congruent versus incongruent condition) from the Bayesian model (b3) range between 17.87% and 24.4% across the three experiments. Their 95% quantile intervals far from include the value zero. Each experiment thus shows a strong unequal resource division effect against the single other that demonstrates a different versus the same outcome in dots estimations, painting preferences, or a mere coin toss.

is sufficient to evoke discriminatory strategies. Significant unequal resource division emerges toward an individual that shows difference versus sameness in quantity estimations, painting preferences, or a coin flip. These findings occurred even while the key manipulation of group division and social identity was removed from the minimal group paradigm. In Experiments 1 to 3ab, participants exhibited typical discriminatory tendencies (e.g., a maximum differentiation or "winning" allocation strategy) against a single individual for showing a different versus the same quantity estimation, painting preference, or even coin toss outcome. We conclude that it seems likely that differences between individuals (i.e., nongroup processes) have a nontrivial contribution to the discrimination observed in the classic minimal group paradigms. In Experiments 4 to 6, participants were willing to assign an average of 43.1% *more money* to another person whenever they showed a similarity versus a difference in a single, specific judgment or chance outcome.

As explained by leading advocates of the minimal group paradigm (18, 22), to attribute minimal group effects to social categorization, the confounding factor of difference versus sameness in seemingly irrelevant characteristics should be ruled out. The fact that individual difference on its own does evoke unequal resource division raises some questions about the methodological design and interpretation of the minimal group paradigm; and about social identity theory. Our findings indeed show in a large sample of participants that clear discriminatory strategies arise following the types of individual dissimilarity that are inherent to the minimal group paradigm, but in a context that is devoid from a group-based manipulation. Social identity theory proponents (1–3) instead had emphasized that the explicit manipulation of group division, that is social categorization, is "critical" to evoke typical discriminatory responses. Indeed, it is a key feature of the theory that competition/comparison between an explicitly divided ingroup and outgroup should lead the participant to benefit their ingroup at the expense of the outgroup, even if they must sacrifice their ingroup's absolute income for it (i.e., the MD strategy). Our individual data showed that even when no such explicit group division was present, evidence for the MD strategy was obtained: Participants benefited the other when they demonstrated sameness versus difference, at the expense of the other's absolute income when demonstrating sameness. Following the logic of Tajfel and other scholars in the field (18, 22), this questions social identity theory's assumptions that social categorization is necessarily central to the discrimination effects observed in the minimal group paradigm.

We did observe that the group pull scores were somewhat larger than the individual pull scores across our experiments 1 to 3a. In Experiment 3b, we also observed that the difference in Experiment 3a was likely not a consequence of an order effect as it continued to exist when the "individual" and "group" tasks were assessed between-subjects rather than within-subjects. Both a mechanism in terms of individual difference and one in terms of group identity could in principle predict larger "group" than "individual" pull scores: Sheer difference theory can assume that an added layer of difference (in this case: the group membership) will increase discrimination (see also ref. 21). Social identity theory would, in contrast, expect discrimination to be driven *primarily* by explicit group division/social categorization (and *therefore* for it to be larger). For this reason, this difference in individual versus group effects was not the main focus of our analyses. Nevertheless, the finding does not rule out that group division may still have had an additional effect. Yet, if social categorization was most central to the effects, one would not expect the individual pull scores to be so consistently present (1, 8, 18, 22). All in all, the pattern of results suggests that a process of individual difference may account for a larger proportion of the effects in the minimal group paradigm than previously assumed.

Typical resource allocation strategies, including MD and MIP, can thus follow from an *individual* comparison of seemingly irrelevant features such as a random coin flip. This, then, can be a step for future research into what exactly drives the effects in the individual conditions. We put forward two speculative trains of thought, which can complement each other. First, we speculate that a basic cognitive and brain system that detects sheer difference versus sameness, which has been evidenced in the field of social neuroscience, may play a role (24, 25). This raises the theoretical possibility that a neural conflict signal may serve as a cognitive mechanism that underlies discriminatory tendencies. Social interactions may be less *enjoyable* in the presence of neural conflict versus alignment. Following conflict, negative emotions may result in a tendency to disadvantage the other, whereas following alignment, positive emotions may result in a tendency to advantage the other. This line of thinking allows for discrimination studies to emerge based on prior cognitive neuroscience research into the valence of conflict versus alignment (27, 50–53). Of course, further research that can corroborate this proposed neural mechanism would be welcomed. Second, we refer back to the aforementioned social-psychological or incidental similarity literatures, as well as other types of self-positivity biases, to account for the effects in the coin flip tasks (33–38). For instance, maybe sameness in our paradigms can be considered as a form of incidental similarity. While research on incidental similarity has not usually involved random coin flips made on a trial-by-trial level by a computer, it remains to be seen whether our findings involve the same processes as the incidental similarity effects observed elsewhere. Yet, this general train of thought is not inconsistent with the idea that more negative emotional processes may follow from experiencing sheer difference. Future research may be able to compare and contrast both lines of thinking.

Even though there was no explicit mention of groups or any group assignment in our individual task setup, in principle, one could imagine that, even without any instruction to do so, some participants may still project an ingroup or outgroup identity onto the single other individual when they demonstrated the same versus a different outcome. We make several comments about this possibility. First, such implicit group assignment to individuals would oppose social identity theory's assumptions that a group manipulation is logically required to link discriminatory tendencies to intergroup processes (1). Second, while this theoretical possibility cannot be excluded from our experimental design, the experimental setup that we used does not make it likely. In Exp. 4 to 6, where no groups were mentioned, none out of 225 participants made any reference to groups when explaining the strategy that they used to allocate points—instead, they referred mostly to disagreement or the difference in coin flip. Moreover, studies that have focused on similarity versus difference in meaningful opinions/values/attitudes to explain discrimination (8, 21) have similarly been presented as an alternative to, rather than an extension of, the social identity literature. The a priori assumption in the discrimination domain, including by Tajfel and colleagues (1), is thus that an individual difference with a single other individual cannot be taken as evidence for intergroup processes. Likewise, social congruency designs similar to those described in this manuscript have also been implemented for decades in the field of cognitive neuroscience without results being attributed to group-based or identity processes (24, 27, 42–46). All in all, the assumption that groups are projected to the individual remains speculative at best, given the experimental design and the

assumptions of social identity theory. If intergroup processes associated with social identity theory should be expected to apply during interactions with one individual in contexts devoid of a group manipulation, then this assumption needs to be made explicit in the theory and supported by empirical evidence.

Broad Conceptual Implications. The development of the minimal group paradigm ushered a historical turning point for theories that underscored ideological attitudes such as authoritarianism (54) or conflicting group interests as vital constituents for discrimination (55). Our conclusions advance social identity theory, which has as a central assumption that an explicit association with intergroup divisions or social identities is fundamental to understand discriminatory tendencies (1–3, 17, 18). The individual task findings to our knowledge cannot straightforwardly be explained using any other existing social psychological theory of discrimination that is based on groups, identity or beliefs. Our manipulations of a transient and ad hoc individual difference rules out that any preexisting sources of societal division or identity (e.g., race, beliefs, values, attitudes), account for the observed discriminatory tendencies. The work thus also ventures beyond frameworks that attempted to explain the cognitive drivers of discrimination or prejudice as consequent to projected or perceived actual (dis)similarity in terms of (group-based) worldly attitudes or value-laden belief systems (8, 39, 40, 56–59). Attraction theories of attitudinal similarity (39, 58), for instance, would not predict the emergence of unequal resource division merely after the deliberately trivial individual, ad hoc and transient similarities such as those following the same coin flips. This is reflected in the fact that minimal group paradigm scholars typically do not refer to a sameness in coin flip outcomes as real "similarity" (18, 22). Overall, the present evidence could in part redirect discrimination theories (10) from a focus on certain societal groups to accounting for mechanisms of unequal resource division toward an individual that demonstrates an ad hoc difference —even when based on a coin flip—outside of any group membership or identity.

Implications. In many societies, unfair behavior has hitherto foremost been recognized as an act of discrimination based on social categories, such as age, race, sexual orientation, religion, or gender (8). The present experiments suggest that we may potentially use the same strategies of unequal resource division against a person when they are in a transient, insignificant, and ad hoc way different from us, and when this difference does not form the basis of group membership or social identity. While this event may be too singular for patterns to emerge, discrimination based on social difference versus sameness can in principle account at least in part for known societal outcomes. If many humans individually respond to the same interpersonal dissimilarity (a difference in racial, religious, or other societal characteristics) this may materialize in apparent intergroup discrimination. Because these are basic scientific results, what they may mean for the prevention of discrimination in wider society is highly speculative at the moment. With this said, we do note that social identity theory has informed many societal interventions to reduce prejudice, which often aim to expand the identity of one's own group (60). As such, future intervention research can potentially assess whether facilitating a sense of "sheer sameness" between single individuals can have an effect on societal outcomes.

Constraints on Generality. Our results are limited in several ways (61): First, conclusions should initially be restricted to the UK-based community sample and the kind of paradigm/s that we studied. It is yet to be seen how sheer difference presents in non-WEIRD populations (62) and in other discrimination designs. Second, in Experiments 1 to 3a, minimal group manipulations were tested *after* the individual versions, to allow for testing the effects of difference between individuals without any exposure to a context of group assignment. This may have led to order effects. However, Experiment 3b shows that the group effect is larger than the individual effect even when using a between-subjects design. Therefore, we suggest that the larger group effect in Exps. 1 to 3a is unlikely to be completely accounted for by an order effect. Third, we are not making the claim nor do we have any data that support the view that group assignment and social identities *cannot* lead to discrimination. Intergroup processes may well have a discriminatory contribution that operates beyond mere differences between individuals, and both mechanisms may interact. Fourth, elements of reciprocity may well be at play in our Exp. 1 to 3ab, as the other is thought to also assign resources to the participant (a methodological decision made to align with the classical minimal group paradigm). Yet, because this is not the case in Experiments 4 to 6, these cannot explain all of our results. Finally, these results should not be taken as evidence that humans primarily use discrimination strategies when deciding on others' monetary rewards. Even while substantial discriminatory tendencies were present, many participants in Experiments 1 to 3ab divided their resources in a relatively equal way.

Data, Materials, and Software Availability. Behavioral data have been deposited in osf (https://osf.io/zd5ey/) (63).

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