Being in the minority boosts in-group love: Explanations and boundary conditions

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Abstract

People appreciate members of their in-group, and they cooperate with them—tendencies we refer to as in-group love. Being a member of a minority (vs. majority) is a common experience that varies both between groups in a context and within a group between contexts, but how does it affect in-group love? Across six studies, we examined when and why *being in the minority boosts in-group love*. In Study 1, being in the minority boosted people's appreciation of various real-life in-groups but not out-groups. In Study 2, a real-life interaction between and within groups, people cooperated more with minority in-group (but not minority out-group) members. In Studies 3-6, we measured cooperation (Study 3, incentive-compatible), appreciation (Studies 4-6), and four mediators: perceived in-group distinctiveness, experienced in-group belongingness, expected in-group cooperation, and perceived in-group status. These four mediators independently and simultaneously explained why being in the minority boosted in-group love. In Studies 5 and 6, we observed two theoretical boundary conditions for the effect. The size of the effect was smaller when the minority in-group had many (vs. few) members (Study 5), and when the imbalance between the in-group and out-group was either low or high (here: 46% minority & 54% majority, or 20% minority & 80% majority) rather than moderate (here: 33% minority & 67% majority). We discuss how these findings align with and build on Optimal Distinctiveness Theory (ODT) and other theoretical accounts.

Keywords: Minority representation; in-group love; appreciation; cooperation; ODT

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Lived experience and extensive psychological research establish that people who share group membership are more likely to appreciate and cooperate with one another than those who do not (e.g., Hewstone et al., 2002; Nowak, 2006; Tajfel et al., 1971). We refer to this phenomenon as *in-group love* (conversely, we refer to *out-group love[1]* as appreciation for and cooperation with out-group members). Because in-groups are prevalent and central to people's social lives (Baumeister & Leary, 1995), abundant research has examined which attributes of in-groups boost in-group love. For example, an in-group's high status and moral reputation boost in-group love (Ellemers, 2017; Sachdev & Bourhis, 1991). Another fundamental attribute that can boost in-group love is having fewer members in the group (Balliet et al., 2014; Barcelo & Capraro, 2015; Bonacich et al., 1976; Hamburger et al., 1975; Nosenzo et al., 2015). We sought to contribute to this literature by focusing on an in-group's *relative size* or size in proportion to an overall population. We refer to the in-group as being in the *minority* when it makes up less than half of the people in a context. Being in the minority is ubiquitous in the real world: nearly any population can be partitioned into groups of unequal size, which implies that at least one group is in the minority. Because in-groups matter to their members and being in the minority is a common experience, we examined why and when *being in the minority boosts in-group love*.

Previous work on the relationship between minority group membership and in-group love

Two lines of research anticipate that being in the minority may boost in-group love. First, members of minority groups display greater group identification (Ellemers et al., 1999; Simon &

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[1] Empirical work on out-group love typically documents its lack rather than its presence and therefore refers to it as out-group hate. However, we use the term out-group love to keep our terminology consistent.

Brown, 1987), which is correlated with in-group love (Leach et al., 2007; Woitzel & Koch, 2023). However, people often identify as a member of a group without loving it (e.g., Millennials, Midwesterners, or math majors), or they love a group without identifying as its member (e.g., teachers, doctors, etc.). Thus, though group identification and love are correlated and related constructs, we argue that they should be examined separately (Ellemers et al., 1999).

Second, the literature on in-group favoritism—favoring an in-group over an out-group—has established that people prefer their minority in-group over a majority out-group (Brewer, 1979; Gerard & Hoyt, 1974; Mullen et al., 1992; Otten et al., 1996). However, the work on in-group favoritism focuses on comparing attitudes and behavior towards in-groups relative to out-groups. It does not compare attitudes and behaviors towards two in-groups that differ in group size. Thus, we know people prefer minority in-groups to majority out-groups, but this work does not clarify the effect of between being in the minority (vs. majority) on in-group love.

Some studies have examined the link between being in the minority and in-group love, however. One paper (Bettencourt, Miller, & Hume, 1999) found that after interacting with other members of an in-group on a problem-solving task, people formed better impressions and allocated greater rewards to the in-group when it was a numerical minority (vs. majority). In two other papers, people felt more proud of their in-group (Ellemers et al., 1992) and indicated stronger in-group ties (Lücken & Simon, 2005) when it was a numerical minority (vs. majority). The two papers examined minimal groups defined by their members' style of thought and taste in art, respectively. Ellemers and colleagues (1992) found that being in the minority (vs. majority) boosted in-group love only when the in-group's status was higher (vs. the out-group). Meanwhile, Lücken and Simon (2005) found that being in the minority (vs. majority) boosted in-group love only when the in-group's power was lower (vs. the out-group). In another paper,

people's satisfaction with their minimal in-group was higher when it was the minority (vs.

majority; Leonardelli & Brewer, 2001), but only among people who were induced to identify

with the in-group strongly (vs. weakly). Leonardelli and Loyd (2016) also examined minimal

groups defined by just a letter ("A" or "B") and varied whether the in-group's relative size was

20% or 45% of the population. They found greater in-group cooperation when the in-group was

of smaller relative size (i.e., 20% of the population), and identified optimal distinctiveness as a

key driver of this effect, see below.

In sum, across different papers, being in the minority increased in-group love (i.e.,

appreciation and cooperation). However, the studies primarily examined small samples of

White college students in campus labs. Additionally, we do not yet have a comprehensive

understanding of the mechanisms and theoretically relevant boundary conditions. We examine

why and when being in the minority boosts in-group love.

Why being in the minority may boost in-group love

Optimal Distinctiveness Theory (ODT) posits that membership in a minority group

satisfies two fundamental yet opposing identity needs (Brewer, 1991; 1993; 2003; Leonardelli

et al., 2010). The first need is to be unique. Membership in a majority group interferes with this

need for distinctiveness; a minority group tends to be salient, homogeneous, and entitative

(Ellemers et al., 1999; McGuire & McGuire, 1988; Simon & Brown, 1987) and could thus satisfy

the need for distinctiveness at the *inter*group level. The second need is being included and

assimilated in a community (Baumeister & Leary, 1995). Membership in a moderate-sized

minority group could satisfy this need for belongingness at the *intra*group level. Thus, being in a

moderate-sized minority (vs. majority) may boost in-group love because it fulfills the

distinctive identity need while not conflicting with the belonging identity need.

Thus far, this theoretical account is consistent with the findings from Leonardelli and Loyd (2016). They established distinctiveness and belongingness as key drivers of greater in-group cooperation in minority (vs. majority) in-groups. However, their model also included a serial mediator: expected cooperation. They theorized that due to the heightened distinctiveness and belongingness of minority (vs. majority) in-groups, their members might expect greater cooperation from other members, which in turn predicts their own willingness to cooperate.

However, distinctiveness and belongingness are identity benefits, whereas cooperation is an instrumental benefit of being in a group (Halevy & Landry, 2024; Scheepers et al., 2006). We suggest that expected cooperation might be an independent pathway that directly explains the impact of minority (vs. majority) group membership on in-group love, and not just a downstream consequence of increased optimal distinctiveness. That's because a minority group is likely to have fewer members than a majority group (in terms of absolute size), and this should heighten expected cooperation for several reasons. First, people may expect others to contribute more resources and work to an in-group of smaller absolute size because their contribution would loom larger (Kerr, 1996). For example, a co-author of a report seems more laudable if they are one of three versus ten co-authors. People may therefore perceive their fellow in-group members as having stronger incentives to cooperate in smaller in-groups. Second, people may expect less diffusion of responsibility in an in-group with few (vs. many) members (Fisher et al., 2011). Third, monitoring and punishing others (e.g., through gossip) is easier when an in-group has few members, and people may think that this deters social loafing (Carpenter, 2007). Fourth, people may expect to interact with one another more often in an in-group that has few members. This increased contact and familiarity may also increase expected cooperation (Bornstein & Craver-Lemley, 2017; Keller & Reeve, 1998; Zajonc, 1968). Therefore, being in the minority

may directly boost in-group love via instrumental and expected cooperation (which induces reciprocity), regardless of identity-relevant distinctiveness and belongingness.

Another possible explanation for the effects of being in the minority that does not derive from ODT is perceived group status. Rarity and exclusivity tend to increase the perceived value of objects, interests, and societies (Angulo & Courchamp, 2009; Imas & Madarasz, 2023). And the elite groups of various societies throughout history and across the globe have been minorities, not majorities. People therefore tend to make the reverse inference that minority groups (whose members are fewer and rarer to encounter) are higher status than majority groups (whose members are greater in number and more common; Cao & Banaji, 2017). Status is a fundamental need (Kenrick et al., 2010; Schwartz et al., 2012) and confers socioeconomic benefits, so people may prefer to identify, affiliate, an cooperate with higher-status in-groups. Thus, being in the minority may also boost in-group love because it increases the perceived status of the in-group. Again, such a psychological process would occur independently from the identity-related belongingness and distinctiveness effects predicted by ODT.

In sum, minority (vs. majority) in-groups may display greater in-group love due to perceived in-group distinctiveness, belongingness, expected cooperation, and status.

When being in the minority may boost in-group love

We draw on ODT to propose that both relative group size and absolute group size may moderate the relationship between being in the minority and in-group love. First, ODT argues that the distinctiveness and belongingness of an in-group are balanced when it is a moderate minority (Brewer, 1991), that is, when it is neither close to parity with the majority group, nor too small relative to the majority group. The precise optimal proportion depends on the context (Leonardelli et al., 2010). What is certain, however, is that as the in-group's relative size

approaches 0%, its belongingness declines, and as the in-group's relative size approaches 50%, its distinctiveness declines. Greater in-group love emerges when the in-group satisfies its members' needs, including distinctiveness and belongingness. Thus, ODT predicts that minority group membership is particularly likely to boost in-group love when the minority in-group is moderate-sized (vs. approaching 0% or 50% representation).

Moreover, larger absolute group size might also deactivate the benefits of being in a minority (vs. majority) in-group. Specifically, the homogeneity and entitativity of an in-group tend to decline when it has many (vs. few) members (Hamburger et al., 1975; Hornsey & Hogg, 1999; Lickel et al., 2000). As such, large absolute group size may disrupt the identity benefit of shared in-group distinctiveness. Additionally, larger absolute size is likely to reduce instrumental expectations of in-group cooperation, as larger groups have smaller incentives to cooperate, more diffusion of responsibility, fewer deterrents to social loafing, and less intragroup contact. Together, these lines of reasoning suggest that larger absolute size is likely to interrupt the effects of minority group membership on in-group love.

We test these two proposed boundary conditions in this work, exploring whether the benefits of being in the minority for in-group love only manifest among in-groups of moderate relative size and small absolute size. Moreover, we examine whether the four mediators proposed above (belongingness, distinctiveness, expected cooperation, and status) explain any boundary condition we identify.

Research questions and objectives

In the current work, we address three open questions. First, does being in the minority increase in-group love across a variety of real-life in-groups? The previous work cited above mostly examined small samples of White college students who encountered minimal (i.e.,

artificial) groups in scientific studies run in campus labs. This was an acceptable standard at the turn of the millennium, even though detecting small effects ($d = 0.2$) with an 80% chance while accepting a 5% chance of making a false discovery requires roughly 400 people per between-subjects cell (Faul et al., 2009). To answer whether being in the minority increases in-group love more conclusively, we draw on large and diverse samples of online workers and examine a vast digital archive to test the ecological validity of the relationship between minority group membership and in-group love.

Second, does ODT fully explain why being in the minority boosts in-group love? According to ODT, a moderate-sized minority satisfies its members' fundamental identity needs for standing out (distinctiveness) and blending in (belonging). These, in turn, are characterized as antecedents of reliable cooperation. Indeed, previous research showed that the members of a minority (vs. majority) in-group feel more unique at the intergroup level (Brewer & Weber, 1994; Simon & Hamilton, 1994) and sufficiently assimilated at the intragroup level (Ellemers et al., 1999; Nelson & Miller, 1995; Simon & Brown, 1987). Moreover, the results reported by Leonardelli and Loyd (2016) were consistent with a serial mediation pathway whereby minority group membership predicted greater optimal distinctiveness, which in turn increased expected cooperation, which was ultimately correlated with in-group love. However, we suggest that expected cooperation may be an explanation that operates orthogonally to distinctiveness and belongingness, also because cooperation is an instrumental benefit, whereas optimal distinctiveness in an identity benefit (Scheepers et al., 2006). We also suggest that perceived group status may explain the effect of minority (vs. majority) representation independently. Thus, we modeled distinctiveness, belongingness, expected cooperation, and perceived status as parallel, not serial mediators / explanations.

Third, what are theoretically relevant boundary conditions of the effect of being in the minority on in-group love? We propose two relevant factors: absolute and relative group size. First, think of an in-group with 200 members in comparison to an out-group with 800 members. The in-group is the minority but includes many people. As reviewed above, a large absolute group size may interfere with the group's shared distinctiveness and the extent of in-group cooperation that its members expect. As a result, in-group love among minority group members may dampen when the minority in-group has many (vs. few) members. In addition, and consistent with ODT, the distinctiveness and belongingness of an in-group are optimally balanced only when it is a moderate-sized minority. Thus, in-group love may also diminish when the in-group's relative size approaches 0% or 50% (Leonardelli & Loyd, 2016). We explore these theoretical moderators in our experiments, and empirically test their relationship to our hypothesized mediators.

Overview of the current work

This paper has three parts. The first part concerns ecological validity. In Study 1, people listed a variety of real-life in-groups and out-groups. People rated their minority (vs. majority) in-groups but not their minority (vs. majority) out-groups as more communal. In Study 2, opponents in a chess game were more likely to cooperate by agreeing on a draw if both players represented the same nation and their represented nation was a minority (vs. majority) at the tournament. Membership in minority (vs. majority) groups did not predict drawing if the two players represented different nations.

The second part of this paper disentangles separate explanations for the effect of being in the minority on in-group love. Study 3 found that being in a 33% minority (vs. 67% majority), minimal ("green" or "blue") in-group, transferred more money to fellow in-group members when

we guaranteed that the receiver would pocket double the transferred amount. We did not observe

the same effect for their transfer to a minority (vs. majority) out-groups. People's expectation

that the receiver would reciprocate only partially explained this cooperative behavior, leaving

room for further, non-instrumental explanations. Study 4 found that people appreciated their

minimal ("circle" or "square") in-group more when it was a 33% minority (vs. 67% majority). In

contrast, their appreciation of the out-group did not depend on whether it was a 67% majority or

33% minority. People also rated their in-group's distinctiveness, belongingness, and expected

cooperation. Modeling these separate, instrumental as well as identity-related explanations as

parallel mediators fully explained why being in the minority boosted in-group love. Studies 5

and 6 supported a fourth parallel mediator, namely, the perceived status of the in-group.

The third part establishes theoretical boundary conditions for minority group membership

boosting in-group love. In Study 5, people's appreciation of their minimal in-group (but not

out-group) was greater when it was a two-member 33% minority (vs. a four-member

67% majority). This pattern weakened when the two groups had larger absolute size, expressed

via frequencies (i.e., 167 members vs. 334 members) or proportions (i.e., 33% vs. 67% of

500 people). Being in the minority (vs. majority) was less predictive of in-group distinctiveness

and expected cooperation when it had many (vs. few) members in absolute terms. This suggested

that small absolute group size is a theoretically relevant boundary condition for the benefits of

minority (vs. majority) group membership for in-group love. Study 6 replicated people's greater

appreciation of their minority (vs. majority) in-group but not out-group when their minority

in-group was moderate-sized (here: 33% vs. a 67% majority), but not when the imbalance

between their minority in-group and the majority out-group was low (i.e., 46% and 54%) or

high (i.e., 20% and 80%). Larger imbalances were associated with less belongingness, and

smaller imbalances with less distinctiveness. This suggested that moderate relative group size is a boundary condition for the identity-clarifying processes proposed by ODT—distinctiveness and belongingness—to increase people's love for their minority in-groups.

Open science

Studies 4-6 were preregistered (link for Study 4; link for Study 5; link for Study 6), and all studies report all conditions and measures. All study materials, anonymized data, code, and results are available on the website of the Open Science Foundation (Gallardo & Koch, 2024; https://osf.io/84gnv/?view_only=c53e6507b1cc49aeb35721c6a524c406), except the data from Study 2 (because it was assembled by other researchers; see Zak, 2021). All studies (except Study 2) rescaled all independent variables to make them vary from -.5 to .5 and rescaled all dependent variables to make them vary from 0 to 1. This allows direct comparison of effect sizes across Studies 1, 3-6, and S1-S5 (i.e., five supplemental studies).

Study 1

People listed minority and majority groups that they are members of in real life (i.e., in-groups) and that they are not members of in real life (i.e., out-groups). This process resulted in a large and ecologically valid sample of groups. Next, people rated the communality of each group that they had listed. We predicted that people would perceive greater communality in the minority (vs. majority) in-groups but not out-groups.

Method

Study 1 had a within-subjects 2 x 2 design with relative group size (-0.5 = minority vs. 0.5 = majority) as one factor and membership (-0.5 = out-group vs. 0.5 = in-group) as the other. The dependent measure was perceived communality (ranging between 0 and 1).

Participants

We recruited 600 U.S. residents from the online worker platform Prolific Academic

(51.8% female, 47.3% male, 0.9% other; $M_{age} = 40.81$, SD = 14.28). Each person had completed

at least 100 other tasks and had been approved at a rate of at least 97% (we used these two

inclusion criteria in Studies 3-6 as well). We ran an effect size-sensitivity analysis via

100 simulations of Study 1's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the

size of the key interaction between relative group size and membership to be -0.02, -0.04,

and -0.06. The analysis yielded a statistical power of $1\text{-}\beta = 34\%$, 86%, and 100% to detect the

key interaction, respectively.

Procedure

All people listed eight societal groups. In the minority in-group condition, people listed

two groups for which both "**<u>Few</u>** people in society are a member of this group" and "You [the

participant] **<u>are</u>** a member of the group" were true. Examples of groups listed include "Twins,"

"Startup co-founders," and "Childless women." In the majority in-group condition, people listed

two groups for which both "**<u>Many</u>** people in society are a member of this group" and "You [the

participant] **<u>are</u>** a member of the group" were true (e.g., "Women," "Middle Class," and

"Parents"). In the two out-group conditions, people listed two minority groups that they were

not a member of (e.g., "Navy Seals", "Olympic athlete", and "billionaire") and two majority

groups that they were *not* a member of (e.g., "Democrats", "Heterosexuals", and "Atheists").

The order of these four within-subject conditions was randomized.

On the next survey page, people rated the communality of the eight groups in random

order on an efficient and factor-analytically validated slider (Koch et al., 2016) that ranged from

"UNTRUSTWOTHY, DISHONEST, COLD, THREATENING, REPELLENT, and

EGOISTIC" (0) to "TRUSTWORTHY, SINCERE, WARM, BENEVOLENT, LIKABLE, and

ALTRUISTIC" (100). We divided scores by 100 to create a measure of communality that ranged

between 0 and 1, with 1 meaning that a group was seen as more communal.

Finally, people provided demographic information, including their age and gender.

Results

Main effects and interactions

Table 1 shows the results of a linear mixed model with random intercepts for participant,

to account for the multiple conditions and ratings per person. The model predicted perceived

communality from relative group size (minority vs. majority), membership (out-group vs.

in-group), and their interaction. We found a main effect of relative group size such that people

reported more communality in minority versus majority groups. Additionally, a main effect of

membership showed that people reported more communality in their in-groups, compared to

out-groups. Finally, there was an interaction between relative group size and membership. Two

planned contrasts clarified the interaction effect.

Table 1. Perceived communality by relative group size and membership in Study 1

|	*b* and 95% CI [LB, UB]	*t*	*p*
Relative Group Size: Minority vs. Majority	-0.02 [-0.03, -0.003]	-2.44	.015
Membership: Out-groups vs. In-groups	0.26 [0.24, 0.27]	38.65	< .001
R. Group Size * Membership	-0.06 [-0.09, -0.04]	-4.74	< .001
R. Group Size @ Membership = Out-groups	0.02 [-0.003, 0.03]	1.63	.104
R. Group Size @ Membership = In-groups	-0.05 [-0.07, -0.03]	-5.07	< .001

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Planned contrasts

As predicted, people rated minority in-groups as more communal than majority

in-groups. However, there was no significant difference in perceived communality

between people's minority and majority out-groups, see Figure 1 and Table 1.

Figure 1. Perceived communality of minority and majority in-groups and out-groups in Study 1
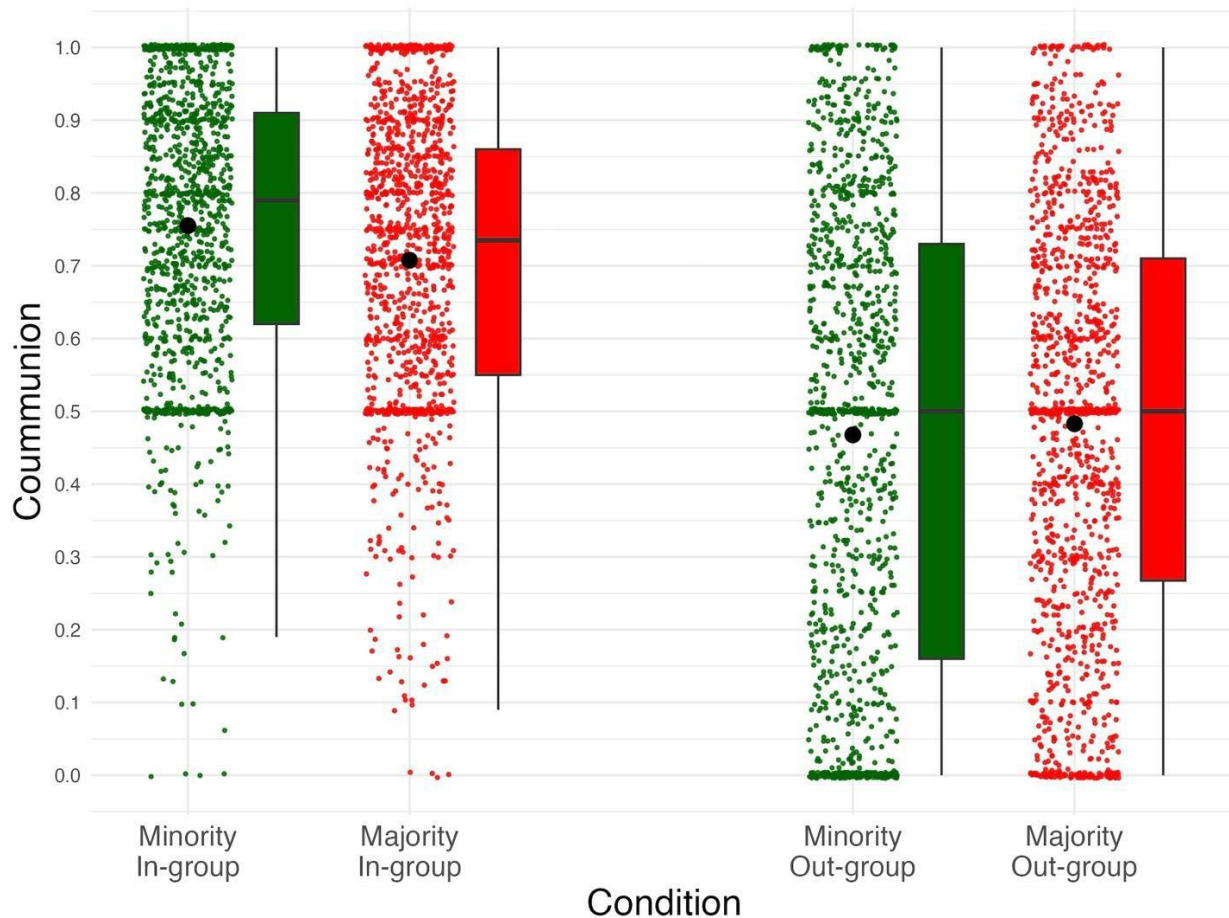
Note. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Discussion

People reported more communality in their real-life in-groups that are minorities (vs. majorities). However, perceived communality did not vary as a function of the relative size of people's real-life out-groups. This suggests that the amplification of in-group love through relative group size is an ecologically valid effect.

Study 1 has limitations. First, participants listed the groups whose communality they then

rated. Perhaps minority in-groups that come to mind first are group types that appear more communal than the majority in-groups that people list frequently (e.g., intimate groups such as one's family vs. social categories such as one's gender; Lickel et al., 2000). Thus, we may have found an effect of in-group type rather than relative group size. Second, Study 1 was conducted in an online lab where people are aware that they are being observed by researchers, which may influence their responses. Third, the outcome variable was a social evaluation (i.e., perceived communality) that did not have behavioral consequences. Study 2 addressed these limitations by analyzing people's cooperation with others in their minority (or majority) in-group (or out-group) in a real-life, high-stakes context.

Study 2

We examined face-to-face games in international chess and treated the nation that a player represented at a tournament as their in-group. We predicted that two opponents were more likely to draw their game if their in-group was a minority at the tournament. We did not predict this for two opponents who represented different nations (i.e., out-group games). A draw earned each player half a tournament point, whereas a win-loss earned the winner one tournament point and the loser none. Thus, drawing distributed tournament points evenly between the players without wasting any points. Although drawing can be the result of a hard-fought game, we used drawing as a proxy for cooperation because of a known phenomenon in tournament chess of early draw by agreement (Chassy & Gobet, 2015; Moul & Nye, 2009). Our data do not include information on game length, but we assumed that higher draw rates involve higher early-draw rates, indicating cooperation because they save mental and physical energy and time that can be invested in preparing for the next tournament game. Thus, Study 2 tested whether behavioral cooperation was more likely in minority (vs. majority) in-groups. This test included a variety of

nation groups whose members interacted synchronously in real life.

Method

Participants

We re-examined a dataset of game outcomes from official tournaments of the World Chess Federation, played between 2008 and 2015 (De Sousa & Hollard, 2023; Smerdon et al., 2020; Zak, 2021). We focused on standard games (i.e., at least one hour of thinking time per player) between rated opponents[2] that took place at international tournaments involving two or more nations and between 6 and 700 players. This left us with 144,778 players from 174 nation groups that played 3,675,577 games at 30,365 tournaments.

Procedure

We treated the nation that a player represented as their in-group and calculates its minority / majority representation relative to the other nation groups as $1 - (N_{\text{in-group players at the tournament}} / N_{\text{all players at the tournament}})$ so that it ranged from 0 (largest majority) to 1 (smallest minority). We treated games between players representing the same nation as in-group games, and games between players representing different nations as out-group games. By definition, in-group games included two opponents with the same minority / majority representation at the tournament. To study a comparable situation in out-group games, we focused on out-group games in which both opponents had about the same minority / majority representation at the tournament (i.e., their respective in-groups were of the same size, plus or minus three players). Finally, for each game, we measured whether it ended in a win-loss (0) or a draw (1).

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[2] In chess, a higher rating indicates that a player's relative skill is greater (Elo, 1978). We focused on rated opponents because it is essential to statistically control for chess ratings when predicting game outcomes.

Analysis

To comprehensively test whether the minority representation of a player's nation group increased the likelihood of drawing in in-group and out-group games, we estimated 72 linear probability models across five fully-crossed analytical decisions. This specification-curve analysis (Simonsohn et al., 2020) means that we ran the pivotal analysis separately for each combination of analytical decisions, without imposing assumptions on what analytical decisions should be made. The analysis goes beyond computing the proportion of combinations in which the pivotal statistic is significant, by testing this proportion against the null-hypothesis proportion (computed by subtracting out the relevant effect and reshuffling the data in each combination of analytical decisions; Simonsohn et al., 2020).

The first analytical decision was to include or exclude games of inter-club leagues, which arguably reduced the salience of the nation as a group (as it may have been supplanted by club-group identity), thereby interfering with the effect of nation-group minority on draws. The second decision was to include or exclude unbalanced games involving a rating difference larger than 400 points, where the likelihood of drawing is considerably low. The third decision was related to the overall size of a tournament, which could affect competitive motivation (Garcia & Tor, 2009). We considered including all tournaments, only tournaments with up to 100 players, or only tournaments with up to 50 players. The fourth decision was to include or exclude non-expert games (average rating < 2000), a common practice in the study of tournament chess (e.g., Chassy & Gobet, 2015; Smerdon et al., 2020). The fifth decision was to include fixed effects (dummy variables) for each player[3], each player in each year, or each tournament, which

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[3] To capture all the games played by a player, each game entered the analyses twice (player-game observations). This double-counting caused no bias: We clustered standard errors within each game and player.

disentangled player-related or tournament-related predictors from the effects of nation-group minority representation. These 2 x 2 x 3 x 2 x 3 analytical options resulted in 72 analyses for each subsample (i.e., in-group opponents and same-representation out-group opponents).

Across analyses, we statistically controlled for the opponents' average chess rating, a linear, quadratic, and cubic function of their absolute rating difference, whether they had played against each other before (dummy variable), and whether the player with the lower rating had the first-mover advantage of playing with the white pieces (dummy variable). We also statistically controlled for the players' gender and whether they played abroad. We did not control for country size because being in the minority is context dependent. Therefore, country size should not influence the effect of being in the minority on in-group love. For example, if two U.S. players and twenty Serbian players participate in an international chess tournament that includes 30 total competitors, the U.S. players are the minority and the Serbian players are the majority at the tournament, regardless of the overall size of their respective countries. Finally, we included fixed effects for the players' birth year, nation group, and number of games recorded in the dataset, as well as for the game's year and the tournament's day of play.

Results

We drew inferences from this specification-curve analysis, as suggested by Simonsohn and colleagues (2020). Across the 72 analyses using in-group games, the median effect of the smallest minority (vs. largest majority) of a player's nation on drawing was 3.13%. This median was larger than any of the 100 medians we computed when resampling the data 100 times under the null (by subtracting out the effects of minority representation observed in the real data). In other words, 3.13% was a significantly larger effect than what would be expected if the true effect of minority representation was zero, $p < .01$. The effect was also sizeable: considering

the baseline average draw frequency among our participants of 27.39%, the median effect of

smallest minority (vs. largest majority) was (3.13 / 27.39) = 11.42%. In addition, 62 out of the 72

analyses yielded a significantly positive coefficient (Figure 2), a rate larger than expected under

the null, $p < .01$.

Figure 2. Draw rates in the smallest minority (vs. largest majority) in-groups in Study 2
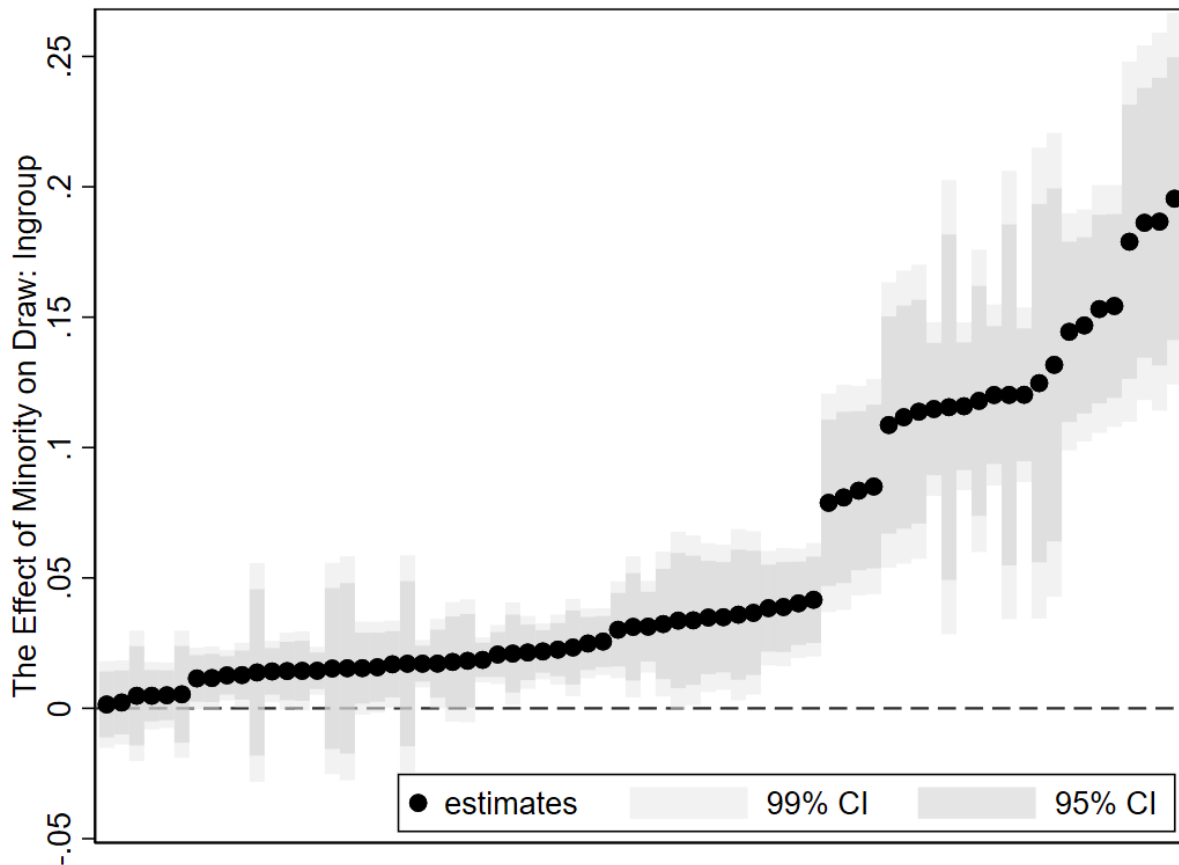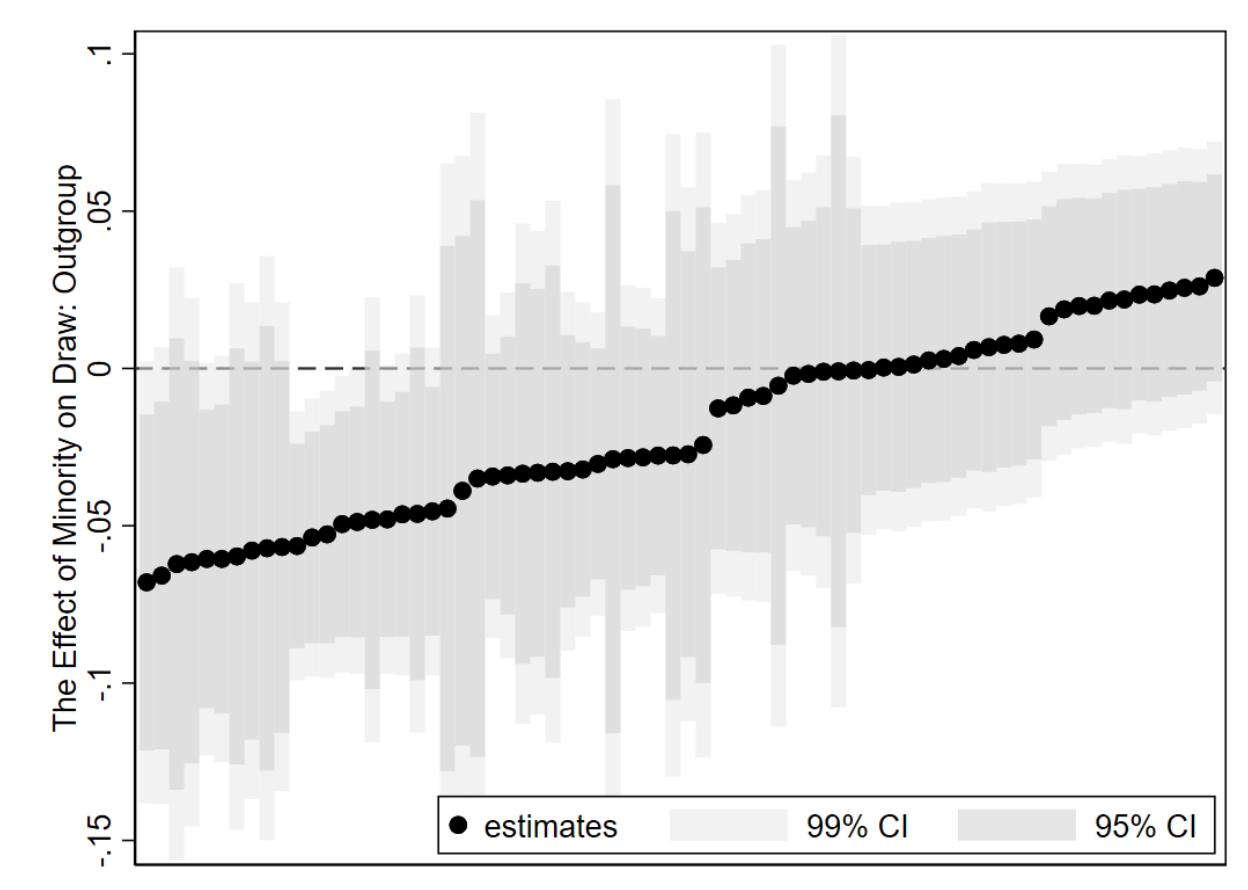

Note. Black dot = estimated effect of the minority of a player's nation on in-group drawing in each of 72 analytical specifications (Simonsohn et al., 2020); the curve orders effect sizes from most negative (left) to most positive (right).

Across the 72 analyses using out-group games, the median effect of smallest minority (vs.

largest majority) of a player's nation on drawing was -2.75%.[4] This median was smaller than expected under the null, $p = .04$. Here, 12 out of the 72 analyses yielded a significantly *negative* coefficient at the 5% level (Figure 3), a rate larger than expected if the true effect of minority was zero, $p < .01$.

Figure 3. Draw rates in the smallest minority (vs. largest majority) out-groups in Study 2

Note. Black dot = estimated effect of the minority of a player's nation on out-group drawing in each of 72 analytical specifications (Simonsohn et al., 2020); the curve orders effect sizes from most negative (left) to most positive (right).

Next, we examined the interaction: We reran the 72 analyses using both in-group and

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[4] Note that looking at the effects of a player's relative minority representation is equivalent to looking at the effects of their out-group opponent's relative minority representation since we only included games where both players were similarly represented in our analyses.

out-group games and included a dummy variable indicating the subsample (0 = out-group, 1 = in-group) and the interaction term of this dummy variable with our continuous minority representation variable. Across the 72 analyses, the median interaction effect was 9.00%, meaning that the minority-drawing effect was larger among in-group games than out-group games, as expected. This median was larger than expected under the null, $p < .01$. Moreover, the minority-drawing effect was larger among in-group games than out-group games in 72 out of the 72 analyses (Figure S2 in the online supplement). This rate was larger than expected under the null, $p < .01$.

Discussion

Study 2 examined a variety of national groups. The results showed that people in a dyad cooperated more with each other when they shared a minority nation group, but not when they came from differing minority nation groups. Importantly, the minority representation of people's national in-group enhanced a meaningful behavior (i.e., cooperation) in a real-life context (i.e., public contests) where people were unaware that they were being observed. Taken together, Studies 1 and 2 established that minority (vs. majority) in-groups feature greater perceived communality and exhibit more cooperation (both of which we take as proxies for in-group love) in real life. Thus, it seems that "being in the minority boosts in-group love" is an ecologically valid effect.

Next, we turned our attention to mediators and then moderators. Studies 3 and 4 addressed *why* the members of minority groups display greater in-group love than the members of majority groups (mediators). Studies 5 and 6 addressed *when* the members of minority groups display greater in-group love than members of majority groups (moderators). To these ends, Studies 3-6 relied on efficient research designs that maximized control at the expense of realism. We examined how people feel and behave towards color- or shape-coded minimal groups that

were either the minority or majority in their context (Tajfel et al., 1971).

Study 3

A minority group can have few members. People whose in-group has only few (vs. more) members should expect more instrumental cooperation in their in-group for several reasons. First, each member's contribution to sustained cooperation would loom larger (Kerr, 1996). Second, each member can rely on less other members to contribute in their stead (Fischer et al., 2011). Third, each member is more easily caught and punished for slacking off (Carpenter, 2007). Fourth, few (vs. many) in-group members have more contact with one another, which breeds familiarity and trust (Keller & Reeve, 1998; Zajonc, 1968). Thus, people may expect more cooperation in minority in-groups with few members (vs. majority groups with more members), in turn increasing actual cooperation. Study 3 tested this in the context of two minimal groups the members of which played an incentivized cooperation game with one another. We predicted that expected and actual cooperation would depend on whether people's in-group (but not out-group) is a few-members minority or more-members majority.

Method

Study 3 had a mixed 2 x 2 design, with relative group size (-0.5 = minority vs. 0.5 = majority) as the between-subjects factor and membership (-0.5 = out-group vs. 0.5 = in-group) as the within-subjects factor. The dependent measure was transferred money (actual cooperation).

Participants

We recruited 1,000 U.S. residents from Prolific. We excluded 133 people who failed an attention check, leaving 867 people (38.8% female, 58.7% male, 2.5% other; 41.9% young, 50.5% middle-aged, 5.7% elderly, 2.0% other). The exclusion rate was higher in this study because the attention check was disguised as a dependent measure instead of appearing on a

separate page at the beginning of the study in an obvious way. We ran an effect-size sensitivity

analysis via 100 simulations of Study 3's data (Green & MacLeod, 2016). We set α to 0.05 and

estimated the size of the key interaction between relative group size and membership to be -0.02,

-0.04, and -0.06. The analysis yielded a statistical power of $1\text{-}\beta = 12\%$, 41%, and 63% to detect

the key interaction, respectively.

Procedure

All people played an economic game within a minimal group paradigm (Tajfel et al.,

1971). First, people read "For the purpose of this study, you are a member of the BLUE [or

GREEN] group." Next, they clicked on a button that completed the sentence "I understand that I

am a member of the" with "BLUE [or GREEN] group." These groups count as minimal or

at least get close to minimal according to Tajfel and colleagues (1971) criteria of random

assignment, anonymity, distance (i.e., no in-person encounter of other in-group members),

temporariness, and insignificance.

People were then randomly assigned to join the minority or majority. People in the

minority condition read: "You are a member of the BLUE [or GREEN] group. There are 5 other

people. 1 person who is also a member of the BLUE [or GREEN] group, and 4 people who are

members of a GREEN [or BLUE] group." Conversely, people in the majority condition were

informed: "You are a member of the BLUE [or GREEN] group. There are 5 other people. 3

people who are also members of the BLUE [or GREEN] group, and 2 people who are members

of the GREEN [or BLUE] group." Thus, in the minority condition, people encountered one other

in-group member and four out-group members, whereas in the majority condition, people

encountered three other in-group members and two out-group members. People were then

grouped with these five people online and in real time.

Following this, all six people were briefed with the rules of a dyadic economic game and

upon passing two comprehension checks, simultaneously played the incentivized game with each of the five other people they had been grouped with. Each player received five $0.50 bonuses and had the option to transfer any portion of their bonuses to each of their five co-players ("To player BLUE2, I send …").[5] Players were informed that the transferred money would be doubled for the recipient co-players. They were also informed that each other player also received five $0.50 bonuses and would have the opportunity to transfer any portion of their bonuses to each of their five co-players, and that transferred money would be double for the recipient co-players as well. Importantly, players were unaware of the amounts sent to them by their five co-players when making their own transfer decisions. The players' interaction was anonymous. They could not communicate and knew nothing about one another except that they were members of the color-coded minority or majority.

Before transferring between $0 and $0.50 to one another, players used five 0-50 sliders to indicate how much money they expected their co-players to transfer to them ("I expect BLUE2 will send me …"), which we used as a measure of expected cooperation. Co-players never learned how much money the players expected from them. We used the transferred amount as a measure of actual cooperation. The more they transferred, the more they cooperated by creating value (Dorrough & Glöckner, 2016; Koch et al., 2020). For example, if both players in a dyad transferred $0.50, we would pay both $1. If one transferred $0.5 and the other transferred $0, we would pay them $0 and $1.5, respectively. If both transferred $0, we would pay them (their initial bonuses of) $0.5. For each player, we randomly selected one co-player and paid the player according to their own transfer decision and the co-player's transfer decision towards the player.

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[5] Given that our study design created more majority (vs. minority) members, we had more observations of transfers to majority members (12) than minority members (2). Thus, our statistical power was constrained by the number of minority observations in our sample.

There was no deception in the game.

Finally, people provided demographic information, including their age and gender.

Results

Table 2. Actual and expected cooperation by relative group size and membership in Study 3

|	b and 95% CI [LB, UB]	t	p
DV = Expected Cooperation			
Relative Group Size: Minority vs. Majority	-0.01 [-0.02, -0.01]	-4.22	< .001
Membership: Out-group vs. In-group	0.10 [0.09, 0.11]	29.49	< .001
R. Group Size * Membership	-0.02 [-0.06, 0.02]	-0.93	.354
R. Group Size @ Membership = Out-group	-0.004 [-0.03, 0.02]	-0.39	.697
R. Group Size @ Membership = In-group	-0.02 [-0.05, -0.001]	-2.08	.038
DV = Actual Cooperation			
Relative Group Size: Minority vs. Majority	-0.02 [-0.02, -0.01]	-7.93	< .001
Membership: Out-group vs. In-group	0.06 [0.06, 0.06]	25.13	< .001
R. Group Size * Membership	-0.03 [-0.08, 0.02]	-1.24	.214
R. Group Size @ Membership = Out-group	-0.003 [-0.03, 0.02]	-0.24	.809
R. Group Size @ Membership = In-group	-0.03 [-0.06, -0.01]	-2.65	.008
Mediation Test @ Membership = In-group			
c: R. Group Size → Actual Coop.	-0.03 [-0.06, -0.01]	-2.94	.003
a: R. Group Size → Expected Coop.	-0.02 [-0.05, -0.002]	-2.21	.027
b: Expected Coop → Actual Coop.	0.55 [0.51, 0.59]	26.65	< .001
c': R. Group Size → Actual Coop.	-0.02 [-0.04, -0.001]	-2.10	.036
Indirect Effect: IV → M → DV	-0.01 [-0.03, -0.001]		

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Main effects and interactions

Table 2 shows the results of a linear mixed model (with random intercepts for participant)

that predicted transferred money (actual cooperation) from three fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), and their interaction. We found a main effect of relative group size such that people transferred more money to the members of the minority (vs. majority) group. Additionally, a main effect of membership indicates that people transferred more money to in-group members than out-group members. Finally, there was no interaction between relative group size and membership on transferred money. We found the same pattern of results in a second model that predicted expected money (expected cooperation) instead of transferred money, see Table 2.

Figure 4. Money transferred within minority and majority in-groups and out-groups in Study 3
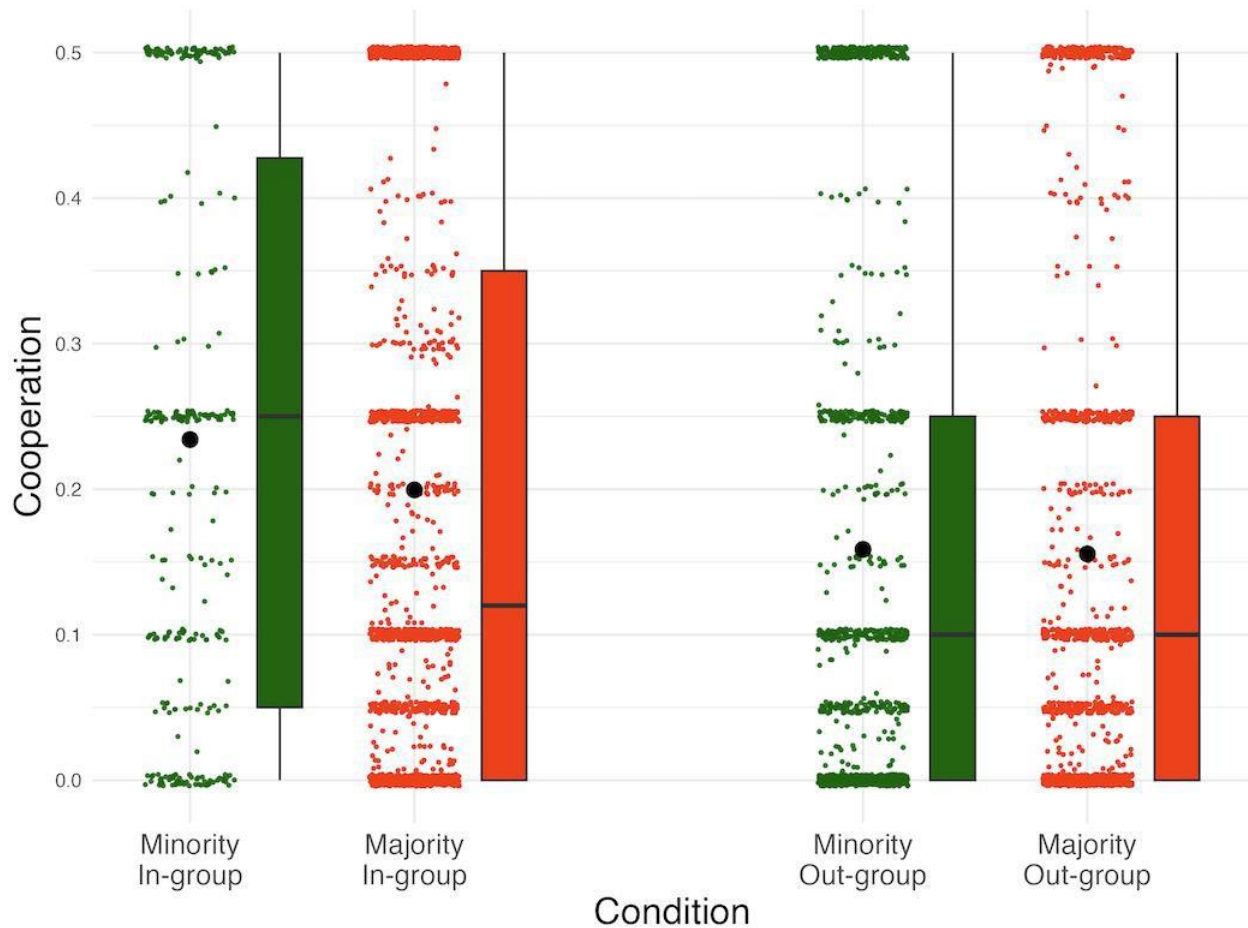
Note. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Planned contrasts

As predicted, people transferred more money to in-group members if their in-group was the minority, compared to when their in-group was the majority. In contrast, the relative size of the out-group did not influence the amount of money that people transferred to out-group members, see Table 2 and Figure 4. We found the same pattern of results for planned contrasts that predicted expected money (expected cooperation), see Table 2.

Test of mediation

We used Hayes's (2018) PROCESS model 4 code to test whether the players transferred more money to minority (vs. majority) in-group members because they expected to receive more money from minority (vs. majority) in-group members. In all studies, we followed Yzerbyt and colleagues' (2018) recommendation to conclude statistical mediation: the IV needs to predict the mediator (significant a path), the mediator needs to predict the DV (significant b path), and the 95% CI of the indirect effect of the IV on the DV through the mediator needs to exclude 0 (be statistically significant). Table 2 shows that expected in-group cooperation partially mediated the effect from the in-group being the minority (vs. majority) to actual in-group cooperation. This statistical mediation supports (but does not prove, see Fiedler et al., 2011) the theoretical mediation hypothesized above.

Discussion

Study 3's main effects revealed that expected and actual cooperation were greater within (vs. between) groups and with minorities (vs. majorities). The interaction between membership and relative group size was not significant. The absence of an interaction might be explained by our design: one third of the participants play the cooperation game with the one other member of their minority in-group, and the other two thirds play the cooperation game with the three other members of their majority in-group. Thus, we had six times more observations for the majority

(vs. minority) in-group. Nevertheless, as predicted and consistent with previous work (Bonacich et al., 1976; Leornardelli & Loyd, 2016; Mullen, 1991; Schmitt & Marwell, 1972), our planned contrasts showed greater expected and actual cooperation in people's in-group when it was the minority and had few members (vs. majority and had more members). Expected and actual cooperation with out-group members did not depend on whether the out-group was the minority (vs. majority).

Importantly, expected in-group cooperation partially but not fully mediated the effect of minority (vs. majority) group membership on actual in-group cooperation. This suggests (but does not prove) that there are additional mediators explaining the relation between relative group size and in-group love, with the needs for distinctiveness and belongingness, as proposed by ODT (Brewer, 1993; Leonardelli et al., 2010; Leonardelli & Loyd, 2016), as possible candidates. We test these identity-clarifying mediators in Studies 4-6.

The results of Supplemental Study 1 also suggest that there are additional underlying mechanisms. In SS1, participants played a similar game that did not allow direct cooperation—a dictator game (as opposed to the prisoner's dilemma game in Study 3). Thus, SS1 was the same as Study 3 except that the participants transferred money without creating value (i.e., we did not double the transferred amount) and without the possibility of receiving money in return. The results showed that people transferred (i.e., donated) more money to in-group members if they were in the minority (vs. majority), whereas people's donations to members of the out-group did not depend on whether the out-group was in the minority or majority. Thus, minority group membership boosted in-group love even in the absence of direct cooperation. Although the absence of direct cooperation does not ensure the absence of reciprocity (Yamagishi et al., 2012; Yamagishi & Kiyonari, 2000), we argue that these findings, combined with the partial mediation finding in Study 3, provide reason to believe that expected cooperation from fellow in-group

members, an instrumental motive, is not the only motive and mechanism at play.

Study 4

According to Optimal Distinctiveness Theory (ODT; Brewer, 1991; 2003; Leonardelli et al., 2010), membership in a moderate-sized minority sufficiently satisfies people's fundamental identity need to belong. At the same time, a moderate-sized minority group satisfies its members' fundamental identity need to be distinct much more than membership in a majority group. Through these processes, ODT predicts that the members of a moderate-sized minority in-group should appreciate, and cooperate with, one another more, compared to the members of a majority in-group. In Study 4, we relied on a test of parallel mediation to examine whether the processes of distinctiveness, belongingness, and expected and instrumental cooperation separately explain why people's appreciation of their in-group is greater when it is the minority (vs. majority). We predicted that people's appreciation of the out-group would not depend on its relative group size.

A secondary objective of Study 4 was to test whether the effect of being in the minority on in-group love generalizes to groups people choose to join (vs. those they are randomly assigned). Such groups, including one's religion, political party, neighborhood, occupation, employer, and hobbies, are common in real life. In Study 1, people did not exclusively list in-groups that they had chosen to join (i.e., they also listed groups like gender, age, race/ethnicity, and sexual orientation). Similarly, most chess players in Study 2 probably did not choose their national group. And in Study 3, we forced people to join a minimal color group. Thus, it remains unclear whether being in the minority boosts in-group love for chosen in-groups. Moreover, sharing rare preferences attracts relative to sharing common preferences (people fancying the same song vs. music in general; Alves, 2018; Vélez et al., 2019), and many preferences are chosen rather than forced. Aiming to generalize from chosen preferences to chosen membership, we predicted that relative minority (vs. majority) in-group members would

display greater in-group love regardless of whether membership is forced or chosen.

Method

      Study 4 had a mixed 2 x 2 x 2 design with relative group size (-0.5 = minority vs. 0.5 = majority) as a between-subjects factor, membership (-0.5 = out-group vs. 0.5 = in-group) as a within-subjects factor, and way of joining (-0.5 = by force vs. 0.5 = by choice) as a between-subjects factor. The dependent measure was expressed appreciation.

Participants

      We recruited 4,075 U.S. residents from Prolific (49.3% female, 48.7% male, 2.0% other; $M_{age} = 40.63$, $SD = 15.03$). We ran an effect size-sensitivity analysis via 100 simulations of Study 4's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06. The analysis yielded a statistical power of $1-\beta = 22\%$, 72%, and 91% to detect the key interaction between relative group size and membership, respectively.

Procedure

      We manipulated membership (in-group vs. out-group) as in Study 3, but used shapes (i.e., circle vs. square) in lieu of colors to vary the labels of the minimal groups. We randomly assigned people to join their in-group by way of force or choice. People in the *by force* condition read: "For the purpose of this study, you are a member of the CIRCLE [or SQUARE] group." Next, they clicked on a button that labeled "CIRCLE [or SQUARE] group" as part of the sentence: "I understand that I am a member of the CIRCLE [or SQUARE] group." People in the *by choice* conditions read: "For the purpose of this study, you can choose between being a member of the CIRLCE group and being a member of the SQUARE group. Which group do you choose?" They clicked on one out of two buttons that read "CIRCLE group" and "SQUARE group" as part of the sentence: "I choose to be a member of the CIRCLE [or SQUARE] group."

On the next page, we manipulated relative group size as in Study 3. That is, in the minority in-group condition, people encountered only one other in-group member and four out-group members, whereas in the majority in-group condition, people encountered three other in-group members and two out-group members.[6] On the same page, we used two warmth sliders and two positivity sliders to measure people's *appreciation* of the in-group and out-group (we operationalized love in terms of appreciation throughout Studies 4-6). We randomized whether people rated warmth before positivity or vice versa, and whether people rated the in-group before the out-group or vice versa.

The warmth sliders asked people to rate how warmly versus indifferent they feel towards the members of their in-group and out-group. The sliders ranged from 0 ("I feel indifferent towards them") to 100 ("I feel warmly towards them"; Haddock et al., 1993). The positivity sliders asked people to rate how positively versus neutral they think about the members of their in-group and out-group. The sliders also ranged from 0 ("I am neutral about them") to 100 ("I think positively about them"). For each person, we averaged perceived warmth and positivity separately for the in-group ($r = .87$, $p < .001$) and out-group ($r = .84$, $p < .001$), and we rescaled this measure so that it ranged from 0 (least appreciation) to 1 (greatest appreciation).

On each of the next four pages, we reminded people that they are a member of the CIRCLE or SQUARE group, and that their in-group is the minority or majority (minority: one other in-group member, four out-group members; majority: three other in-group members, two out-group members). Below this reminder, three randomly ordered sliders that ranged from "COMPLETELY DISAGREE" (0) to "COMPLETELY AGREE" (100) asked people to rate the distinctiveness, belongingness, expected cooperation, or relative size of their in-group. People

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[6] Unlike Study 3, participants in Study 4 were randomly assigned to the minority or majority condition, with nearly equal numbers in each group. This was also the case for Studies 5 and 6.

rated the three mediators on the first three pages in random order, and they rated relative size, the manipulation check, on the fourth page. The three sliders that captured *distinctiveness* read: "Being a member of the CIRCLE [or SQUARE] group makes me feel … distinctive [or unique, or like I stand out]" (α = .94). The three sliders that captured *belongingness* read: "Being a member of the CIRCLE [or SQUARE] group gives me a sense of … belonging [or community, or inclusion]" (α = .94). The three sliders that captured *expected cooperation* read: "In my view, members of the CIRCLE [or SQUARE] group … share goals and would pull together [or would repay favors to one another, or would cooperate with one another]" (α = .91). Finally, the three sliders that captured *relative size* read: "In my view, the CIRCLE [or SQUARE] group is … rare [or small, or few]" (α = .90). We rescaled the three mediators and the manipulation check so that they ranged from 0 to 1 (greatest distinctiveness, greatest belongingness, greatest expected cooperation, but smallest relative size).

Finally, people provided demographic information, including their age and gender.

Results

Manipulation check

People in the minority in-group condition perceived the relative size of their in-group to be smaller than people in the majority in-group condition, b = -0.27, 95% CI = [-0.29, -0.26], t = -37.01, $p < .001$.

Main and interaction effects

Table 3 shows the results of a linear mixed model (with random intercepts for the people) that predicted appreciation from seven fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), way of joining (by force vs. by choice), their two-way interactions, and their three-way interaction.

Table 3. Appreciation by relative group size, membership, and way of joining in Study 4

	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.02 [-0.03, -0.01]	-5.87	< .001
Membership: Out-group vs. In-group	0.17 [0.16, 0.17]	44.52	< .001
Way of Joining: by Force vs. Choice	0.02 [0.01, 0.04]	2.37	.018
R. Group Size * Membership	-0.07 [-0.10, -0.03]	-3.74	< .001
R. Group Size * Joining	0.01 [-0.001, 0.03]	1.84	.066
Membership * Joining	-0.02 [-0.04, -0.01]	-2.96	.003
R. Group Size * Membership * Joining	0.03 [-0.04, 0.10]	0.73	.467
Membership = Out-group			
R. Group Size @ Joining = Force	0.01 [-0.02, 0.04]	0.80	.422
R. Group Size @ Joining = Choice	0.01 [-0.01, 0.04]	0.86	.390
Membership = In-group			
R. Group Size @ Joining = Force	-0.07 [-0.09, -0.04]	-5.02	< .001
R. Group Size @ Joining = Choice	-0.04 [-0.07, -0.02]	-3.07	.002
Mediation Test @ Membership = In-group			
c: R. Group Size → Appreciation	-0.05 [-0.07, -0.04]	-5.47	< .001
a1: R. Group Size → Distinctiveness	-0.19 [-0.21, -0.17]	-21.58	< .001
a2: R. Group Size → Belongingness	0.05 [0.04, 0.07]	6.00	< .001
a3: R. Group Size → Expected Coop.	-0.02 [-0.04, -0.01]	-3.63	< .001
b1: Distinctiveness → Appreciation	0.22 [0.19, 0.26]	14.02	.003
b2: Belongingness → Appreciation	0.31 [0.27, 0.34]	16.86	< .001
b3: Expected Cooperation → Appreciation	0.55 [0.51, 0.60]	24.00	< .001
c': R. Group Size → Appreciation	-0.02 [-0.03, 0.0001]	-1.94	.052
Indirect Effect through Distinctiveness	-0.04 [-0.05, -0.03]		
Indirect Effect through Belongingness	0.02 [0.01, 0.02]		
Indirect Effect through Expected Coop.	-0.01 [-0.02, -0.01]		

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

We found a main effect of relative group size. People's appreciation of the minority group was greater than their appreciation of the majority group. We also found a main effect of membership; people's appreciation of their in-group (vs. the out-group) was greater. A third

significant main effect revealed that people's appreciation for the two groups was greater when they chose their in-group, versus when they joined their in-group by force.

Two out of the three two-way interactions were significant; the three-way interaction was not significant. The first significant two-way interaction revealed that people's greater appreciation of their in-group (vs. the out-group) was reduced when they had chosen to join it (vs. when we had forced them to join it). More importantly, we confirmed the predicted two-way interaction between relative group size and membership. Four planned contrasts clarified this interaction effect.

Planned contrasts

As predicted, people's appreciation of their in-group was greater when it was the minority (vs. majority). This was the case both when they had chosen to join it, and when we had forced them to join it, see Table 3. People's appreciation of the out-group did not depend on whether it was the minority or majority. This was the case both when they had chosen not to join it, and when we had forced them not to join it, see Table 3.

Test of mediation

We used Hayes's (2018) PROCESS model 4 code to test whether people's greater appreciation of their minority (vs. majority) in-group emerged due to their experienced distinctiveness, felt belongingness, or expected cooperation. We tested the three mediators simultaneously (i.e., in a parallel mediation model) such that the test of one mediator always controlled for the other two mediators. Table 3 shows that increased distinctiveness, decreased belongingness, and increased expected cooperation all mediated the effect of the in-group's minority (vs. majority) representation on people's appreciation of it. We used the same criteria as in Study 3 to conclude statistical mediation and found that the three parallel, simultaneous mediators fully explained the effect of the IV on the DV (see the significant total IV-DV effect

compared to the non-significant direct IV-DV effect in Table 3).

Discussion

Study 4 supported our hypothesis that people's appreciation of their minimal in-group is greater when it is a minority (vs. majority) that they joined by force or choice. Also, people's appreciation of the minimal out-group did not vary as a function of its relative group size regardless of whether the people had joined their in-group by force or choice.

Moreover, Study 4 estimated a parallel mediation model. Consistent with ODT (Brewer, 1991; Leonardelli et al., 2010), the in-group's minority (vs. majority) representation increased its distinctiveness a lot while not decreasing its belongingness much (a paths), suggesting that the 33% minority was close to being an optimally moderate-sized in-group. Going beyond ODT's identity-clarifying mechanisms (i.e., distinctiveness and belongingness), the in-group's minority (vs. majority) representation also directly increased the instrumental cooperation that its few (vs. more) members expected (a path). Distinctiveness, belongingness, and expected cooperation all increased people's appreciation of their in-group (b paths), resulting in three separate indirect effects from minority (vs. majority) representation to in-group appreciation. This pattern of results suggests that when a minority (vs. majority) in-group has few (vs. more) members, expected instrumental cooperation is a separate reason for increased in-group love, beyond ODT's shared distinctiveness (being in the minority slightly decreased in-group love through ODT's belongingness). Judging by the size of the three parallel indirect effects, distinctiveness had the greatest explanatory power, however. These inferences come with the caveats of interpreting tests of statistical mediation and inferring theoretical from statistical mediation (Fiedler, 2011), which we address in the general discussion.

In Supplemental Study 2 (SS2), we replicated both the significant simple effect of relative group size on appreciation of the in-group and the non-significant simple effect of

relative group size on appreciation of the out-group when we forced people to join a minimal, "green" or "blue" group. SS2 also replicated Study 4's two-way interaction between relative group size and membership. In addition, SS2 generalized these results from appreciation to willingness to interact as the dependent measure.

One potential limitation to these studies is that the online workers that we recruited from Prolific complete a comprehensive survey when they open their account on the platform. This survey records attributes, including the workers' gender, age, race, socioeconomic status, ideological beliefs, etc. Researchers can invite workers to participate in a study based on one or more of these attributes (e.g., only workers ages 60 or higher). For this or other reasons, minority in-group members in Studies 3 and 4 may have assumed that we assigned them to the minority group based on an attribute that they have, and the majority in-group members may have thought of a different attribute. The content of the first versus second attribute may explain why minority (vs. majority) in-group members expressed greater in-group love in Studies 3 and 4. To rule this out, the participants in Supplemental Study 3 (SS3), an offline (i.e., lab) study, spun a wheel of fortune to experience that their assignment to the "green" or "blue" minority or majority group was credibly random rather than based on some meaningful attribute. SS3 replicated the benefits of minority (vs. majority) representation on in-group love, and the lack of effect of relative group size on out-group love.

Study 5

Study 5 is the first study of the third and final empirical section of our paper, which is focused on exploring theoretically relevant boundary conditions. Study 5 tested whether small absolute group size is a boundary condition for the effects of minority group membership on in-group love. A 30% minority and 70% majority can be 3 and 7 people or 300 and 700 people, respectively. The absolute size of a 30% minority of 300 people may be so large that its members

no longer feel that their in-group is homogeneous, entitative, and distinct in a shared way (Brewer, 1991; Leonardelli et al., 2010), or they may start to expect inaction or defection (Latané & Nida, 1981; Hamburger et al., 1975). Thus, in Study 5 we tested whether the effect size of "being in the minority boosts in-group love" would shrink when the absolute sizes of a 33% minority and 67% majority are hundreds of people (vs. few folks as in Studies 3 and 4). We also tested whether such a shrinkage would be due to large (vs. small) absolute group size interfering with the effects of minority (vs. majority) group membership on the in-group's distinctiveness, belongingness, and expected cooperation.

However, any shrinkage we document may also be due to a greater ease of computing the relative size of a minority and majority group when their absolute size is small (e.g., 2 versus 4 members make a 33% minority and 67% majority) versus large (e.g., 166 versus 334 members; Barth et al., 2003; Xu & Spelke, 2000; 2005). To test this explanation, we operationalized large absolute group size in two ways. In a (more difficult to interpret) frequencies condition, people learned that the minority and majority included 167 and 333 of 500 people. In a (more easy to interpret) proportions condition, they learned that the minority and majority included 33% and 67% of 500 people. We predicted that the effect size of "being in the minority boosts in-group love" would shrink in both conditions, compared to a small absolute group size condition (2 and 4 people, as in Studies 3 and 4).

Study 5 also captured a fourth process, perceived status. Perhaps people would rate a smaller group as higher in status because socioeconomic elites tend to be smaller groups (Cao & Banaji, 2017). Thus, minority group membership may also boost in-group love through the perceived status of the in-group.

Method

Study 5 had a mixed 2 x 2 x 2 design with relative group size (-0.5 = minority vs. 0.5 = majority) as a between-subjects factor, membership (-0.5 = out-group vs. 0.5 = in-group) as a within-subjects factor, and absolute group size (-0.5 = few people vs. 0.5 = many people) as a between-subjects factor. We manipulated large absolute size (i.e., many people) in two ways. The first way was by frequencies (e.g., 167 people in the in-group and 333 people in the out--group). The second way was by proportions (e.g., 33% of the 500 other people are in the in-group and 67% of the 500 other people are in the out-group). We collapsed across the two manipulations of absolute group size in the main analysis, but some planned contrasts treated them as separate. The dependent measure was expressed appreciation.

Participants

We recruited 6,096 U.S. residents from Prolific (51.1% female, 46.8% male, 2.1% other; M_{age} = 39.87, SD = 14.83). We ran an effect size-sensitivity analysis via 100 simulations of Study 5's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06. The analysis yielded a statistical power of 1-β = 35%, 83%, and 99% to detect the key interaction between relative group size and membership, respectively.

Procedure

Study 5 manipulated relative group size and membership as in (the *joining by force* condition of) Study 4. That is, people joined a minority or majority in-group (i.e., "For the purpose of this study, you are a member of the CIRCLE [or SQUARE] group […]"), and there was one majority or minority out-group. We randomly assigned a third of the people to the *few people* condition of the absolute group size factor. As in Study 4, people in the minority in-group encountered one other in-group member and four out-group members, whereas people

in the majority in-group encountered three other in-group members and two out-group members. We randomly assigned another third of the people to the *many people indicated as frequencies* condition in which they encountered 500 other people. People in the minority in-group read: "You are a member of the CIRCLE [or SQUARE] group. There are 500 other people. 167 people who are also members of the CIRCLE [or SQUARE] group, and 333 people who are members of the SQUARE [or CIRCLE] group." People in the majority in-group read: "[…] 500 other people. 333 people who are also members of the CIRCLE [or SQUARE] group, and 167 people who are members of the SQUARE [or CIRCLE] group." We randomly assigned another third of the people to the *many people indicated as proportions* condition in which they encountered 500 other people. People in the minority in-group read: "You are a member of the CIRCLE [or SQUARE] group. There are 500 other people. 33% of the people are also members of the CIRCLE [or SQUARE] group, and 67% of the people are members of the SQUARE [or CIRCLE] group." People in the majority in-group read: "[…] 500 other people. 67% of the people are also members of the CIRCLE [or SQUARE] group, and 33% of the people are members of the SQUARE [or CIRCLE] group."

On the same page, we used two warmth sliders and two positivity sliders to measure people's *appreciation* of the in-group and out-group as in Study 4. For each person, we averaged perceived warmth and positivity separately for the in-group ($r = .87$, $p < .001$) and out-group ($r = .83$, $p < .001$), and as in Study 4 we rescaled this measure of appreciation so that it ranged from 0 (least appreciation) to 1 (greatest appreciation).

On each of the next five pages, we reminded people that they are a member of the CIRCLE or SQUARE group, that their in-group is the minority or majority, and that their in-group includes one other member or three other members (few people condition), 167 or 333 of the 500 other people (many people indicated as frequencies condition), or 33% or 67% of the

500 other people (many people indicated as proportions condition). Below, three randomly

ordered sliders per construct that ranged from "COMPLETELY DISAGREE" (0) to

"COMPLETELY AGREE" (100) asked people to rate the distinctiveness (α = .94),

belongingness (α = .94), expected cooperation (α = .91), status (α = .95), or relative size (α = .87)

of their in-group. People rated the four mediators on the first four pages in random order, and

they rated relative size, the manipulation check, on the fifth page. We measured the first three

mediators and the manipulation check as in Study 4. The three sliders that captured the fourth,

new mediator (*perceived status*) read: "In my view, the CIRCLE [or SQUARE] group is

prestigious [or has high social status, or is of high standing]." We rescaled the four mediators and

the manipulation check so that they ranged from 0 to 1 (greatest distinctiveness, belongingness,

expected cooperation, and status, but smallest relative size).

Finally, people provided demographic information, including their age and gender.

Results

Manipulation check

People in the minority in-group condition perceived the relative size of their in-group to

be smaller than people in the majority in-group condition, b = -0.34, 95% CI = [-0.35, -0.33], t =

-54.22, $p < .001$.

Main and interaction effects

Table 4 shows the results of a linear mixed model (with random intercepts for the people)

that predicted appreciation from seven fixed effects: relative group size (minority vs. majority),

membership (out-group vs. in-group), absolute group size (few people vs. many people), their

two-way interactions, and their three-way interaction. As before, people's appreciation of the

minority (vs. majority) was greater, and people's appreciation of their in-group (vs. the

out-group) was greater. A third significant main effect revealed that people's appreciation for the

two groups was greater when they encountered few (vs. many) people.

Two two-way interactions and the three-way interaction were significant or marginally significant as well. The two-way interaction between relative group size and absolute group size indicated that people's greater appreciation of the minority (vs. majority) group was more pronounced when they encountered few (vs. many) people. The two-way interaction between membership and absolute group size indicated that people's greater appreciation of their in-group (vs. the out-group) was more pronounced when they encountered few (vs. many) people. More importantly, the marginally significant two-way interaction between relative group size and membership was qualified by a significant three-way interaction between relative group size, membership, and absolute group size. Eight planned contrasts clarified this three-way interaction.

Planned contrasts

Table 4 shows that when people encountered few people as in Study 4, their appreciation of their in-group was greater when it was the minority (vs. majority), $b = -0.07$, $p < .001$, but their appreciation of the out-group did not depend on whether it was the minority (vs. majority), $b = -0.01$, $p = .404$. When people encountered many people, their appreciation of their in-group did not depend on whether it was the minority (vs. majority), $b = -0.01$, $p = .123$, while their appreciation of the out-group was greater when it was the minority (vs. majority), $b = -0.02$, $p = .040$. Four additional planned contrasts examined the simple effect of relative group size when distinguishing between the frequencies-based and proportions-based manipulations of large absolute group size. To summarize, the two-way interaction between relative group size and membership that we observed in the small absolute group size condition weakened and vanished when people encountered many people indicated by frequencies and proportions, respectively.

Table 4. Appreciation by relative group size, membership, and absolute group size in Study 5.

|	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.03 [-0.03, -0.02]	-8.86	< .001
Membership: Out-group vs. In-group	0.17 [0.17, 0.18]	56.09	< .001
Absolute Group Size: Few vs. Many People	-0.02 [-0.03, -0.01]	-2.73	.006
R. Group Size * Membership	-0.03 [-0.05, 0.001]	-1.92	.055
R. Group Size * A. Group Size	0.02 [0.01, 0.04]	3.78	< .001
Membership * A. Group Size	-0.02 [-0.04, -0.01]	-3.84	< .001
R. Group Size * Membership * A. Group Size	0.06 [0.01, 0.12]	2.24	.025
Membership = Out-group			
R. Group Size @ A. Group Size = Few	-0.01 [-0.03, 0.01]	-0.83	.404
R. Group Size @ A. Group Size = Many	-0.02 [-0.04, -0.001]	-2.05	.040
R. Group Size @ A. Group Size = Many/Freq.	-0.01 [-0.04, 0.01]	-0.99	.321
R. Group Size @ A. Group Size = Many/Prop.	-0.02 [-0.05, 0.001]	-1.90	.057
Membership = In-group			
R. Group Size @ A. Group Size = Few	-0.07 [-0.09, -0.04]	-5.48	< .001
R. Group Size @ A. Group Size = Many	-0.01 [-0.03, 0.003]	-1.54	.123
R. Group Size @ A. Group Size = Many/Freq.	-0.03 [-0.05, -0.001]	-2.11	.035
R. Group Size @ A. Group Size = Many/Prop.	-0.001 [-0.03, 0.02]	-0.06	.951

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Test of moderated mediation

We used Hayes's (2018) PROCESS model 7 code to test whether people's greater appreciation of their minority (vs. majority) in-group emerged due to its distinctiveness, belongingness, expected cooperation, or perceived status. We tested these four mediators simultaneously (i.e., in a parallel mediation model) such that the test of one mediator always controlled for the other three mediators. Additionally, we tested *moderated* parallel mediation to test whether the minority (vs. majority) representation of people's in-group boosted their appreciation of it more strongly when it had few (vs. many) members because the minority (vs.

majority) of the in-group predicted its distinctiveness, belongingness, etc. more strongly when it

had few (vs. many) members. This analysis collapsed across the two manipulations of large

absolute group size (i.e., frequencies and proportions). We used the same criteria as in Study 3

and 4 to conclude statistical moderated mediation. Figure 3 shows three significant moderated

mediations and we discuss the results below.

Figure 3. Moderated parallel mediation model estimated in Study 5
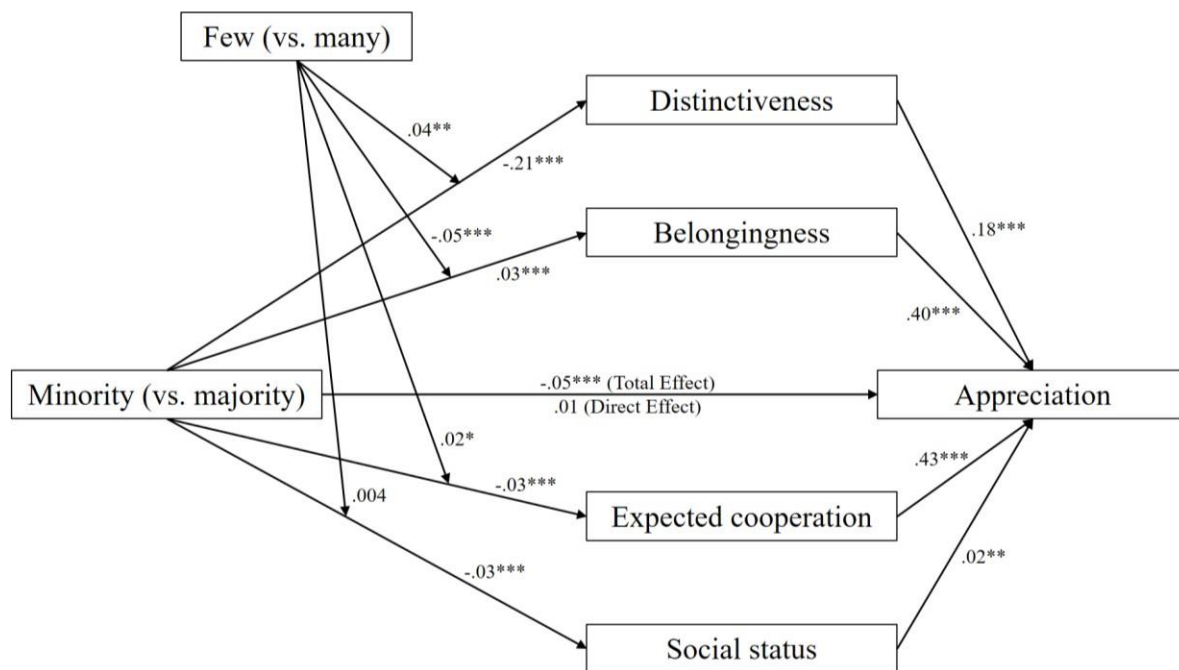
Note. * indicates *p* < .05; ** indicates *p* < .01; and *** indicates *p* < .001.

Discussion

Study 5 confirmed the three-way interaction that we had predicted. Specifically, minority

(vs. majority) group membership boosted in-group love but not out-group love when the

absolute size of both groups was as small as in Studies 3 and 4 (i.e., 2 and 4 people in the

minority and majority, respectively). This pattern of results was weaker when the groups'

absolute size was large and indicated as frequencies (i.e., 166 and 334 of 500 people), and the

pattern vanished entirely when their absolute size was large and indicated as proportions (i.e.,

33% and 67% of 500 people).

In addition, we estimated a moderated parallel mediation model, which suggested that

minority (vs. majority) representation boosted people's appreciation of their in-group through

increasing their experienced in-group distinctiveness, expected cooperation, and status, despite

decreasing felt in-group belongingness. The indirect effect through distinctiveness was largest

in size, as in Study 4. This parallel mediation was moderated because the sizes of the indirect

effects through distinctiveness, belongingness, and expected cooperation all shrunk in the large

absolute group size conditions, compared to the small absolute group size condition. This

suggests that small absolute group size is a theoretical boundary condition for the

identity-clarifying and instrumental benefits of being in the minority that increase in-group love.

Minority in-groups that are larger in absolute terms do not reap the same distinctiveness and

expected cooperation benefits as those that are smaller in absolute terms.

Supplemental Study 4 (SS4) was similar to Study 5, except that in SS4 we did not

measure mediators, there was only one large absolute group size condition that indicated

frequencies (not proportions), and we randomly assigned people to a minimal group defined by

its color (not shape). The results from SS4 replicated Study 5's key result that minority (vs.

majority) group membership boosted in-group love but not out-group love only when the

absolute size of both groups was small. When the absolute sizes of the groups were large

frequencies, this pattern vanished. In fact, in the large frequencies condition in SS4, minority (vs.

majority) group membership boosted out-group love ($p = .043$) rather than in-group love.

However, it boosted out-group love in neither the large frequencies condition of Study 5,

$p = .321$, nor in Study 5's condition that indicated large absolute group size as proportions,

$p = .057$. These marginal and inferentially inconsistent *p*-values do not convince us that minority

(vs. majority) group membership resoundingly boosts out-group love when the out-group has

many members indicated as a frequency or proportion.

One important question is whether and how our results can be reconciled with previous

research that found greater love within, say, a 20% minority (vs. an 80% majority) in-group (e.g.,

Leonardelli et al., 2001). One possible explanation is that in this past research, being in the

minority (vs. majority) only boosted in-group love if an additional condition was fulfilled (e.g.,

identifying with the in-group strongly rather than weakly). Another idea is that the past research

did not mention absolute group size, and the participants may have converted proportions to

small absolute group size (e.g., "2 out of 10 […]"), effectively self-generating our manipulation

of a few-people minority versus more (but not many)-people majority. Another possibility is that

people associate proportions with social categories such as blue-eyed people, whereas people

associate frequencies with social groups such as conservatives and football fans. People process

social categories and groups differently (Halevy & Landry, 2023; Scheepers et al., 2006). Thus,

small absolute group size may only become a boundary condition for minority (vs. majority)

boosting in-group love once absolute group size is mentioned, because mentioning absolute

group size makes people think more of social groups and less of social categories.

Study 6

Study 6 examined a second boundary condition for the effect of minority group

membership on in-group love. ODT predicts that a moderate-sized minority balances the

satisfaction of its members' identity needs for distinctiveness and belongingness. In contrast, a

minority that approaches 0% and 50% disrupts its belongingness and distinctiveness,

respectively. Thus, the benefits of minority group membership for in-group love should be larger

when the minority in-group is moderate-sized, compared to when its relative size is small

(approaching 0%) or large (approaching 50%). Study 6 tested this by varying the size of people's

in-group to be a 20% minority, 33% minority (as in Studies 3-5), 46% minority, 54% majority,

67% majority (as in Studies 3-5), or 80% majority. In addition, Study 6 measured distinctiveness,

belongingness, expected cooperation, and perceived status. Besides testing whether these four

processes separately explain the effects of minority group membership on in-group love as in

Study 5, measuring the processes allowed us to test whether the in-group's distinctiveness would

decrease, and whether its belongingness would increase, when its relative size increases from the

20% minority to higher proportions. This pattern of results would be consistent with ODT and

moderate size as a boundary condition for minority group membership boosting in-group love.

Method

Study 6 had a mixed 2 x 2 x 3 design with relative group size (-0.5 = minority vs. 0.5 =

majority) as a between-subjects factor, membership (-0.5 = out-group vs. 0.5 = in-group) as a

within-subjects factor, and imbalance (-0.5 = 46% minority vs. 0 = 33% minority vs. 0.5 = 20%

minority) as a between-subjects factor. The dependent measure was expressed appreciation.

Participants

We recruited 6,093 residents from Prolific (46.08 % female, 51.62% male, 2.3% other; M_{age}

= 39.97, SD = 13.51). We ran an effect size-sensitivity analysis via 100 simulations of Study 6's

data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size of the key interaction

between relative group size and membership to be -0.02, -0.04, and -0.06. The analysis yielded a

statistical power of $1-\beta$ = 38%, 83%, and 99% to detect the key interaction between relative group

size and membership, respectively.

Procedure

Study 6 manipulated relative group size and membership as in Study 5, except that instead of joining a shape minority or majority in-group, people joined a color minority or majority in-group (i.e., "For the purpose of this study, you are a member of the BLUE [or GREEN] group […]"). Again, there was a majority or minority out-group. We randomly assigned a third of the people to the *46% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 14 other people. 6 people who are also members of the BLUE [or GREEN] group, and 8 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 14 other people. 7 people who are also members of the BLUE [or GREEN] group, and 7 people who are members of the GREEN [or BLUE] group." We randomly assigned another third of the people to the *33% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 14 other people. 4 people who are also members of the BLUE [or GREEN] group, and 10 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 14 other people. 9 people who are also members of the BLUE [or GREEN] group, and 5 people who are members of the GREEN [or BLUE] group." We randomly assigned another third of the people to the *20% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 14 other people. 2 people who are also members of the BLUE [or GREEN] group, and 12 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 14 other people. 11 people who are also members of the BLUE [or GREEN] group, and 3 people who are members of the GREEN [or BLUE] group."

On the same page, we used two warmth sliders and two positivity sliders to measure

people's *appreciation* of the in-group and out-group as in Studies 4 and 5. For each person, we averaged perceived warmth and positivity separately for the in-group ($r = .87$, $p < .001$) and out-group ($r = .82$, $p < .001$), and as in Studies 4 and 5 we rescaled this measure of appreciation so that it ranged from 0 (least appreciation) to 1 (greatest appreciation).

On each of the next five pages, we reminded people that they are a member of the BLUE or GREEN group, that their in-group is the minority or majority, and that their in-group includes 11, 9, 7, 6, 4, or 2 of the 14 other people (i.e., that it is an 80%, 67%, or 54% majority or a 46%, 33%, or 20% minority). Below, three randomly ordered sliders per construct that ranged from "COMPLETELY DISAGREE" (0) to "COMPLETELY AGREE" (100) asked people to rate the distinctiveness ($\alpha = .93$), belongingness ($\alpha = .94$), expected cooperation ($\alpha = .90$), status ($\alpha = .95$), or relative size of their in-group ($\alpha = .87$) as in Study 5. People rated the four mediators on the first four pages in random order, and they rated relative size, the manipulation check, on the fifth page.

Finally, people provided demographic information, including their age and gender.

Results

Manipulation check

People in the minority in-group condition perceived the relative size of their in-group to be smaller than people in the majority in-group condition, $b = -0.35$, 95% CI = [-0.36, -0.34], $t = -57.40$, $p < .001$.

Main and interaction effects

Table 5 shows the results of a linear mixed model (with random intercepts for the people) that predicted appreciation from seven fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), imbalance (46% minority vs. 33% minority vs. 20% minority), their two-way interactions, and their three-way interaction. As before, people's

appreciation of the minority (vs. majority) group was greater, and people's appreciation of their

in-group (vs. the out-group) was greater. A third significant main effect revealed that people's

appreciation of the two groups was greater when they were more imbalanced (i.e., 20% and 80%

vs. 46% and 54%). Two out of three two-way interactions were significant as well. The two-way

interaction between relative group size and imbalance indicated that people's greater

appreciation of the minority (vs. majority) group was more pronounced when the two groups

were more imbalanced. The two-way interaction between membership and imbalance indicated

that people's greater appreciation of their in-group (vs. the out-group) was more pronounced

when the two groups were more imbalanced. The three-way interaction was not significant,

$p = .109$. Nevertheless, six planned contrasts tested the effect of relative group size in each cell

of the membership factor crossed with the imbalance factor.

Planned contrasts

Table 5 shows that in the 46% minority condition, people's appreciation of neither their

in-group, nor the out-group depended on whether it was the minority (vs. majority),

$b_{\text{in-group}} = -0.01$, p $= .624$, and $b_{\text{out-group}} = 0.002$, $p = .841$. In the 33% minority condition, people's

appreciation of their in-group was greater when it was the minority (vs. majority), $b = -0.03$,

$p = .028$, but their appreciation of the out-group did not depend on whether it was the minority

(vs. majority), $b = -0.01$, $p = .299$. In the 20% minority condition of the imbalance factor,

people's appreciation of their in-group did not depend on whether it was the minority (vs.

majority), $b = -0.01$, $p = .368$, but their appreciation of the out-group was greater when it was the

minority (vs. majority), $b = -0.06$, p $< .001$.

In sum, the predicted shape of the two-way interaction between relative group size and

membership only emerged when the imbalance between the two groups was moderate (i.e., a

33% minority and 67% majority) as in Studies 3-5. It vanished when the imbalance was low (i.e.,

a 46% minority and 54% majority), and it had a different, unpredicted shape when the imbalance

was high (i.e., a 20% minority and 80% majority).

Table 5. Appreciation by relative group size, membership, and imbalance in Study 6.

|	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.02 [-0.02, -0.01]	-6.45	$< .001$
Membership: Out-group vs. In-group	0.17 [0.16, 0.17]	57.22	$< .001$
Imbalance: 46% vs. 33% vs. 20% Minority	0.02 [0.003, 0.04]	2.35	.019
R. Group Size * Membership	0.01 [-0.02, 0.03]	0.45	.650
R. Group Size * Imbalance	-0.03 [-0.05, -0.02]	-4.45	$< .001$
Membership * Imbalance	0.02 [0.01, 0.04]	3.21	.001
R. Group Size * Membership * Imbalance	0.05 [-0.01, 0.12]	1.60	.109
Membership = Out-group			
R. Group Size @ Imbalance = 46% Minority	0.002 [-0.02, 0.02]	0.20	.841
R. Group Size @ Imbalance = 33% Minority	-0.01 [-0.04, 0.01]	-1.04	.299
R. Group Size @ Imbalance = 20% Minority	-0.06 [-0.08, -0.03]	-4.58	$< .001$
Membership = In-group			
R. Group Size @ Imbalance = 46% Minority	-0.01 [-0.03, 0.02]	-0.49	.624
R. Group Size @ Imbalance = 33% Minority	-0.03 [-0.05, -0.003]	-2.20	.028
R. Group Size @ Imbalance = 20% Minority	-0.01 [-0.04, 0.01]	-0.90	.368

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Test of mediation

We used Hayes's (2018) PROCESS model 4 code to test whether people's greater

appreciation of their minority (vs. majority) in-group emerged due to felt distinctiveness,

experienced belongingness, expected cooperation, or perceived status. We tested these four

mediators simultaneously (i.e., in a parallel mediation model) such that the test of one mediator

always controlled for the other three mediators. Study 6's imbalance factor (46% minority &

54% majority vs. 33% minority & 67% majority vs. 20% minority & 80% majority) was nuances

of the relative group size factor (minority vs. majority). Thus, we recoded the six conditions. We

recoded the 20% minority as -0.5, the 33% minority as -0.333, the 46% minority as -0.167, the

54% majority as 0.167, the 67% majority as 0.333, and the 80% majority as 0.5. This became the

independent variable in the parallel mediation model.

Figure 4. Parallel mediation model estimated in Study 6
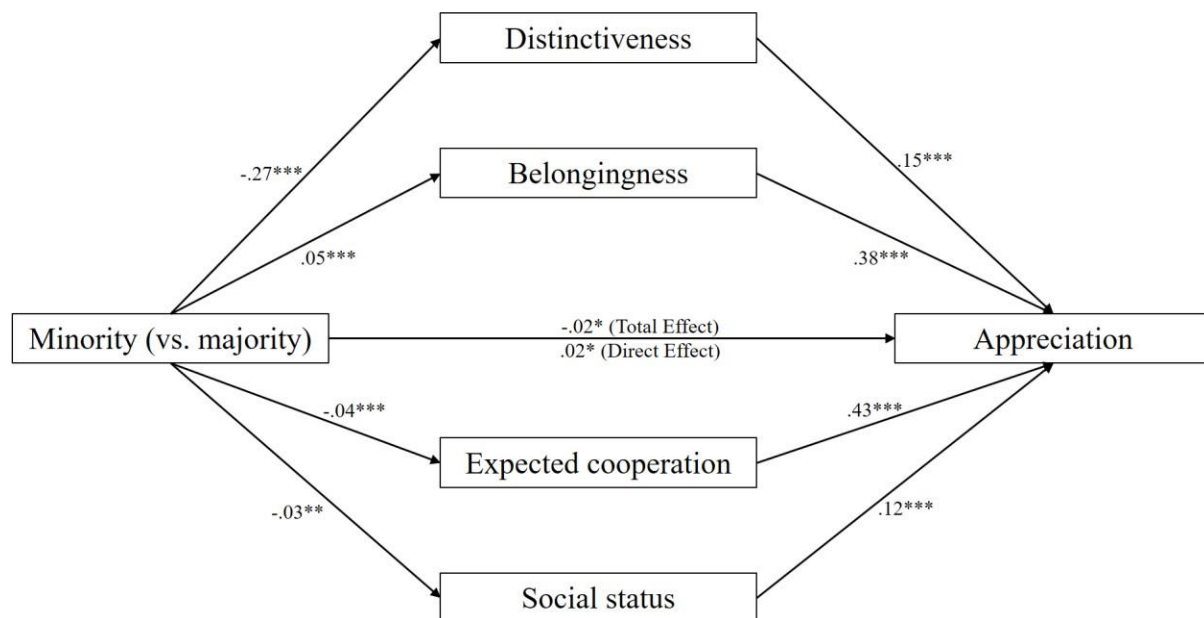
Note. * indicates $p < .05$; ** indicates $p < .01$; and *** indicates $p < .001$.

Using the same criteria for concluding statistical mediation as in Studies 4 and 5, we find

that distinctiveness, belongingness, expected cooperation, and status all mediated the effect of

the in-group's minority (vs. majority) group membership on people's appreciation of it,

$b_{distinctiveness} = -0.04$, 95% CI = [-0.05, -0.03], $b_{belongingness} = 0.02$, 95% CI = [0.01, 0.03],

$b_{expected cooperation} = -0.02$, 95% CI = [-0.02, -0.01], and $b_{status} = -0.003$, 95% CI = [-0.01, -0.001].

Indeed, the four parallel mediators flipped the IV's effect on the DV, compare the negative sign

of the significant total IV-DV effect with the positive sign of the significant direct IV-DV effect in Figure 4.

Discussion

Study 6's three-way interaction was not significant, which may be due to insufficient statistical power. Nevertheless, the results from the six planned contrasts were theoretically informative. Specifically, minority (vs. majority) group membership boosted in-group love but not out-group love when it was a 33% minority (vs. 67% majority), which replicated the results from Studies 3-5. This pattern vanished, however, when the imbalance of the minority and majority was low (i.e., 46% vs. 54%) or high (i.e., 20% vs. 80%). This pattern of planned contrasts is consistent with ODT (Brewer, 1991), which predicts that in-group love should peak in a moderate-sized minority because it balances its members' identity needs for distinctiveness and belongingness, which go unsatisfied in a minority group whose relative size approaches 0% (disrupting belongingness) or 50% (disrupting distinctiveness). To corroborate this inference, we estimated a parallel mediation model as in Study 4. The results showed that the in-group's distinctiveness decreased, and its belongingness increased, as its relative size increased from a 20% minority to higher proportions all the way to an 80% majority. These results are consistent with moderate-sized minority group membership as a theoretical, ODT-related boundary condition for the benefits of minority membership on in-group love.

Moreover, the parallel mediation model replicated the results of Studies 4 and 5 in that it was consistent with distinctiveness, belongingness, expected cooperation, and perceived status as separate explanations for why minority (vs. majority) group membership boosts in-group love. Distinctiveness emerged as the most powerful (i.e., predictive) explanation, as in Studies 4 and 5.

An unexpected result from Study 6 was that minority (vs. majority) group membership

strongly boosted out-group love but not in-group love when the imbalance between the minority and majority was high (20% and 80%, respectively). One possible explanation is that relatively small out-groups come across as vulnerable and elicit empathic concern, or relatively large out-groups come across as presumptuous and elicit malicious envy, or both. These speculations require future research. The above result was also unexpected because it was inconsistent with Supplemental Study 5 (SS5), a precursor to Study 6. SS5 was similar to Study 6, except that in SS5 we did not measure mediators, the minority plus majority were 11 people (vs. 15 people in Study 6), and we varied the relative size of people's in-group to be an 18%, 27%, 36%, or 45% minority (vs. a 82%, 73%, 64%, or 55% majority, respectively). The 18% minority and 82% majority condition of SS5 were similar to Study 6's 20% minority and 80% majority condition. Yet in the 18% minority and 82% majority condition of SS5, we found that minority (vs. majority) group membership boosted in-group love but not out-group love, the opposite of what we found in Study 6. This could be because in SS5 the 18% minority was a dyad (2 of 11 people), whereas Study 6's 20% minority was a triad (3 out of 15 people), and people might be particularly likely to exhibit in-group love in dyadic groups. Nevertheless, these inconsistent findings suggest that the effects of being the in minority on in-group love when the imbalance between the minority and majority group is very high are not very stable. We encourage future research to explore this question in more depth.

General Discussion

Previous work examined the attributes that increase people's appreciation of their in-group. One of these attributes is relative size, to which we refer as minority if the in-group's members make up less than 50% of the people in a context. The minority (vs. majority) representation of an in-group boosts its members' appreciation of, and cooperation with,

one another (i.e., in-group love; Bettencourt et al., 1999; Ellemers et al., 1992; Leonardelli &

Brewer, 2001; Lücken & Simon, 2005). Social appreciation and cooperation are essential for

humans to function wisely (Epley et al., 2022; Kumar & Epley, 2023; Silver & Small, 2023).

Thus, that minority group membership boosts in-group love is an important effect. Across six

main studies and five supplemental studies, we tested the ecological validity, separate identitarian

and instrumental explanations, and theoretical boundary conditions for this effect.

In Study 1, people appreciated various real-life groups by rating their communality.

People rated their minority (vs. majority) in-groups as more communal, but their impression of

the communality of out-groups did not depend on their minority (vs. majority) representation. In

Study 2, we examined drawing in chess games as a proxy for cooperating. Opponents were more

likely to end their game in a draw when they represented the same nation and it was a minority

(vs. majority) in an international tournament. Drawing did not depend on minority (vs. majority)

representation if the opponents represented different nations. Thus, Studies 1 and 2 established

the ecological validity of the effect that minority boosts in-group love but not out-group love.

Studies 3-6 predicted and confirmed separate explanations for the effect. In Study 3,

players in a dyadic game cooperated by transferring money to their co-player and creating value.

People transferred more money to co-players from their minimal in-group if it was the minority

(vs. majority), but the amount that people transferred to out-group members did not depend on

the out-group's relative size. Importantly, the expectation that the co-player would reciprocate

instrumental cooperation partially but not fully explained why people transferred more money to

co-players from their in-group if it was the minority (vs. majority). This left room for other,

identity-related explanations that we tested in Studies 4-6.

Optimal Distinctiveness Theory (ODT; Brewer, 1991; Leonardelli et al., 2010) argues

that minority (vs. majority) representation boosts in-group love because membership in a moderate-sized minority (vs. majority) better satisfies people's identity need to be distinct without undermining the satisfaction of their identity need to belong. A different explanation is that people perceive a minority (vs. majority) in-group as higher in status, consistent with socioeconomic elites being minorities, not majorities. In Studies 4-6, minority (vs. majority) representation boosted in-group appreciation but mostly not out-group appreciation, consistent with the results from Studies 1-3. Parallel mediation models suggested that distinctiveness, expected cooperation, and perceived status separately explain why minority (vs. majority) representation boosts in-group appreciation (even though being in the minority [vs. majority] slightly interferes with people's needs to belong).

Studies 5 and 6 dealt with theoretical boundary conditions. Large absolute group sizes may disrupt not only the shared distinctive identity of people's in-group but also the instrumental cooperation that they expect from other in-group members. Accordingly, people's greater appreciation of their minority (vs. majority) in-group but not out-group should replicate for a context in which the two groups have few members, but not so much when they have many members. Study 5 confirmed this and traced the dampened effect in the many-members context to a weakened link between the minority (vs. majority) representation of the in-group on one hand and its distinctiveness, belongingness, and expected cooperation on the other.

According to ODT, if the relative size of a minority in-group approaches 0% and 50%, its belongingness and distinctiveness decline, respectively. Thus, the benefits of minority group membership for in-group love should be most pronounced when the minority (vs. majority) in-group is moderate-sized. Study 6 found the effect for a 33% minority (vs. 67% majority) in-group as in Studies 3-5, but neither for a 46% minority (vs. 54% majority) in-group, nor for a

20% minority (vs. 80% majority) in-group. The belongingness of the 20% minority in-group was seen as lower, and the distinctiveness of the 46% minority in-group was seen as lower, compared to the 33% minority in-group. In sum, Study 6 suggested that as predicted by ODT, moderate size may be a theoretical boundary condition for minority boosting in-group love.

The present paper can also shed light on a central question (Brewer, 2007; Halevy et al., 2008; Yamagishi & Mifune, 2009) in the literature on in-group favoritism: Is favoring the in-group over the out-group caused by increased in-group love or decreased out-group love? To test this in the context of the effect of minority group membership, we jointly analyzed 5 of the studies reported here and the 5 studies reported in the supplemental materials ($N = 31,292$)[7]. In each study, we coded relative group size as minority = -0.5 and majority = 0.5, we coded membership as -0.5 = out-group and 0.5 = in-group, and the dependent measure varied from 0 to 1. Table 7 and 8 show the means and standard deviations per condition. We ran a linear mixed model with random intercepts for the participant and the study they participated in. The two planned contrasts in Table 6 show that minority group membership strongly boosted in-group love and had a smaller but significant effect on out-group love. This pattern of results translated into a significant interaction effect between relative group size and membership, which showed that being in the minority boosted in-group favoritism. Importantly, this increase in in-group favoritism (a.k.a. as favoring the in-group over out-group[s]) was driven by the benefits of minority group membership for in-group love, and not by harms to out-group love.

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[7] Study 2 did not include an out-group, and the dependent measure was binary, thus it is not included in this analysis.

Table 6. Love by relative group size and membership across all studies in the main text and supplement, except for Study 2 in the main text.

	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.03 [-0.03, -0.02]	-22.71	< .001
Membership: Out-groups vs. In-groups	0.16 [0.16, 0.16]	134.17	< .001
R. Group Size * Membership	-0.03 [-0.04, -0.02]	-7.10	< .001
R. Group Size @ Membership = Out-groups	-0.01 [-0.02, -0.01]	-4.02	< .001
R. Group Size @ Membership = In-groups	-0.04 [-0.05, -0.04]	-16.63	< .001

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Limitations and future directions

While we demonstrate that minority group membership boosts in-group love for various real groups in Studies 1 and 2, these were likely more meaningful and lasted for much longer than the duration of a study. Previous work argues that there are different types of groups, including temporary loose associations of people (Lickel et al., 2001). Thus, one avenue for follow-up research is to test whether minority (vs. majority) representation boosts love across these different types of groups, including, for example the riders on a bus who happen to sit next to one another (i.e., loose association groups). Another avenue is to generalize the effect to field settings other than competitive (chess) games as in Study 2. Further, Study 2 showed stronger love for the nation that people represented in a competition when it was a minority (vs. a relatively larger group). However, we observed this within-group variation in minority representation rather than manipulating it. Future studies could examine whether love for the same in-group varies as a function of sudden, manipulated changes in its relative size (e.g., when many in-group or out-group members arrive or depart). In addition, Study 2 showed that minority group membership boosts in-group love across hundreds of national groups. Future research could also examine whether cultural heterogeneity in this effect can be explained

through fundamental cultural differences such as collectivism (Hofstede, 2011; Triandis, 2018).

In the second part, we empirically supported as separate explanations for the minority-love link the satisfaction of people's fundamental identity needs to stand out, blend in, their instrumental need to cooperate reliably, and their need to attain status. However, we measured these four processes instead of manipulating them, and the parallel mediation models that we fit to disentangle them have caveats (Fiedler, 2011). Significant statistical mediation is a necessary condition for, but does not prove, theoretical mediation. Besides, relying solely on tests of indirect effects to substantiate statistical mediation inflates false-positive conclusions. To mitigate this problem, we followed the advice by Yzerbyt and colleagues (2018) to conclude statistical mediation only given a significant indirect effect as well as a path and b path.

In the third part, the effect size of "being in the minority boosts in-group love" was larger when the absolute size of the minority and majority was small (i.e., when they had few instead of many members), and when the relative size of the minority was moderate (here: 33%). Follow-up research could aim to reveal other theoretical or descriptive boundary conditions. One possible boundary condition is mild positive evaluation. Perhaps regardless of relative size, people's baseline feeling towards even a minimal in-group is mildly positive. Thus, it could be that being in the minority intensifies people's baseline feelings towards their in-groups rather than boosting in-group love. A simultaneous test of both hypotheses could examine the effect of being in the minority on people's love for an in-group that they feel bad about initially. Another important constraint is that in all main studies and all but one supplemental study we manipulated minority (vs. majority) representation by directly or indirectly conveying absolute group sizes (e.g., 2 vs. 4 [out of 6] people). This was also the case in Study 5's condition that expressed large absolute group sizes as proportions (i.e., "33% [vs. 67%] of 500 people"). People may associate

absolute group sizes with social groups (e.g., foodies), which differ from social categories (e.g.,

left-handed folks) in ways that may facilitate or impede that being in the minority boosts in-group

love (Halevy & Landry, 2024; Rabbie & Horwitz, 1988; Scheepers et al., 2006). Thus, future

research should aim to generalize the effect from social groups to social categories or show that it

emerges when minimal groups are defined strictly / purely in the sense of social categories.

      Our consistent mentioning of absolute group sizes complicates the comparison of our

results to previous research that manipulated minority (vs. majority) representation purely by way

of proportions. Nevertheless, an important question is how our findings reconcile with previous

research on being in the minority and in-group love. Specifically, Leonardelli and Loyd (2016)

found that people cooperated more with other in-group members when it was a 20% minority

(vs. 45% majority). This finding seems to be at odds with our finding that the effect size of

"being in the minority boosts in-group love" was largest when people's in-group was a 33%

minority, instead of being a 20% minority or 46% minority. However, both their work, our work,

and ODT argue that in-group love should peak when a minority is moderate-sized rather than 0%

and 50% (which would make it the majority). If across contexts a moderate-sized and optimally

distinct minority is roughly a 30% minority, Leonardelli and Loyd (2016) should have found

more love within the 20% minority (vs. 45% minority), and we should have found more love

within the 33% minority (vs. 20% minority and 46% minority). A conceptual replication of

Leonardelli & Loyd (2016) that includes a 33% minority may thus resolve the apparent

inconsistency between their results and the results from our work, specifically Study 6.

      Another fruitful avenue for future research is to better explore the role of dyads in the

effect of being in the minority on in-group love. In Studies 3-5, when being in the minority

boosted in-group love, the relative size of the minority in-group was not only moderate (i.e.,

33%), but also a dyad. Perhaps membership in a dyadic (vs. non-dyadic) minority group more strongly enhances expectations of cooperation or distinctiveness and in turn, more strongly boosts in-group love (Roussin, 2008; Slotter et al., 2014). Although we provided evidence for the minority-love link when the absolute size of the minority is larger than a dyad (Studies 1, 2, and 6), follow-up research could make a renewed and stronger effort to explore the implications of dyads for the benefits of minority group membership on in-group love.

Finally, in Studies 4, 5, SS4, and SS5, we sometimes observed greater appreciation of people's minority (vs. majority) out-group. Although this effect was inconsistent and impressions of the out-group were not the focal point of this paper, future research should aim to explain when and why relative group size predicts love for out-group minorities (majorities).

Conclusion

The present research advances the literature on when and why being in the minority boosts in-group love in three ways. We generalize the effect to various real groups and a real-life interaction within and between groups. Our results suggest that distinctiveness, belongingness, expected cooperation, and status simultaneously mediate the effect, which cannot be explained by just optimal distinctiveness theory (ODT). And the effect is larger when the absolute size of the minority and majority is small, and when the imbalance of the minority versus majority is moderate (here: 33% & 67%) rather than low (here: 46% & 54%) or high (here: 20% & 80%). Moderated mediation analyses suggest that small absolute group size and moderate imbalance amplify benefits of minority group membership on in-group love through said mediators. These conclusions have theoretical and practical implications, as groups substantially influence their members' thoughts, feelings, and behaviors, and being in the minority varies across groups within a context and contexts within a group.

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Table 7. Means and standard deviations of DVs for in-groups by condition in all studies.

Study	Dependent Variable	Condition	M (SD)
Study 1	Communality	R. Group Size Minority	0.76 (0.19)
		R. Group Size Majority	0.71 (0.20)
Study 3	Cooperation	R. Group Size Minority	0.23 (0.18)
		R. Group Size Majority	0.20 (0.19)
Study 4	Appreciation	Forced R. Group Size Minority	0.61 (0.32)
		Forced R. Group Size Majority	0.54 (0.33)
		Chosen R. Group Size Minority	0.61 (0.32)
		Chosen R. Group Size Majority	0.57 (0.32)
Study 5	Appreciation	Few R. Group Size Minority	0.66 (0.29)
		Few R. Group Size Majority	0.59 (0.30)
		Many R. Group Size Minority	0.60 (0.29)
		Many R. Group Size Majority	0.59 (0.29)
		Many by Freq R. Group Size Minority	0.61 (0.29)
		Many by Freq R. Group Size Majority	0.59 (0.29)
		Many by Prop R. Group Size Minority	0.60 (0.30)
		Many by Prop R. Group Size Majority	0.60 (0.29)
Study 6	Appreciation	R. Group Size Minority, Imbalance 20%	0.63 (0.30)
		R. Group Size Majority, Imbalance 20%	0.61 (0.30)
		R. Group Size Minority, Imbalance 33%	0.62 (0.29)
		R. Group Size Majority, Imbalance 33%	0.59 (0.30)
		R. Group Size Minority, Imbalance 46%	0.59 (0.29)
		R. Group Size Majority, Imbalance 46%	0.59 (0.30)

Note. Study 2 analyses a curve of 72 analytical specifications and is thus not included in this table.

Table 8. Means and standard deviations of DVs for out-groups by condition in all studies.

Study	Dependent Variable	Condition	M (SD)
Study 1	Communality	R. Group Size Minority	0.47 (0.32)
		R. Group Size Majority	0.48 (0.28)
Study 3	Cooperation	R. Group Size Minority	0.16 (0.19)
		R. Group Size Majority	0.16 (0.18)
Study 4	Appreciation	Forced R. Group Size Minority	0.40 (0.29)
		Forced R. Group Size Majority	0.41 (0.29)
		Chosen R. Group Size Minority	0.43 (0.28)
		Chosen R. Group Size Majority	0.44 (0.30)
Study 5	Appreciation	Few R. Group Size Minority	0.45 (0.27)
		Few R. Group Size Majority	0.44 (0.26)
		Many R. Group Size Minority	0.45 (0.27)
		Many R. Group Size Majority	0.43 (0.27)
		Many by Freq R. Group Size Minority	0.44 (0.27)
		Many by Freq R. Group Size Majority	0.43 (0.27)
		Many by Prop R. Group Size Minority	0.45 (0.27)
		Many by Prop R. Group Size Majority	0.42 (0.27)
Study 6	Appreciation	R. Group Size Minority, Imbalance 20%	0.47 (0.28)
		R. Group Size Majority, Imbalance 20%	0.41 (0.27)
		R. Group Size Minority, Imbalance 33%	0.45 (0.27)
		R. Group Size Majority, Imbalance 33%	0.44 (0.26)
		R. Group Size Minority, Imbalance 46%	0.43 (0.27)
		R. Group Size Majority, Imbalance 46%	0.43 (0.27)

Note. Study 2 analyses a curve of 72 analytical specifications and is thus not included in this table.

Being in the minority boosts in-group love: Explanations and boundary conditions
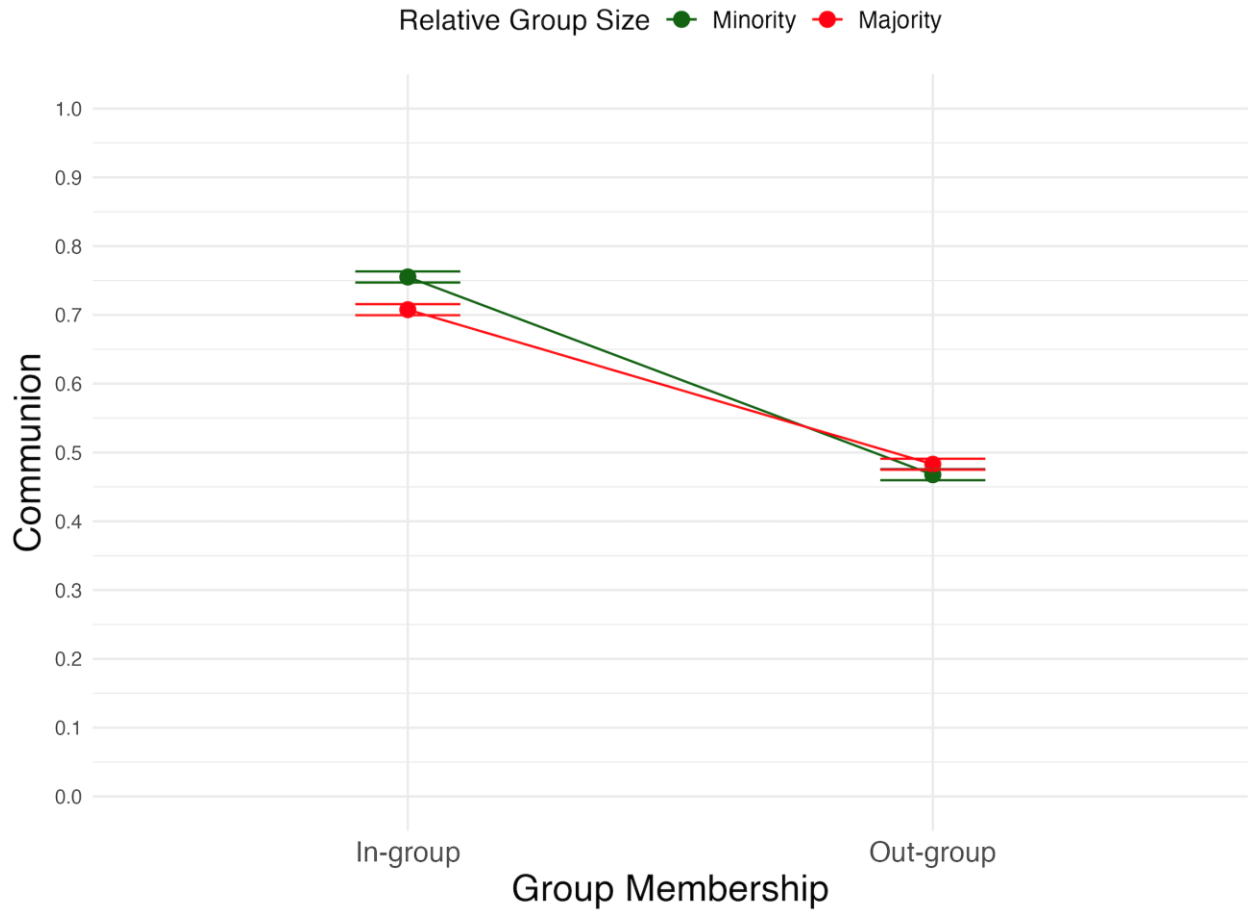
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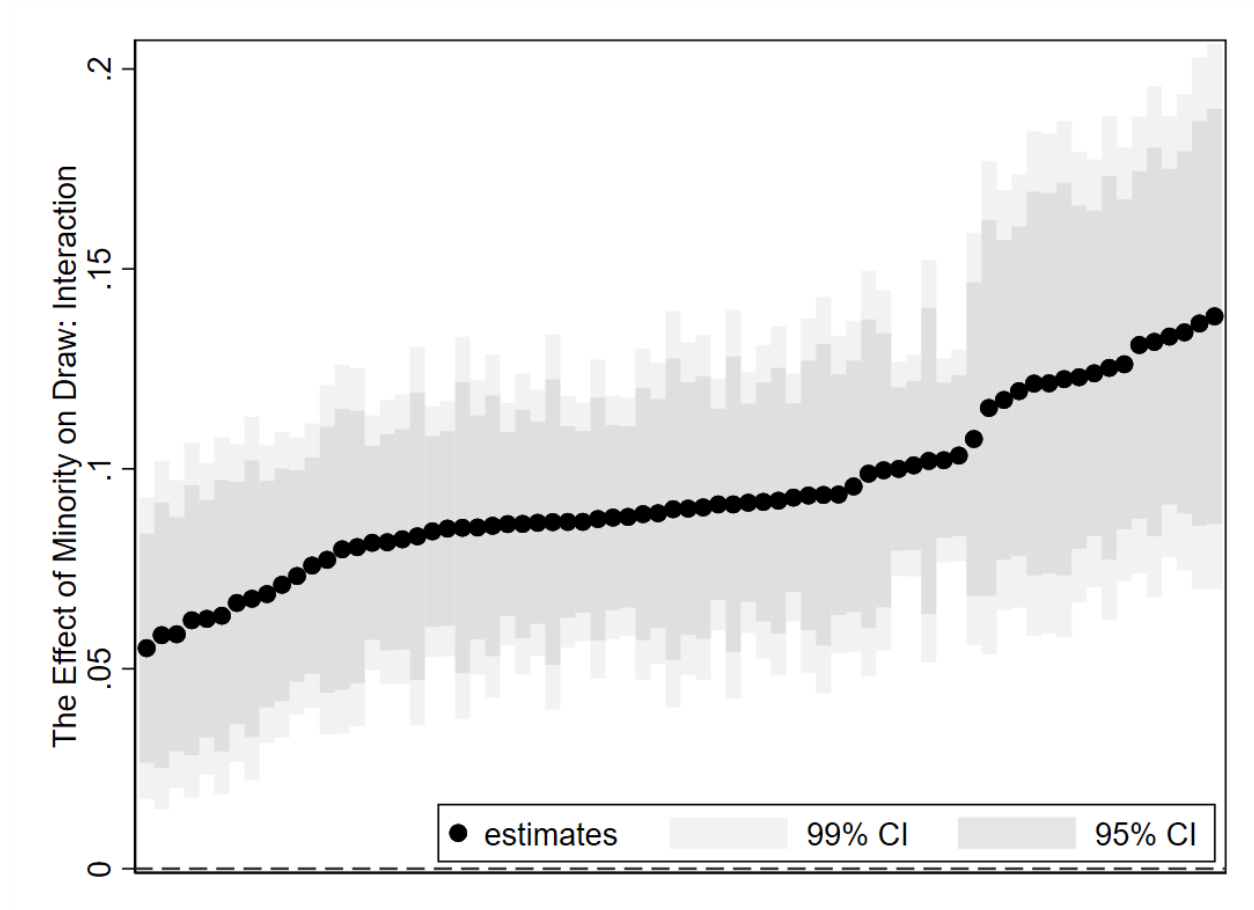**TABLE OF CONTENTS**

Study 1

Figure S1. Relative group size and membership interaction effect on communion in Study 1.
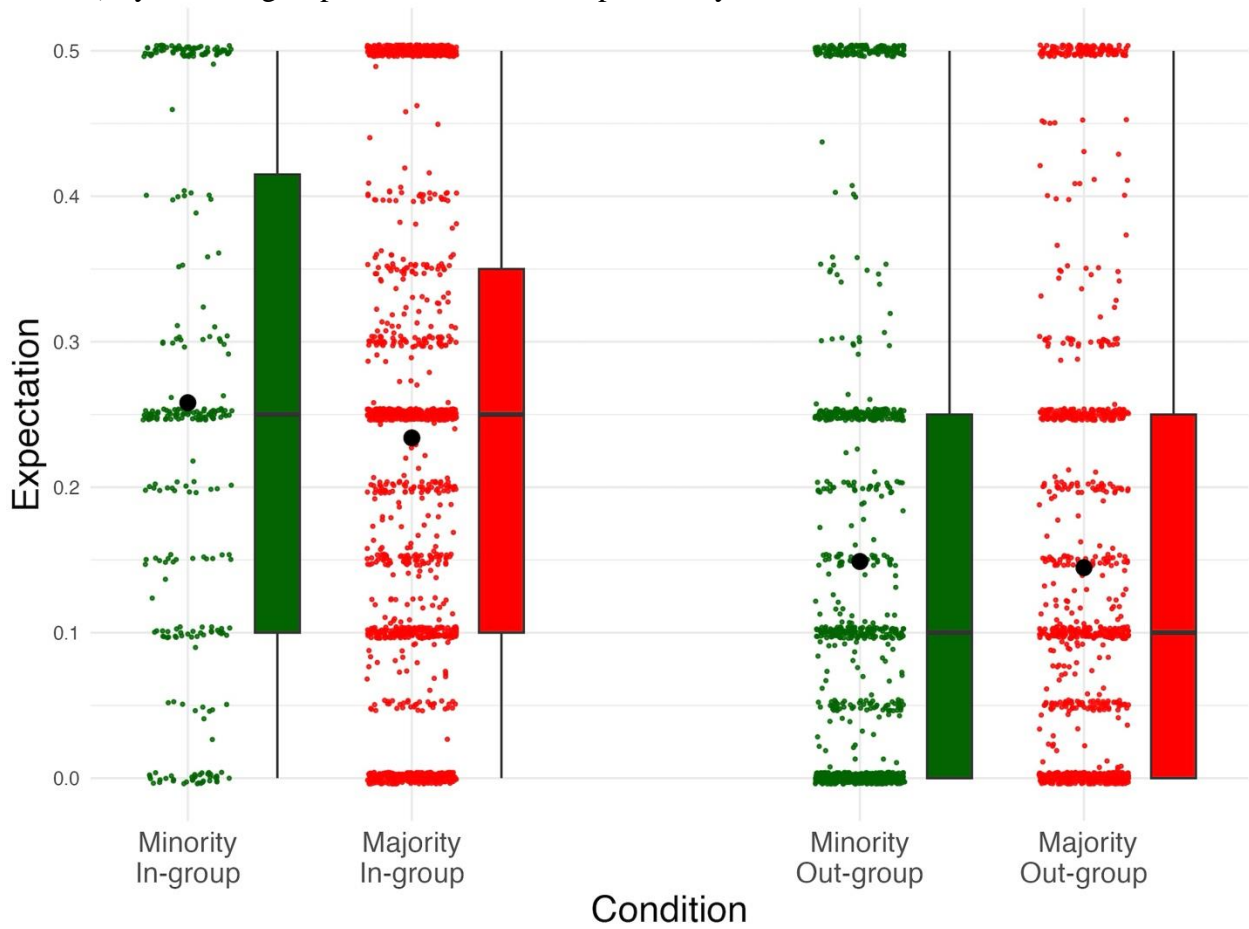
Study 2

Figure S2. Being in the minority and membership interaction effect on draw rates in Study 2.

Notes. Black dot = estimate of the effect of the minority of a player's nation on in-group drawing relative to out-group drawing in each of 72 analytical specifications (Simonsohn et al., 2020); the curve orders effect sizes from most negative (left) to most positive (right).

Study 3

Figure S3.1 Expected cooperation (i.e., the amount of money that the co-player would transfer to the self) by relative group size and membership in Study 3.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S3.2. Relative group size and membership interaction effect on money transferred within groups in Study 3.
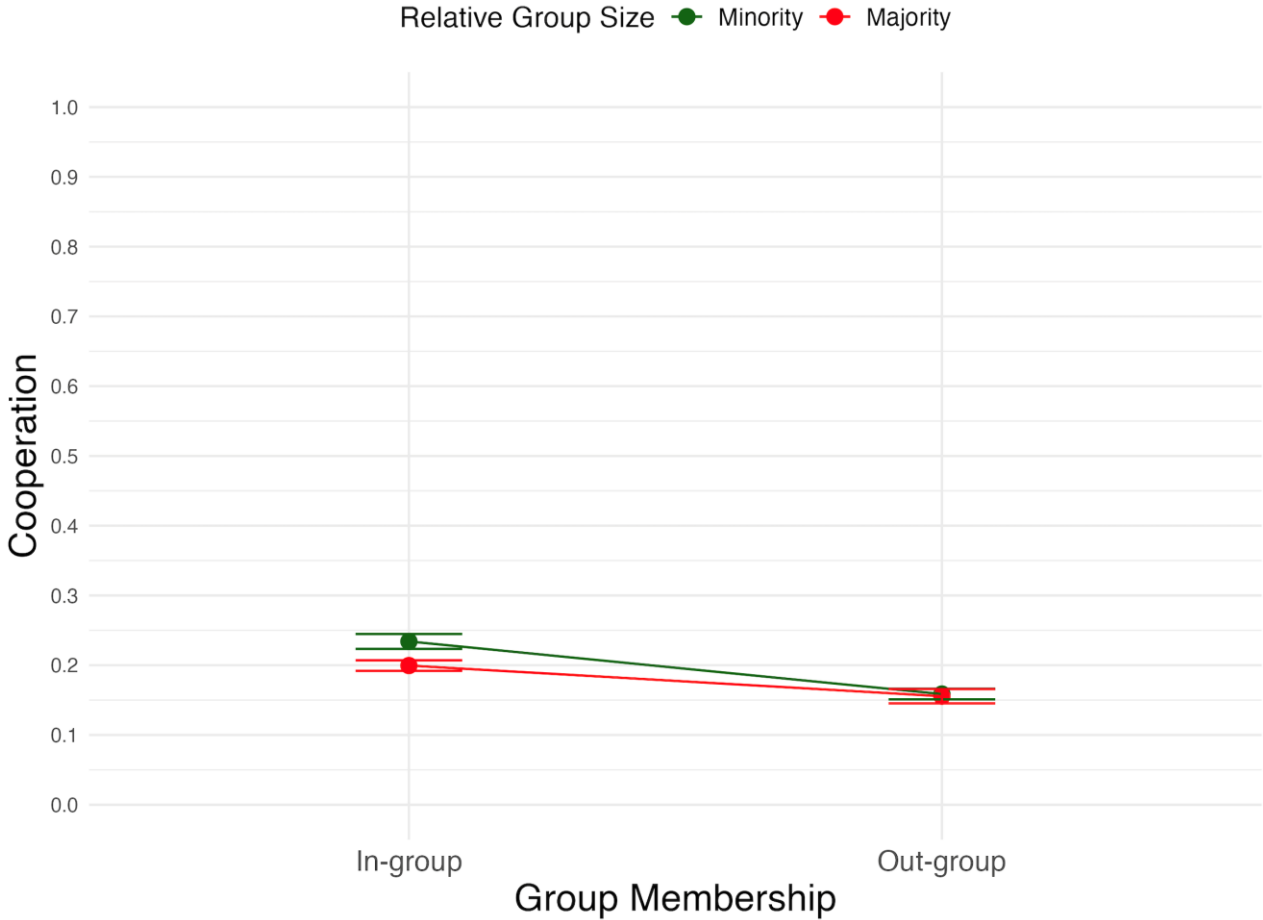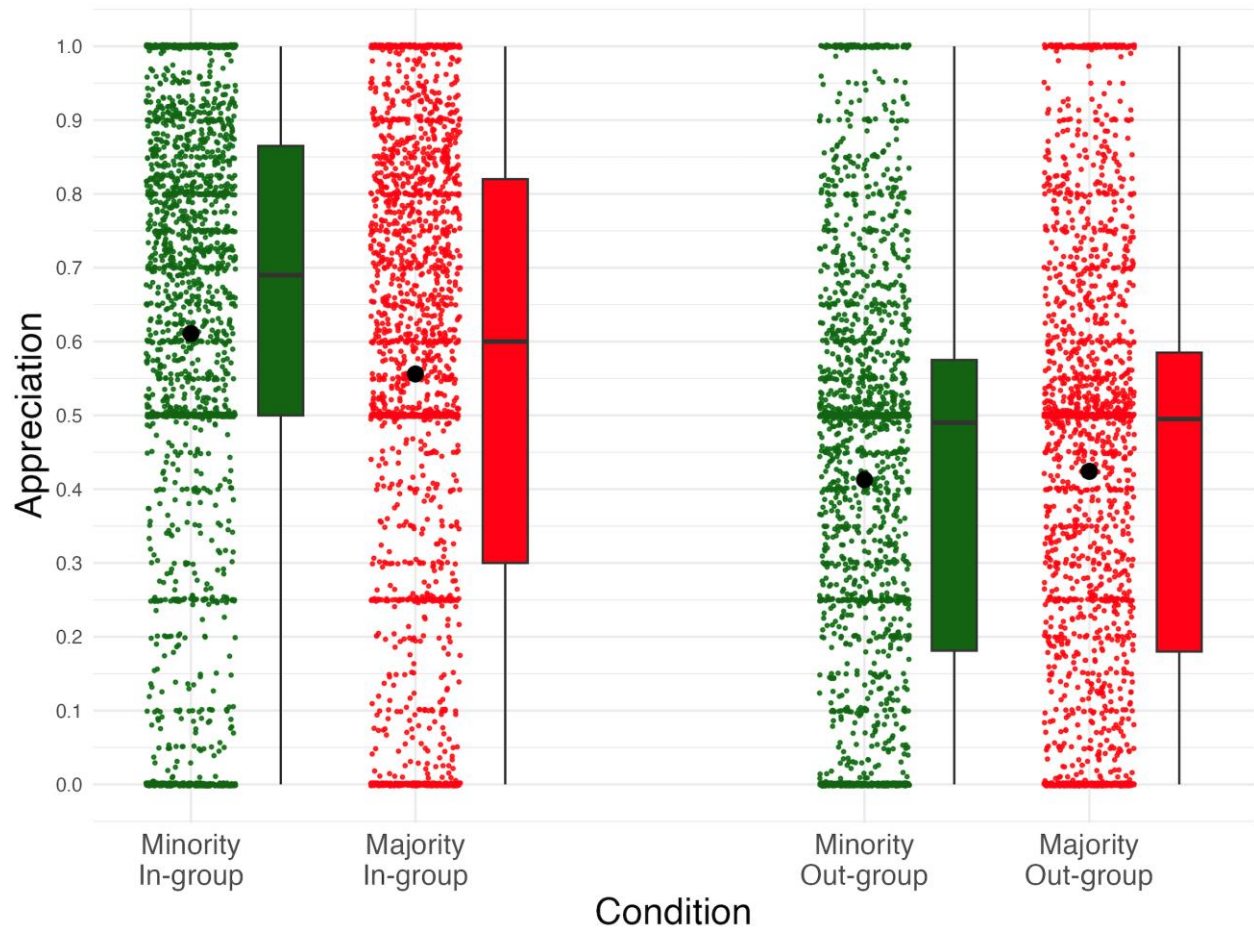
Figure S3.3. Relative group size and membership interaction effect on expected cooperation (i.e., the amount of money that the co-player would transfer to the self) in Study 3.
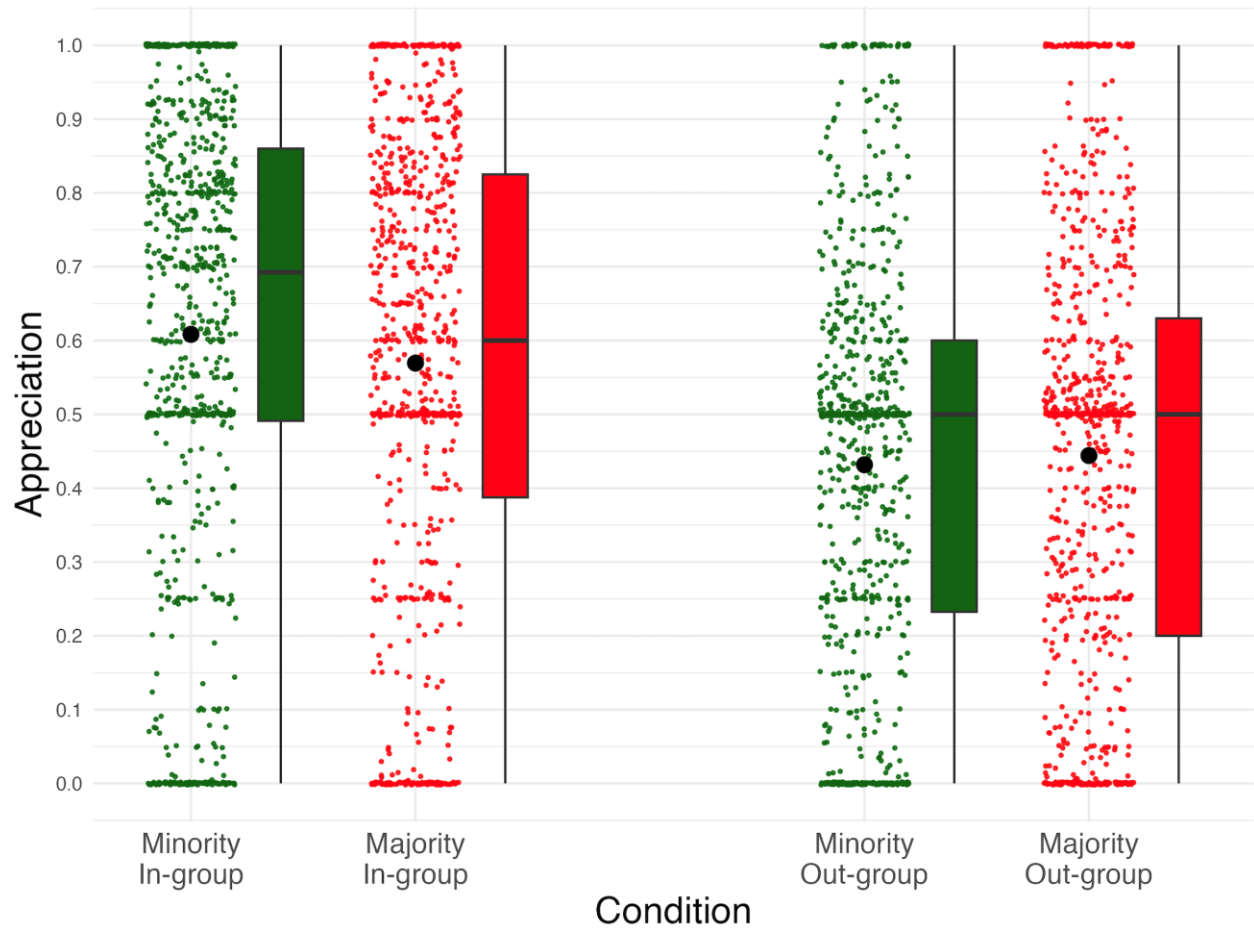
Study 4

Figure S4.1 Appreciation by relative group size and membership when membership was forced in Study 4.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S4.2 Appreciation by relative group size and membership when membership was chosen in Study 4.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S4.3. Relative group size and membership interaction effect on appreciation separated by way of joining in Study 4.
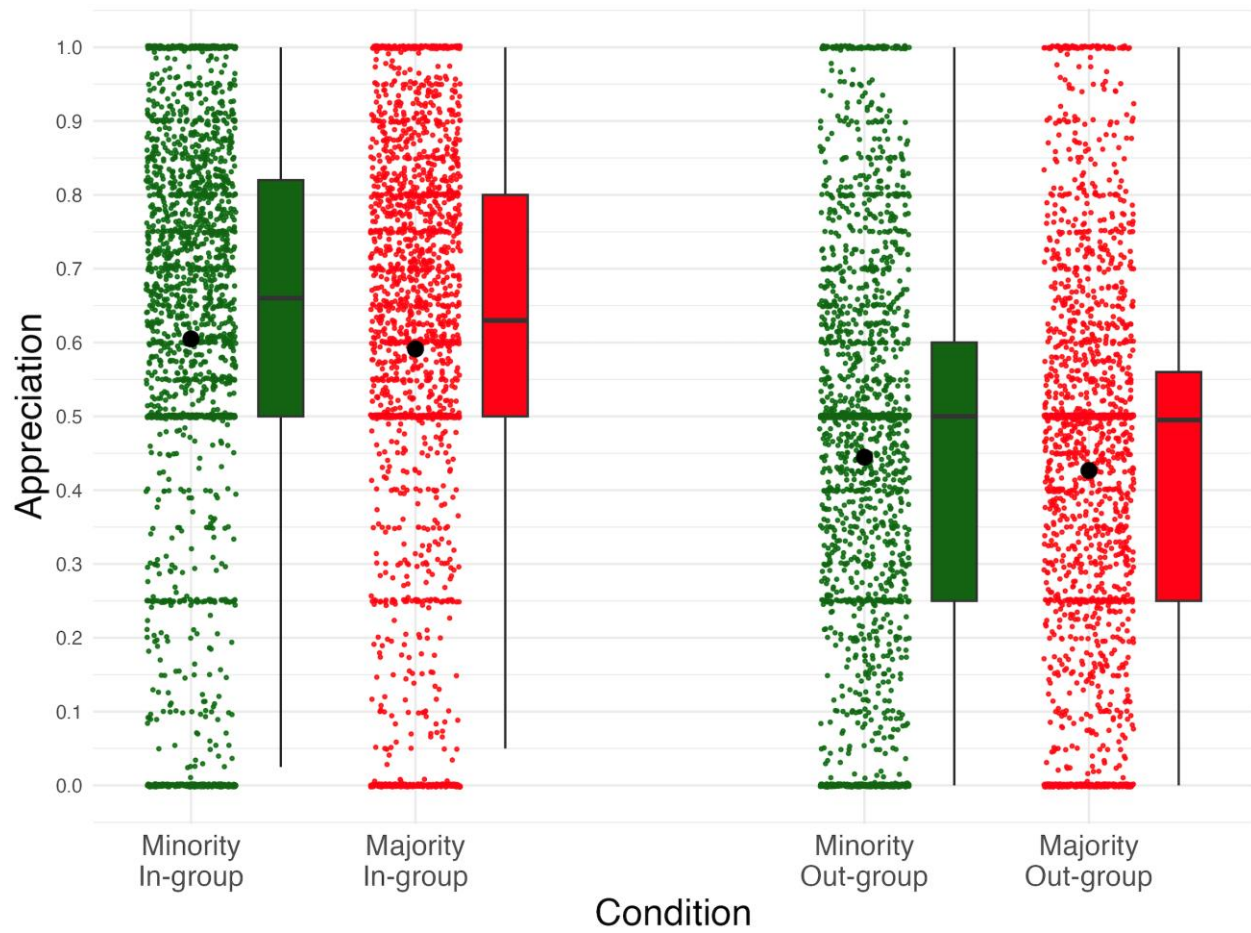
Study 5

Figure S5.1 Appreciation by relative group size and membership when absolute group size was small in Study 5.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

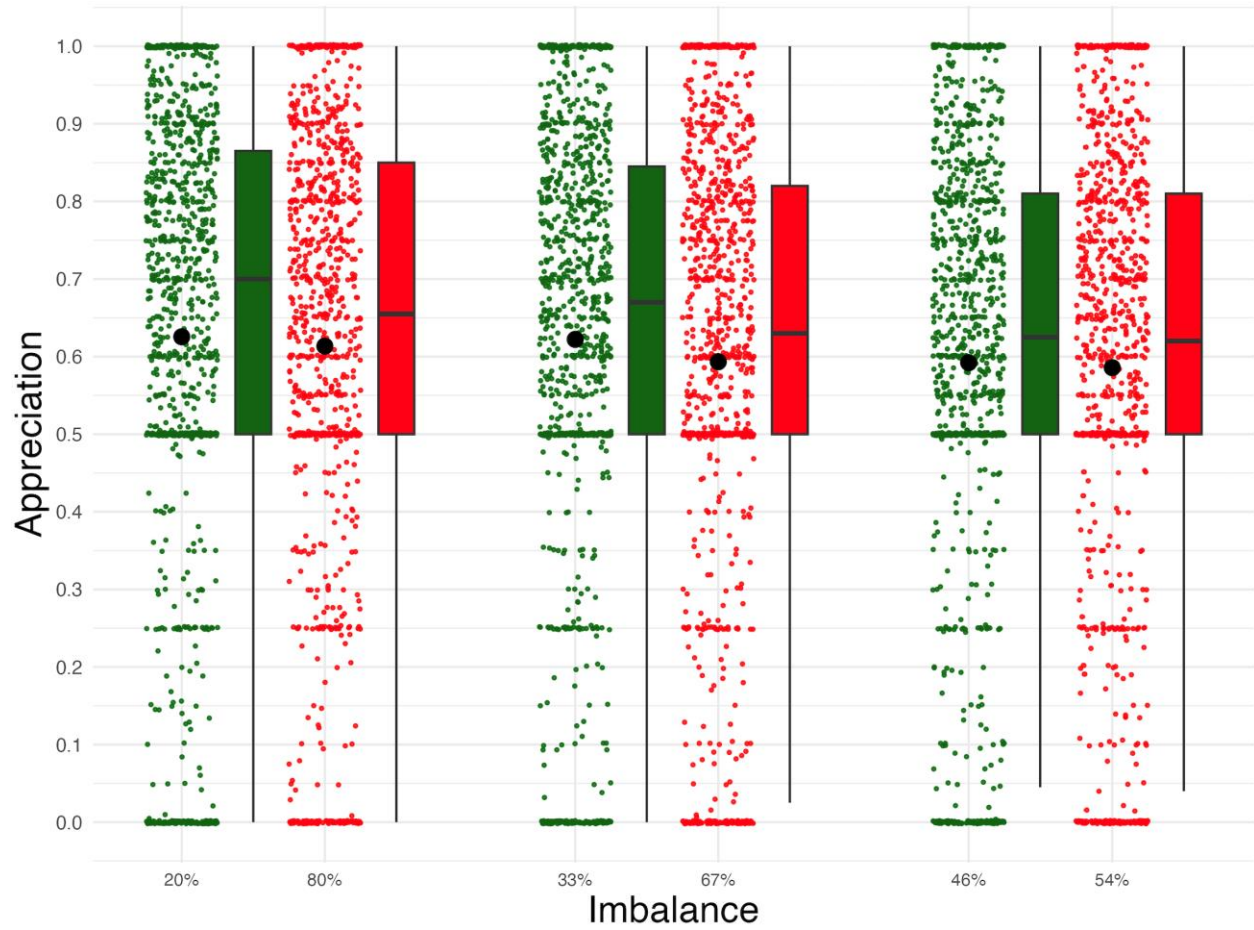**Figure S5.2** Appreciation by relative group size and membership when absolute group size was large in Study 5.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S5.3. Relative group size and membership interaction effect on appreciation separated by absolute size in Study 5.
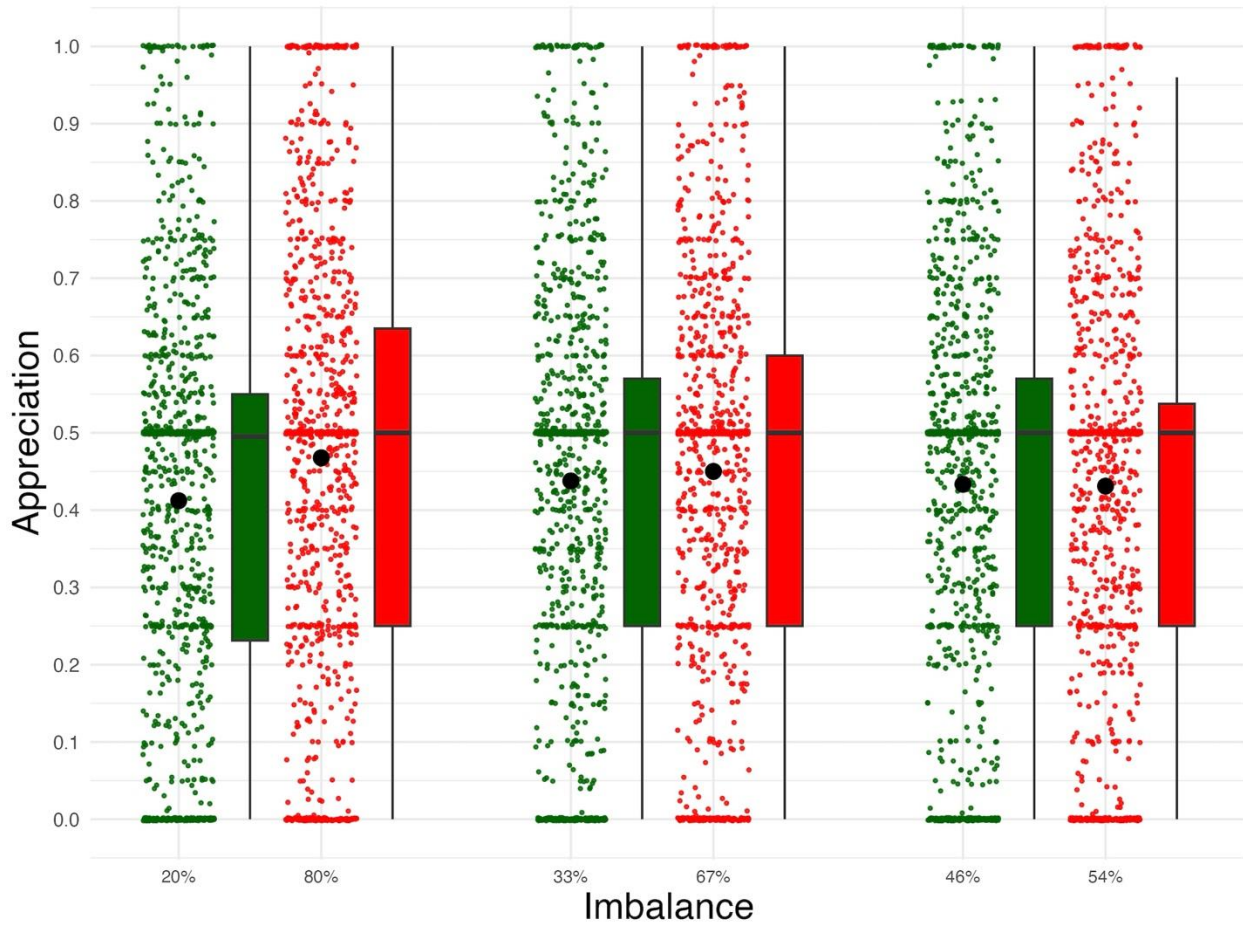
Study 6

Figure S6.1 Appreciation of the in-group by its relative size in Study 6.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S6.2 Appreciation of the out-group by its relative size in Study 6. To read the out-group's relative size, subtract the below proportions from 1.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure S6.3. Relative group size and membership interaction effect on appreciation separated by imbalance in Study 6.
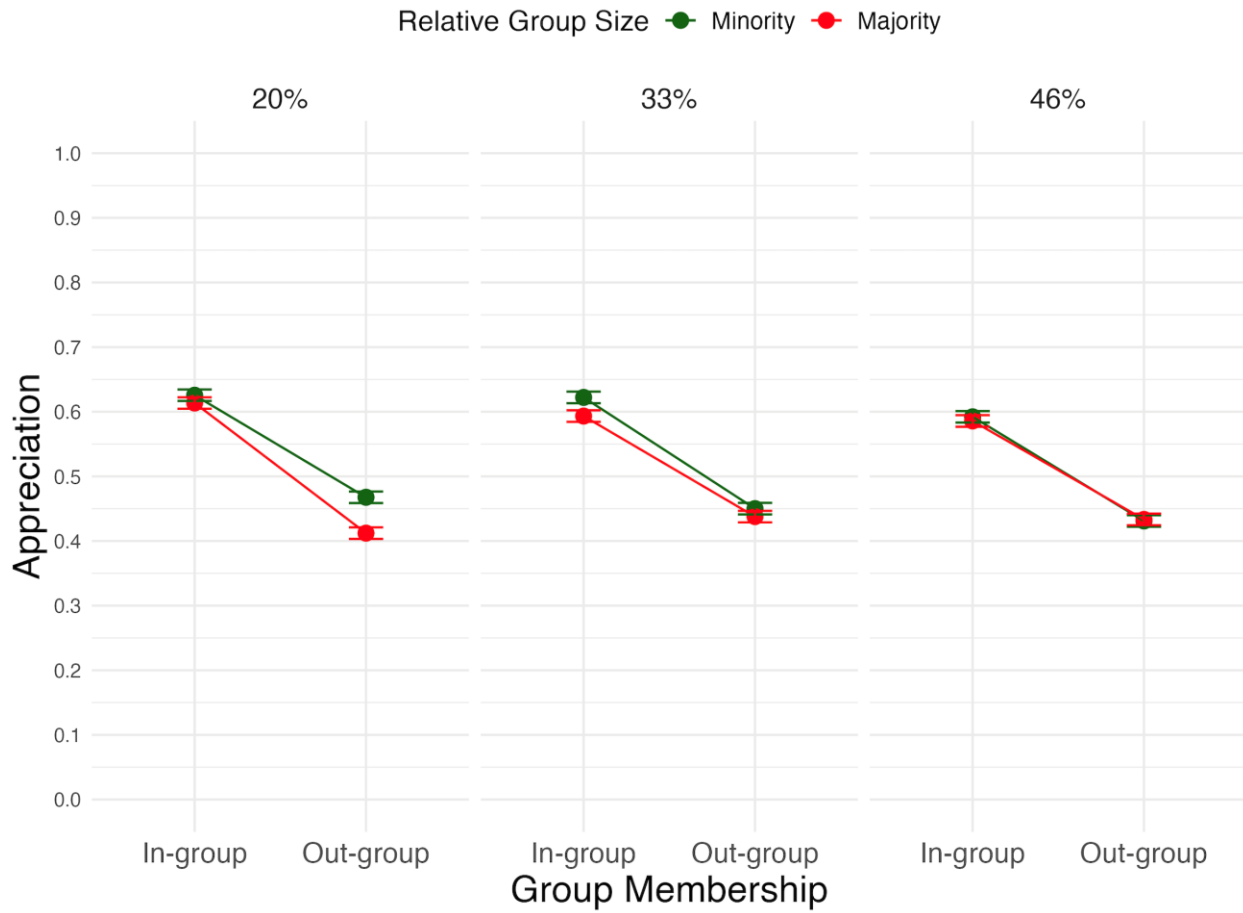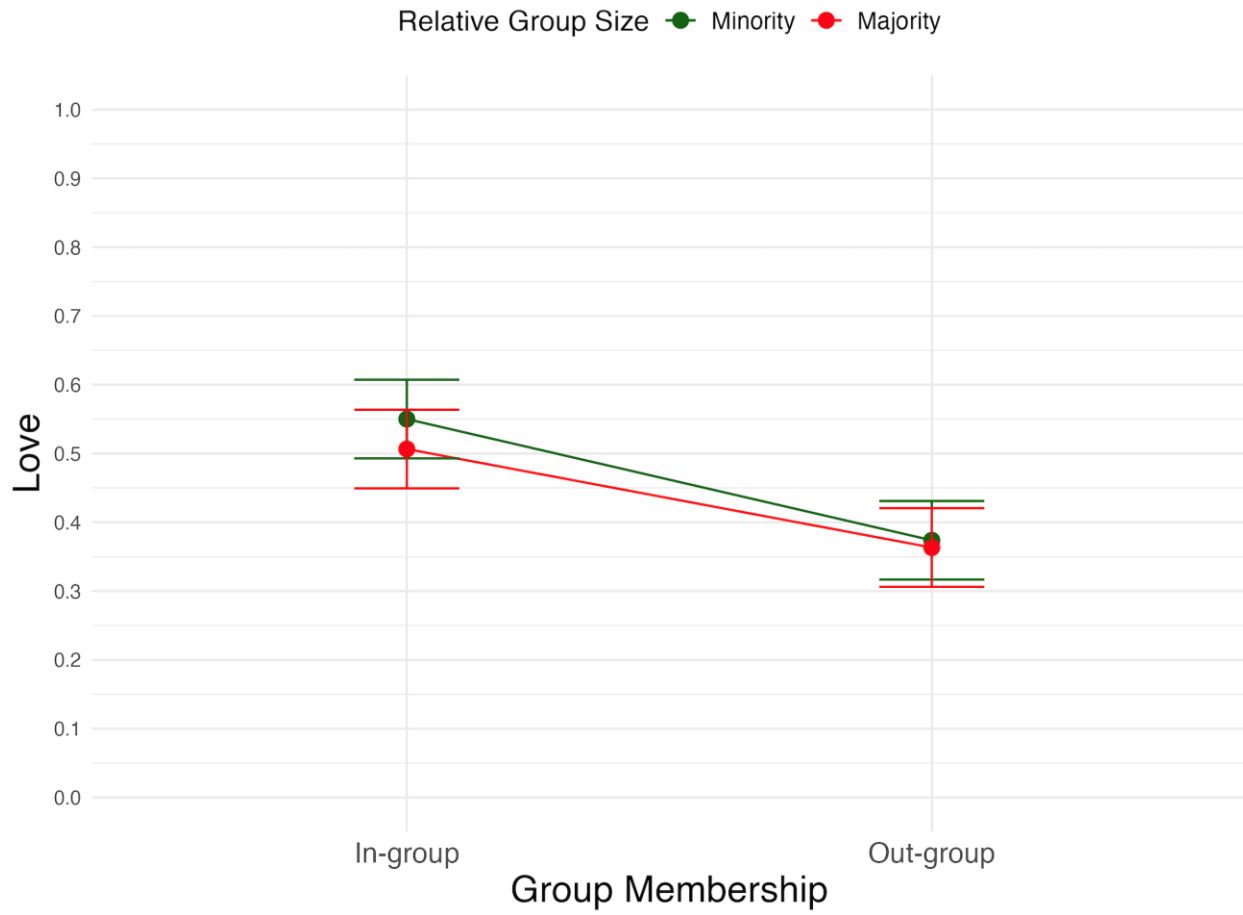
Figure S7. Relative group size and membership interaction effect on love in all studies except Study 2.

Supplemental Study 1

Study 3 found that members of minority (vs. majority) in-groups expected fellow in-group members to give more money to them and, in turn, gave more money to their fellow in-group members. Supplemental Study 1 builds on Study 3 by implementing a dictator game to test whether minority (vs. majority) in-group members give more money to fellow in-group members when there is no possibility for their fellow in-group members to return the favor (i.e., when reciprocated cooperation cannot be expected).

Method

Supplemental Study 1 had a mixed 2 x 2 design, with relative group size (-0.5 = minority vs. 0.5 = majority) as the between-subjects factor and membership (-0.5 = out-group vs. 0.5 = in-group) as the within-subjects factor. The dependent measure was given money (i.e., generosity).

Participants. We recruited 800 U.S. residents from Prolific. We excluded 106 people who failed an attention check, leaving 694 people (41.8% female, 56.2% male, 1.9% other; 39.8% young, 54.9% middle-aged, 4.5% elderly, 0.8% other). As in Study 3, the exclusion rate was higher in this study because the attention check was disguised as a dependent measure instead of appearing on a separate page at the beginning of the study in an obvious way. We ran an effect size-sensitivity analysis via 100 simulations of Supplemental Study 1's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06. The analysis yielded a statistical power of $1\text{-}\beta = 27\%$, 74%, and 98% to detect the key interaction, respectively.

Procedure. All people played an economic game within a minimal group paradigm (Tajfel et al., 1971). First, people read, "For the purpose of this study, you are a member of the BLUE [or GREEN] group." Next, they clicked on a button that completed the sentence, "I understand that I am a member of the" with "BLUE [or GREEN] group." People were then randomly assigned to join the minority or majority. People in the minority condition read: "You are a member of the BLUE [or GREEN] group. There are 5 other people. 1 person who is also a member of the BLUE [or GREEN] group, and 4 people who are members of a GREEN [or BLUE] group." Conversely, people in the majority condition were informed: "You are a member of the BLUE [or GREEN] group. There are 5 other people. 3 people who are also members of the BLUE [or GREEN] group, and 2 people who are members of the GREEN [or BLUE] group." Thus, in the minority condition, people encountered one other in-group member and four out-group members, whereas in the majority condition, people encountered three other in-group members and two out-group members. People were then grouped with these five people in real-time.

Following this, all six people were briefed on the rules of a dyadic dictator game, and upon passing two comprehension checks, simultaneously played the incentivized game with each of the five other people they had been grouped with. Each player received five $0.50 bonuses and had the option to transfer any portion of their bonuses to each of their five co-players ("To player BLUE2, I send …"). The more they transferred, the more they behaved generously because there was no mention of the co-players transferring money to them as well. Players' interaction was anonymous. They could not communicate and knew nothing about one another except that they were members of the color-coded minority or majority.

At the end, all people indicated their age, gender etc.

Results

Table SS1. Generosity by relative group size and membership in Supplemental Study 1

	b, 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.01 [-0.01, -0.01]	-5.52	< .001
Membership: Out-group vs. In-group	0.02 [0.02, 0.02]	13.72	< .001
R. Group Size * Membership	-0.02 [-0.05, 0.01]	-1.28	.200
Group Size @ Membership = Out-group	0.001 [-0.01, 0.02]	0.20	.845
Group Size @ Membership = In-group	-0.02 [-0.03, -0.002]	-2.29	.022

Notes. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Main effects and interactions. Table SS1 shows the results of a linear mixed model (with random intercepts for the people) that predicted given money (generosity) from three fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), and their interaction. We found a main effect of relative group size, such that people gave more money to members of the minority (vs. majority) group. Additionally, a main effect of membership indicates that people gave more money to in-group members than out-group members. Finally, there was no interaction between relative group size and membership on given money, see Table SS1.

Planned contrasts. As predicted, people gave more money to in-group members if their in-group was the minority compared to when their in-group was the majority. In contrast, the relative size of the out-group did not influence the amount of money that people gave to out-group members, see Table SS1 and Figure SS1.

Figure SS1.1. Generosity by relative group size and membership in Supplemental Study 1.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS1.2. Relative group size and membership interaction effect on generosity in Supplemental Study 1.
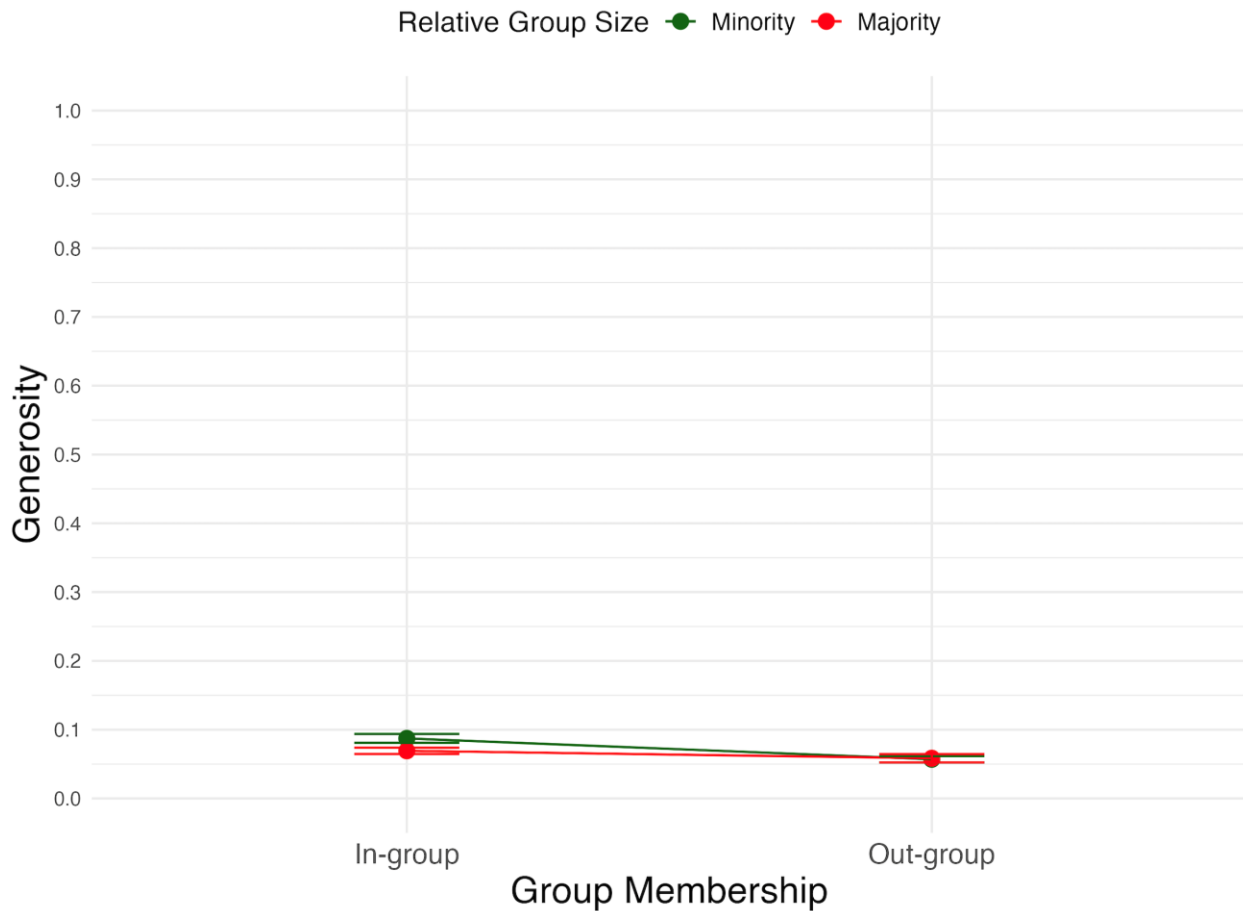
Discussion

      The interaction between membership and relative group size was not significant. As in Study 3, we argue that this lack of interaction may be due to having six times more observations for the majority (vs. minority) in-group. Nevertheless, planned comparisons revealed that people gave more money to fellow in-group members when the in-group was the minority (vs. majority). The amount of money given did not depend on whether people's out-group was the minority (vs. majority). Thus, Supplemental Study 1 suggests that expected cooperation is not the sole reason people show more generosity toward their minority (vs. majority) in-groups.

Supplemental Study 2

Supplemental Study 2 is a replication of the *joining the in-group by force* condition of Study 4 but includes a new dependent variable capturing willingness to approach and interact. The second dependent measure was feeling warmly toward the in-group or out-group. We initially launched three separate studies but pooled their data for brevity of reporting and to increase sample size, and thereby statistical power. We predicted that people would express more warmth toward and more willingness to interact with members of their minority (vs. majority) in-group. We did not expect warmth toward, and willingness to interact with, out-group members to depend on whether the out-group was the minority (vs. majority). Supplemental Study 2 was preregistered, see link.

Method

Supplemental Study 2 had a mixed 2 x 2 design, with relative group size (-0.5 = minority vs. 0.5 = majority) as the between-subjects factor and membership (-0.5 = out-group vs. 0.5 = in-group) as the within-subjects factor. The dependent measures were perceived warmth and willingness to interact.

Participants. To increase statistical power, we pooled three waves of data collection across which we recruited 3,404 U.S. residents from Prolific. Wave 1 data was collected November 5th, 2022. Wave 2 data was collected November 9th, 2022. Wave 3 data was collected on November 10th and 11th, 2022. We excluded 18 people who failed an attention check, leaving 3,386 people (49.6% female, 47.8% male, 2.6% other; 47.1% young, 47.0% middle-aged, 4.7% elderly, 1.2% other). We ran an effect size-sensitivity analysis via 100 simulations of Supplemental Study 2's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06.

The analysis yielded a statistical power of $1\text{-}\beta = 19\%$, 68%, and 94% to detect the key

interaction, respectively.

Procedure. Supplemental Study 2 manipulated relative group size and membership as in

(the *by force* condition of) Study 4 but used colored groups (i.e., "For the purpose of this study,

you are a member of the BLUE [or GREEN] group […]"). Also, there was one majority or

minority out-group. People in the minority in-group encountered one other in-group member and

four out-group members, whereas people in the majority in-group encountered three other

in-group members and two out-group members.

On the same page, we used four sliders: one measuring warmth toward the in-group, one

measuring warmth toward the out-group, one measuring willingness to interact with the

in-group, and one measuring willingness to interact with the out-group. We randomized whether

people rated warmth before willingness to interact or vice versa, and whether they rated the

in-group before the out-group or vice versa.

As in Studies 4-6, the warmth sliders asked people to rate how warmly versus indifferent

they feel towards the members of their in-group and out-group. The sliders ranged from 0 ("I

feel indifferent towards them") to 100 ("I feel warmly towards them"; Haddock et al., 1993). We

rescaled this measure of warmth so that it ranged from 0 to 1 (most warmth). The willingness to

interact sliders asked people to rate their willingness to interact with members of their in-group

and the out-group. The sliders ranged from 0 ("I would not care to chat with them") to 100 ("I

would be excited to chat with them") and were rescaled to 0 to 1 (most willingness to interact)

Finally, people provided demographic information, including their age and gender.

Results

Main and interaction effects. Table SS2.1 shows the results of two linear mixed

models (with random intercepts for the people and waves of data collection) that predicted

warmth and separately, willingness to interact from three fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), and their interaction. Table SS2.2 shows the same results separated by each wave of data collection. At each wave, results are consistently in the same direction as when the waves are pooled together.

Results indicate a main effect of relative group size on warmth and willingness to interact. People's warmth toward and willingness to interact with the minority was greater than their warmth toward and willingness to interact with the majority. We also found a main effect of membership on warmth and willingness to interact. People's warmth toward and willingness to interact with their in-group (vs. the out-group) was greater. Finally, there was an interaction between relative group size and membership.

Table SS2.1 Expressed warmth and willingness to interact by relative group size and membership in Supplemental Study 2

	b and 95% CI [LB, UB]	t	p
DV = Warmth			
Relative Group Size: Minority vs. Majority	-0.03 [-0.03, -0.02]	-6.57	< .001
Membership: Out-group vs. In-group	0.17 [0.16, 0.17]	41.36	< .001
R. Group Size * Membership	-0.04 [-0.07, -0.01]	-2.34	.019
R. Group Size @ Membership = Out-group	-0.01 [-0.03, 0.01]	-0.87	.385
R. Group Size @ Membership = In-group	-0.04 [-0.06, -0.03]	-5.05	< .001
DV = Willingness to Interact			
Relative Group Size: Minority vs. Majority	-0.01 [-0.02, -0.01]	-3.76	< .001
Membership: Out-group vs. In-group	0.12 [0.06, 0.06]	34.92	< .001
R. Group Size * Membership	-0.03 [-0.06, -0.001]	-2.07	.038
R. Group Size @ Membership = Out-group	0.002 [-0.01, 0.02]	0.35	.729
R. Group Size @ Membership = In-group	-0.03 [-0.05, -0.01]	-3.43	< .001

Notes. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Table SS2.2 Expressed warmth and willingness to interact by relative group size and membership at each wave in Supplemental Study 2

	b and 95% CI [LB, UB]	t	p
WAVE 1			
DV = Warmth			
R. Group Size: Minority vs. Majority	-0.03 [-0.05, -0.2]	-3.62	<.001
Membership: Out-group vs. In-group	0.17 [0.15, 0.19]	18.78	< .001
R. Group Size * Membership	-0.05 [-0.12, 0.02]	-1.38	.169
R. Group Size @ Membership = Out-group	-0.001 [-0.05, 0.03]	-0.42	.675
R. Group Size @ Membership = In-group	-0.06 [-0.10, -0.02]	-2.87	.004
DV = Willingness to Interact			
R. Group Size: Minority vs. Majority	-0.01 [-0.03, 0.002]	-1.59	.112
Membership: Out-group vs. In-group	0.11 [0.10, 0.13]	14.08	< .001
R. Group Size * Membership	-0.08 [-0.16, -0.01]	-2.24	.026
R. Group Size @ Membership = Out-group	0.03 [-0.01, 0.07]	1.44	.149
R. Group Size @ Membership = In-group	0.05 [-0.09, -0.01]	-2.68	.007
WAVE 2			
DV = Warmth			
R. Group Size: Minority vs. Majority	-0.03 [-0.04, -0.01]	-2.98	.003
Membership: Out-group vs. In-group	0.19 [0.17, 0.20]	21.02	< .001
R. Group Size * Membership	-0.03 [-0.09, 0.03]	-1.12	.262
R. Group Size @ Membership = Out-group	-0.01 [-0.04, 0.02]	-0.55	.586
R. Group Size @ Membership = In-group	-0.04 [-0.08, -0.01]	-2.45	.013
DV = Willingness to Interact			
R. Group Size: Minority vs. Majority	-0.01 [-0.03, 0.002]	-1.68	.094
Membership: Out-group vs. In-group	0.13 [0.12, 0.15]	17.77	< .001
R. Group Size * Membership	-0.03 [-0.10, 0.03]	-1.02	.209
R. Group Size @ Membership = Out-group	0.003 [-0.03, 0.04]	0.22	.827
R. Group Size @ Membership = In-group	-0.03 [-0.06, 0.01]	-1.63	.104
WAVE 3			
DV = Warmth			
R. Group Size: Minority vs. Majority	-0.02 [-0.03, -0.01]	-4.73	<.001
Membership: Out-group vs. In-group	0.16 [0.15, 0.17]	30.41	< .001
R. Group Size * Membership	-0.03 [-0.08, 0.01]	-1.61	.108

R. Group Size @ Membership = Out-group	-0.007 [-0.03, 0.02]	-0.57	.568
R. Group Size @ Membership = In-group	-0.04 [-0.07, -0.02]	-3.48	< .001
DV = Willingness to Interact			
R. Group Size: Minority vs. Majority	-0.01 [-0.02, -0.005]	-2.98	.003
Membership: Out-group vs. In-group	0.12 [0.11, 0.13]	26.56	< .001
R. Group Size * Membership	-0.02 [-0.06, 0.02]	-0.84	.404
R. Group Size @ Membership = Out-group	-0.01 [-0.03, 0.02]	-0.47	.639
R. Group Size @ Membership = In-group	-0.02 [-0.04, -0.0003]	-1.99	.047

*Note. B* = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Planned contrasts. Four planned contrasts clarified the interaction effect. As predicted, people expressed more warmth toward their minority in-group compared to majority in-group. However, there was no significant difference in expressed warmth between people's minority and majority out-groups, see Figure SS2.1 and Table SS2.1. Moreover, people were more willing to interact with their minority in-group compared to majority in-group, but the relative size of the out-group did not influence people's willingness to interact with the out-group, see Figure SS2.3 and Table SS2.1.

Figure SS2.1 Expressed warmth by relative group size and membership in Supplemental Study 2.
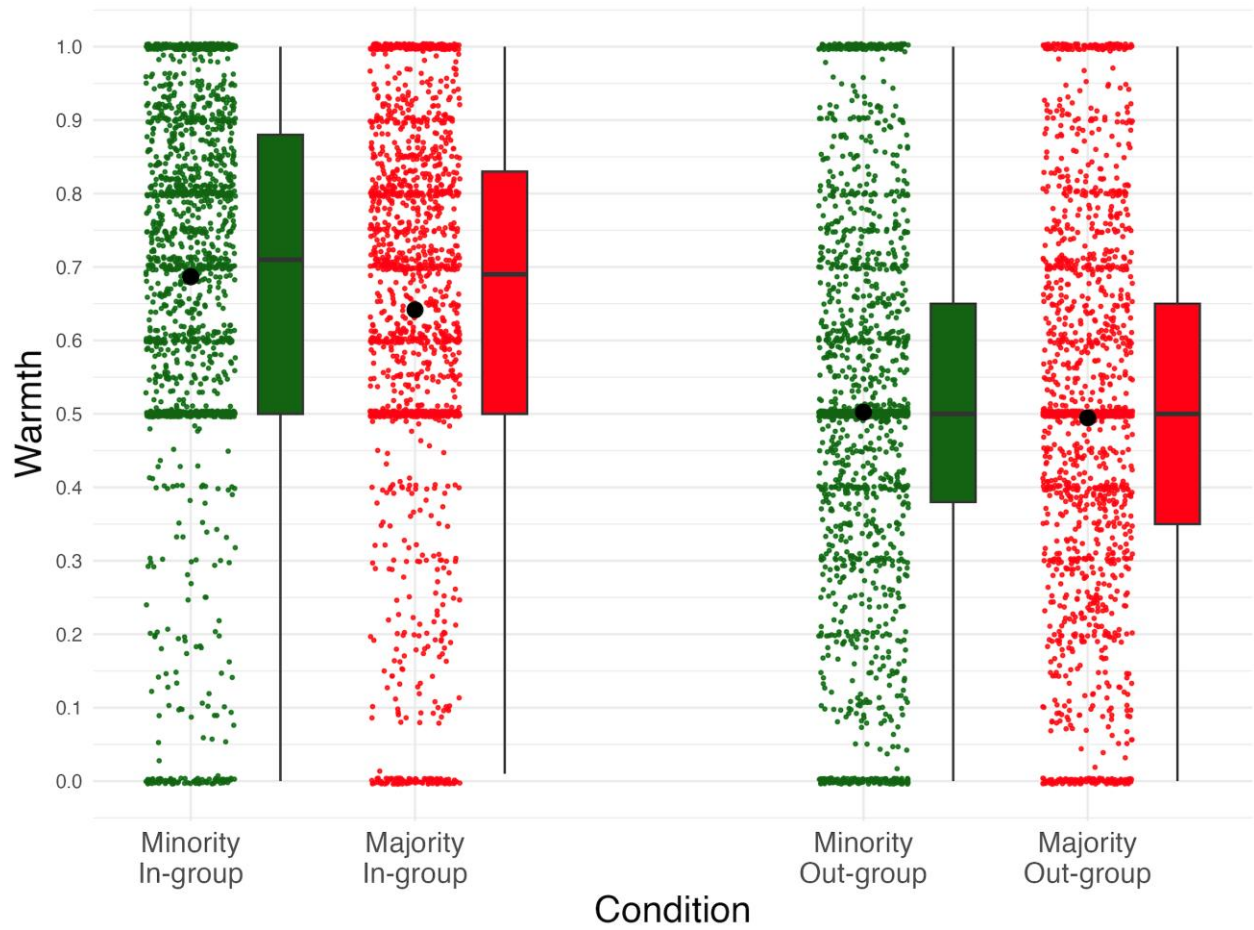
Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS2.2 Willingness to interact by relative group size and membership in Supplemental Study 2.
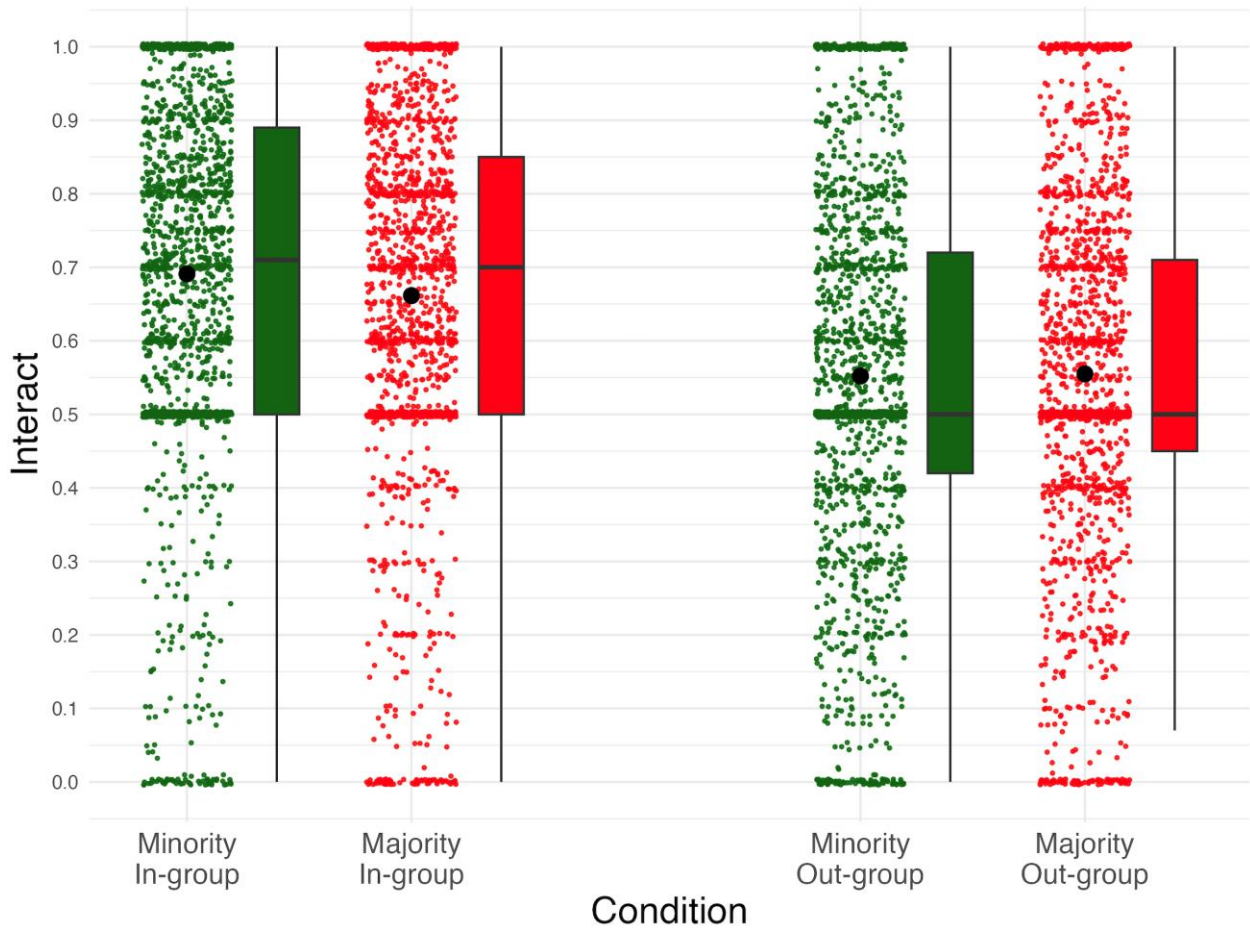
Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS2.3 Relative group size and membership interaction effect on warmth in Supplemental Study 2.

Figure SS2.4 Relative group size and membership interaction effect on willingness to interact in Supplemental Study 2.

Discussion

The main effects were that people expressed more warmth toward and willingness to interact with their in-groups than out-groups and with minority groups than majority groups. Moreover, there was an interaction between relative group size and membership. However, when examining each wave of data collection separately, the interaction was not significant, which we attribute to a lack of statistical power.

At each wave and when results were pooled together, planned contrasts revealed that people expressed more warmth toward and willingness to interact with their minority (vs. majority) in-group members. Additionally, expressed warmth and willingness to interact did

not vary as a function of the relative size of people's out-groups, replicating the trends of the

"by force" condition of Study 4. Thus, Supplemental Study 2 extends the results of Study 4

(which measured appreciation) to willingness to interact, a behavior intention.

Supplemental Study 3

In our previous experimental studies, people's assignment to their minority or majority in-group was random. However, people may have assumed that their group membership was based on a meaningful and lasting similarity that they had reported in their Prolific account (Prolific features recruiting people by various characteristics, including gender, age, and race.) Therefore, in Supplemental Study 3, we ensured that people experienced their assignment to a minority or majority in-group as credibly random by having them spin a physical wheel to determine their group assignment. Although previous work has tested intergroup perceptions with 'credibly random' groups, they did not manipulate relative group size. Thus, our effect of interest—more in-group love in minority versus majority in-groups—was not examined (Billig & Tajfel, 1973). Supplemental Study 3 also tests whether our effects generalize to a sample of almost 1,500 XXXXXXX museum-goers.

Method

Supplemental Study 3 had a mixed 2 x 2 design, with relative group size (-0.5 = minority vs. 0.5 = majority) as the between-subjects factor and membership (-0.5 = out-group vs. 0.5 = in-group) as the within-subjects factor. The main dependent measure was positive attitudes. Our secondary dependent measure was the depth level of a message written to fellow in-group members.

Participants. We recruited 1,498 people who visited the XXXXXXX museum of the XXXXXXX at the XXXXXXX (58.6% female, 38.7% male, 2.6% other; Mage = 34.02, SD = 14.10; 53.1% White, 19.2% Asian, 6.8% Black, 8.9% Latino/a, 9.8% Other). The museum is called XXXXXXX and functions as a lab. We ran an effect size-sensitivity analysis via 100 simulations of Supplemental Study 3's data (Green & MacLeod, 2016). We set α to 0.05 and

estimated the size of the key interaction between relative group size and membership to

be -0.02, -0.04, and -0.06. The analysis yielded a statistical power of $1-\beta = 11\%$, 34%, and 47%

to detect the key interaction, respectively.

Procedure. We manipulated membership (in-group vs. out-group) and relative group size

(minority vs. majority) by having people spin a wheel with six fields. Two fields were blue (or

green, depending on the week) and four were green (or blue). The colored field that they landed

on became their in-group, and the colored field that they did not land on became their out-group.

Landing on the two fields of the same color placed people in the minority condition, while

landing on the four fields of the same color placed them in the majority condition.

After spinning the wheel, all people sat down in front of a computer. Those in the

minority condition read: "You are a member of the rare BLUE [or GREEN] group. Please rate

your impressions of other XXXXXXXX visitors who are also members of the rare BLUE [or

GREEN] group. Please also rate your impressions of other XXXXXXXX visitors who are

members of the frequent BLUE [or GREEN] group." Those in the majority condition read: "You

are a member of the common BLUE [or GREEN] group. Please rate your impressions of other

XXXXXXXX visitors who are also members of the frequent BLUE [or GREEN] group. Please

also rate your impressions of other XXXXXXXX visitors who are members of the rare BLUE

[or GREEN] group."

On the same page, people rated the in-group and out-group in random order and on three

randomly ordered sliders. The first slider ranged from 0 ("I would feel indifferent towards

them") to 100 ("I would feel warmly […]"). The second slider ranged from 0 ("I am neutral

towards them") to 100 ("I think positively about them […]"). The third slider ranged from 0 ("I

am impartial about them") to 100 ("I like them"). We averaged these measures of positive

attitudes separately for each participant rating the in-group ($\alpha = .92$) and out-group ($\alpha = .92$). We rescaled this measure of positive attitudes so that it ranged from 0 to 1 (most positive attitudes).

On the next page, we instructed people to type between 30 and 300 characters to "share something about you" with one other in-group member. After typing a message, people reported how shallow or deep the shared information was, using a slider that ranged from 0 ("Shallow") to 100 ("Deep"). We rescaled this measure of message deepness so that it ranged from 0 1 (most deep).

Finally, people provided demographic information, including age, gender, and ethnicity.

Results

Main effects and interactions. Table SS3 shows the results of a linear mixed model (with random intercepts for the people) that predicted positive attitudes from three fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), and their interaction. We found a main effect of relative group size, such that people expressed more positive attitudes toward members of the minority (vs. majority) group. Additionally, a main effect of membership indicated that people expressed more positive attitudes toward in-group members compared to out-group members. Finally, there was no interaction between relative group size and membership on positive attitudes, see Table SS3.

Table SS3. Expressed positive attitudes and message deepness by relative group size and membership in Supplemental Study 3.

	b, 95% CI [LB, UB]	t	p
DV = Positive Attitude			
Relative Group Size: Minority vs. Majority	-0.02 [-0.03, -0.01]	-4.89	< .001
Membership: Out-group vs. In-group	0.06 [0.05, 0.07]	12.44	< .001
R. Group Size * Membership	-0.02 [-0.09, 0.04]	-0.76	.450
R. Group Size @ Membership = Out-group	-0.01 [-0.04, 0.02]	-0.67	.505
R. Group Size @ Membership = In-group	-0.03 [-0.07, -0.002]	-2.11	.035
DV = Message Deepness @ In-group			
R. Group Size: Minority vs. Majority	0.03 [-0.001, 0.06]	1.88	.060

Note. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Planned contrasts. In two planned contrasts, we predicted positive attitudes toward the in-group and out-group from a fixed effect of relative group size. People expressed more positive attitudes toward in-group members if their in-group was the minority compared to when their in-group was the majority. In contrast, the relative size of the out-group did not influence positive attitudes toward out-group members, see Table SS3 and Figure SS3.

In another planned contrast, we predicted message deepness towards the in-group from a fixed effect of relative group size. The relative size of the in-group did not significantly predict message deepness toward in-group members.

Figure SS3.1. Expressed positive attitudes toward minority versus majority in-groups and out-groups in Supplemental Study 3.
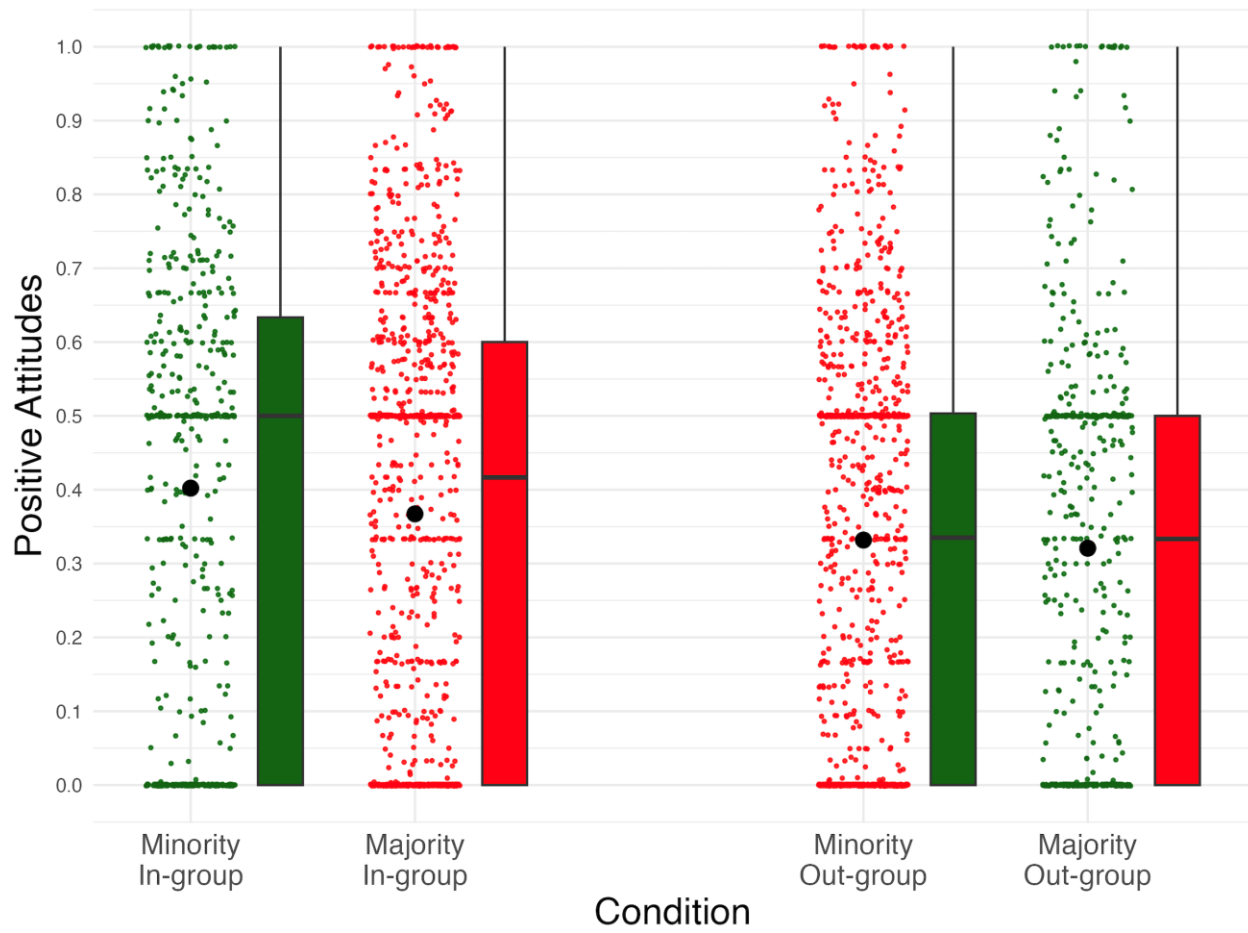
Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS3.2 Relative group size and membership interaction effect on positive attitudes in Supplemental Study 3.

Discussion

Supplemental Study 3 replicates our consistent findings: more love toward the in-group than the out-group, more love toward a minority than majority group, more love toward a minority (vs. majority) in-groups, and love toward the out-group not depending on its relative size. Thus, Supplemental Study 3 generalizes our effects to a population of XXXXX museum-goers. However, the interaction between relative group size and membership was not significant. We reason that this is because only a third of participants were in the minority in-group condition, while two-thirds were in the majority in-group condition. Another drawback of the study is that it had neither a control condition in which people's assignment to their in-

group was credibly systematic (instead of random), nor a manipulation check that would ascertain the higher perceived randomness of the random (vs. systematic) assignment condition.

Moreover, we intended to explore whether "minority boosts in-group love (in the sense of appreciation)" would trickle down to a greater extent of self-disclosure to another member of the in-group if it was the minority (vs. majority). We found that relative group size did not predict the level of depth in messages toward in-group members. In fact, although not significant, people wrote marginally deeper messages to majority (vs. minority) in-group members, a trend that remains to be substantiated and explained, if it is a real effect.

Supplemental Study 4

Like Study 5 of the main text, Supplemental Study 4 tested whether people express

more love for their minority (vs. majority) in-group but not out-group when it has many or just

a few members. However, Supplemental Study 4 had a few key differences from Study 5.

First, Supplemental Study 4 manipulated absolute group size only in terms of frequencies (e.g.,

167 people in the in-group and 333 people in the out-group). Also, Supplemental Study 4 did

not include any mediators, and the outcome variable was expressed warmth, measured using a

feeling thermometer. Supplemental Study 4 was preregistered, see link.

Method

Supplemental Study 4 had a mixed 2 x 2 x 2 design with relative group size (-0.5 =

minority vs. 0.5 = majority) as a between-subjects factor, membership (-0.5 = out-group vs. 0.5 =

in-group) as a within-subjects factor, and absolute group size (-0.5 = few people vs. 0.5 =

many people) as a between-subjects factor.

Participants. We recruited 4,007 U.S. residents from Prolific and excluded 19 people

who failed an attention check, leaving 3988 people (45.1% female, 52.6% male, 2.3% other;

M_{age} = 39.62, SD = 13.55). We ran an effect size-sensitivity analysis via 100 simulations of

Supplemental Study 4's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size

of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06.

The analysis yielded a statistical power of 1-β = 27%, 67%, and 99% to detect the key

interaction between relative group size and membership, respectively.

Procedure. Supplemental Study 4 manipulated relative group size and membership as

in Study 5 but used color-coded groups. That is, people joined a minority or majority in-group

(i.e., "For the purpose of this study, you are a member of the BLUE [or GREEN] group […]"),

and there was one majority or minority out-group. We randomly assigned half of the people to

the *few people* condition of the absolute group size factor. As in Study 5, people in the minority in-group encountered one other in-group member and four out-group members, whereas people in the majority in-group encountered three other in-group members and two out-group members. We randomly assigned the other half of people to the *many people* condition, in which they encountered 500 other people (the same condition as the *many people indicated as frequencies* condition in Study 5). People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 500 other people. 167 people who are also members of the BLUE [or GREEN] group, and 333 people who are members of the GREEN [or BLUE] group." People in the majority in-group read: "[…] 500 other people. 333 people who are also members of the BLUE [or GREEN] group, and 167 people who are members of the GREEN [or BLUE] group."

On the same page, we used two warmth sliders that ranged from 0 ("I feel indifferent towards them") to 100 ("I feel warmly towards them"; Haddock et al., 1993) to measure people's warmth toward the in-group and out-group. We randomized whether people rated warmth toward the in-group before the out-group or vice versa. We also rescaled this measure of warmth so that it ranged from 0 to 1 (most warmth).

Finally, people provided demographic information, including their age and gender.

Results

Main and interaction effects. Table SS4 shows the results of a linear mixed model (with random intercepts for the people) that predicted warmth from seven fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), absolute group size (few people vs. many people), their two-way interactions, and their three-way interaction.

People's warmth toward the minority (vs. majority) was greater, and people's warmth toward their in-group (vs. the out-group) was greater. A third significant main effect revealed that people's warmth toward the two groups was greater when they encountered few (vs. many) people.

Table SS4. Expressed warmth by relative group size, membership, and absolute group size in Supplemental Study 4

	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.02 [-0.03, -0.01]	-4.92	$< .001$
Membership: Out-group vs. In-group	0.19 [0.18, 0.20]	49.14	$< .001$
Absolute Group Size: 5 vs. 500 Others	-0.02 [-0.03, -0.0005]	-2.03	.043
R. Group Size * Membership	0.01 [-0.02, 0.04]	0.51	.611
R. Group Size * A. Group Size	0.02 [0.003, 0.03]	2.34	.018
Membership * A. Group Size	-0.03 [-0.05, -0.02]	-4.19	$< .001$
R. Group Size * Membership * A. Group Size	0.04 [-0.02, 0.10]	1.40	.161
Membership = Out-group			
R. Group Size @ A. Group Size = 5 Others	-0.02 [-0.04, 0.002]	-1.79	.074
R. Group Size @ A. Group Size = 500 Others	-0.02 [-0.05, -0.0007]	-2.03	.043
Membership = In-group			
R. Group Size @ A. Group Size = 5 Others	-0.03 [-0.06, -0.01]	-2.92	.004
R. Group Size @ A. Group Size = 500 Others	0.004 [-0.02, 0.03]	0.37	.708

Notes. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Two two-way interactions were significant. The two-way interaction between relative group size and absolute group size indicated that people's greater warmth toward the minority (vs. majority) was more pronounced when they encountered few (vs. many) people. The two-way interaction between membership and absolute group size indicated that people's greater warmth toward their in-group (vs. the out-group) was more pronounced when they

encountered few (vs. many) people. There was no significant interaction between

relative group size and membership nor a significant three-way interaction between relative
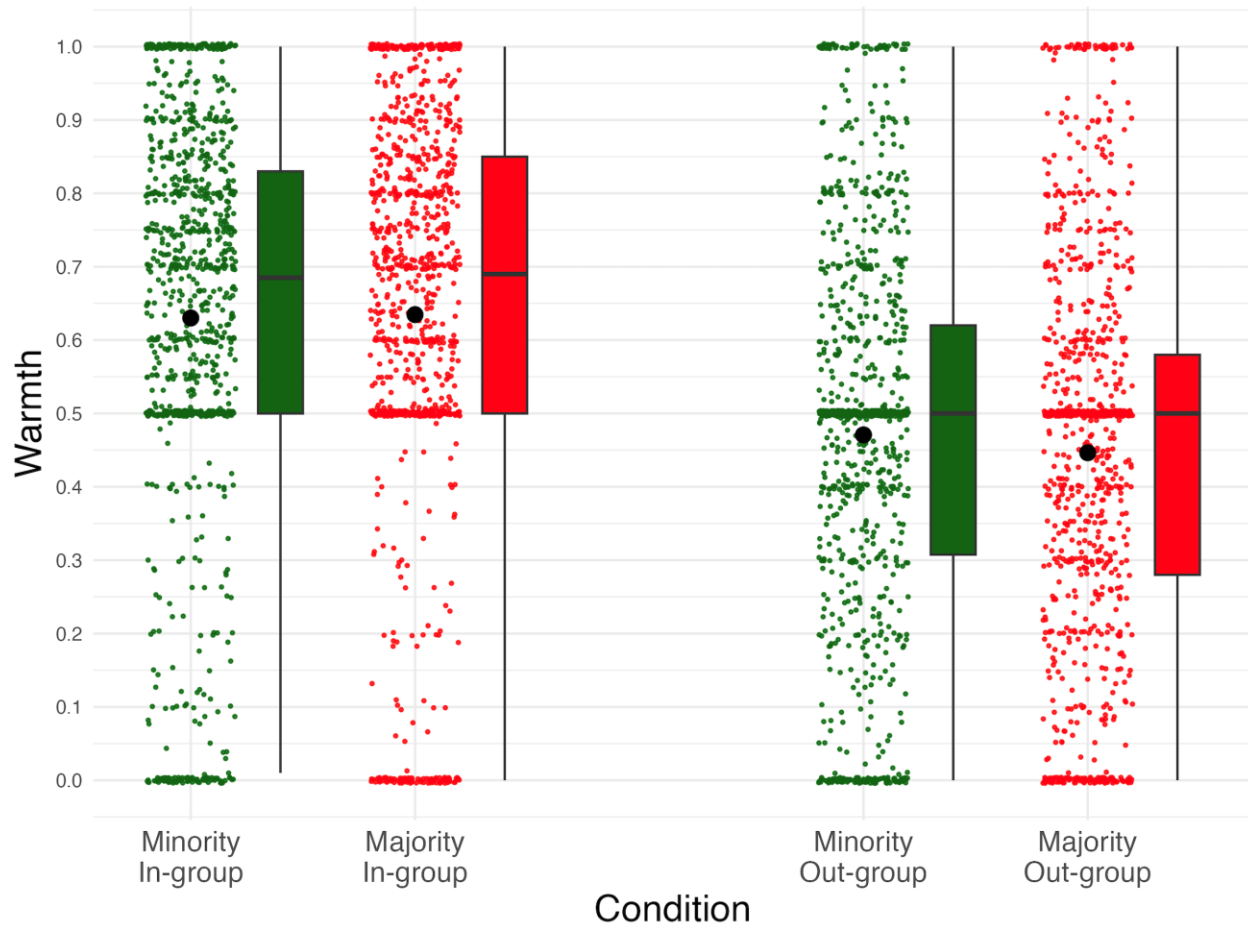
group size, membership, and absolute group size.

      Planned contrasts. In four planned contrasts, we predicted warm feelings from a

fixed effect of relative group size. Table SS4 shows that absolute group size was small,

people expressed more warmth toward their minority (vs. majority) in-group, but their

warmth toward the out-group did not depend on whether it was the minority (vs. majority),

see Table SS4 and Figure SS4.1. When absolute group size was large, their warmth toward

their in-group did not depend on whether it was the minority (vs. majority), but their warmth

toward their out-group was greater when it was the minority (vs. majority), see Table SS4

and Figure SS4.2.

Figure SS4.1 Expressed warmth toward minority versus majority in-groups and out-groups when absolute group size was small in Supplemental Study 4.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS4.2 Expressed warmth toward minority versus majority in-groups and out-groups when absolute group size was large in Supplemental Study 4.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure SS4.3 Relative group size and membership interaction effect on warmth separated by absolute group size in Supplemental Study 4.

Discussion

Supplemental Study 4 replicated some findings from Study 5, showing more love toward the in-group than the out-group and more love toward the minority versus majority group. Additionally, it found that people expressed more love toward 5 others compared to 500 others, as in Study 5. The interaction between relative group size and membership was not significant, which may be due to the introduction of our new manipulation, absolute group size. Further corroborating this possibility is the results of our planned contrasts.

The planned contrasts found that when people encountered 500 others indicated as frequencies (i.e., when absolute group size was large), relative group size did not predict warmth

expressed toward the in-group. While this effect was observed in Study 5 of the main text, these

inconsistencies suggest that this effect is not reliable. Furthermore, in Supplemental Study 4,

people expressed more love toward the relative minority (vs. majority) out-group, but this effect

did not replicate in Study 5. Thus, we reason that this effect is also not reliable. Taken together,

Supplemental Study 4 and Study 5 suggest that absolute group size is a boundary condition for

the effect of more love toward minority versus majority in-groups.

Supplemental Study 5

Like Study 6 of the main text, Supplemental Study 5 tested whether people express more

in-group love toward their minority (vs. majority) in-groups while varying the minority

proportion to the out-group (moving forward, we will refer to this as imbalance). However,

Supplemental Study 5 had a few key differences from Study 6. First, Supplemental Study 5

manipulated imbalance with four conditions at different imbalance levels than Study 6 (i.e.,

18% minority vs. 27% minority vs. 36% minority vs. 45% minority). Additionally, people

encountered 10 others instead of 14 others. Moreover, Supplemental Study 5 does not include

any mediators and the outcome variable is expressed warmth, measured by a feeling

thermometer. Supplemental Study 5 was preregistered, see link.

Method

Supplemental Study 5 had a mixed 2 x 2 x 4 design with relative group size (-0.5 =

minority vs. 0.5 = majority) as a between-subjects factor, membership (-0.5 = out-group vs. 0.5 =

in-group) as a within-subjects factor, and imbalance (-0.5 = 45% minority vs. -1.67 =

36% minority vs. 1.67 = 27% minority vs. 0.5 = 18% minority) as a between-subjects factor. The

dependent measure was expressed warmth.

Participants. We recruited 4,009 U.S. residents from Prolific and excluded 114 people

who failed an attention check, leaving 3,995 people (48.3% female, 49.7% male, 2% other; M_{age}

= 38.67, SD = 13.56). We ran an effect size-sensitivity analysis via 100 simulations of

Supplemental Study 5's data (Green & MacLeod, 2016). We set α to 0.05 and estimated the size

of the key interaction between relative group size and membership to be -0.02, -0.04, and -0.06.

The analysis yielded a statistical power of $1-\beta$ = 21%, 74%, and 99% to detect the key interaction

between relative group size and membership, respectively.

Procedure. Supplemental Study 5 manipulated relative group size and membership as in Study 6. Again, there was a majority or minority out-group. To manipulate imbalance, we randomly assigned people to one of four conditions.

We randomly assigned a fourth of the people to the *45% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 10 other people. 4 people who are also members of the BLUE [or GREEN] group, and 6 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 10 other people. 5 people who are also members of the BLUE [or GREEN] group, and 5 people who are members of the GREEN [or BLUE] group." We randomly assigned another fourth of the people to the *36% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 10 other people. 3 people who are also members of the BLUE [or GREEN] group, and 7 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 10 other people. 6 people who are also members of the BLUE [or GREEN] group, and 4 people who are members of the GREEN [or BLUE] group." We randomly assigned another fourth of the people to the *27% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 10 other people. 2 people who are also members of the BLUE [or GREEN] group, and 8 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 10 other people. 7 people who are also members of the BLUE [or GREEN] group, and 3 people who are members of the GREEN [or BLUE] group." We randomly assigned the last fourth of the people to the *18% minority* condition of the imbalance factor. People in this minority in-group read: "You are a member of the BLUE [or GREEN] group. There are 10 other people. 1 person who is

also a member of the BLUE [or GREEN] group, and 9 people who are members of the GREEN [or BLUE] group." People in this majority in-group read: "[…] 10 other people. 8 people who are also members of the BLUE [or GREEN] group, and 2 people who are members of the GREEN [or BLUE] group."

On the same page, we used two warmth sliders that ranged from 0 ("I feel indifferent towards them") to 100 ("I feel warmly towards them"; Haddock et al., 1993) to measure people's warmth towards the in-group and out-group. We rescaled this measure of warmth so that it ranged from 0 to 1 (most warmth).

Finally, people provided demographic information, including their age and gender.

Results

Main and interaction effects. Table SS5 shows the results of a linear mixed model (with random intercepts for the people) that predicted warmth from seven fixed effects: relative group size (minority vs. majority), membership (out-group vs. in-group), imbalance (45% minority vs. 36% minority vs. 27% minority vs. 18% minority), their two-way interactions, and their three-way interaction. People's warmth toward the minority (vs. majority) was greater, and people's warmth toward the in-group (vs. out-group) was greater. There was not a significant main effect of imbalance. One out of three two-way interactions were significant. The two-way interaction between membership and imbalance indicated that people's warmth toward their in-group (vs. the out-group) was more pronounced when the two groups were more imbalanced. The three-way interaction was not significant. We then ran eight planned contrasts to test the effect of relative group size in each cell of the membership factor crossed with the imbalance factor.

Table SS5. Expressed warmth by relative group size, membership, and imbalance in Supplemental Study 5

|	b and 95% CI [LB, UB]	t	p
Relative Group Size: Minority vs. Majority	-0.03 [-0.04, -0.02]	-8.10	< .001
Membership: Out-group vs. In-group	0.20 [0.19, 0.20]	48.47	<.001
Imbalance: 45% vs. 36% vs. 27% vs. 18% Min.	0.003 [-0.002, 0.01]	1.21	.225
R. Group Size * Membership	-0.01 [-0.04, 0.02]	-0.47	.639
R. Group Size * Imbalance	-0.01 [-0.01, 0.0004]	-1.83	.067
Membership * Imbalance	0.01 [0.001, 0.01]	2.50	.012
R. Group Size * Membership * Imbalance	-0.01 [-0.04, 0.01]	-0.96	.337
Membership = Out-group			
R. Group Size @ Imbalance = 18% Min	-0.03 [-0.06, 0.01]	-1.57	.116
R. Group Size @ Imbalance = 27% Min	-0.04 [-0.07, -0.002]	-2.09	.037
R. Group Size @ Imbalance = 36% Min	-0.04 [-0.07, -0.004]	-2.32	.026
R. Group Size @ Imbalance = 45% Min	-0.02 [-0.05, 0.01]	-1.10	.270
Membership = In-group			
R. Group Size @ Imbalance = 18% Min	-0.07 [-0.10, -0.04]	-4.17	< .001
R. Group Size @ Imbalance = 27% Min	-0.05 [-0.08, -0.01]	-2.73	.007
R. Group Size @ Imbalance = 36% Min	-0.02 [-0.05, 0.01]	-1.28	.202
R. Group Size @ Imbalance = 45% Min	-0.01 [-0.04, 0.02]	-0.51	.611

Notes. B = estimate. 95% CI [LB, UB] = 95% confidence interval [lower bound, upper bound].

Planned contrasts. Table SS5 shows that in the 45% minority in-group condition of the imbalance factor, people's warmth toward neither their in-group, not the out-group depended on whether it was the minority (vs. majority). In the 36% minority in-group condition, people's warmth toward their in-group did not depend on whether it was the minority (vs. majority), but their warmth toward the out-group was greater when it was the minority (vs. majority). In the 27% minority condition, people's warmth toward their in-group was greater when it was the minority (vs. majority), and their warmth toward the out-group was also greater when it was the minority (vs. majority). In the 18% minority condition, people's warmth toward their in-group

was greater when it was the minority (vs. majority), but their warmth toward the out-group did

not depend on whether it was the minority (vs. majority), see Table SS5 and
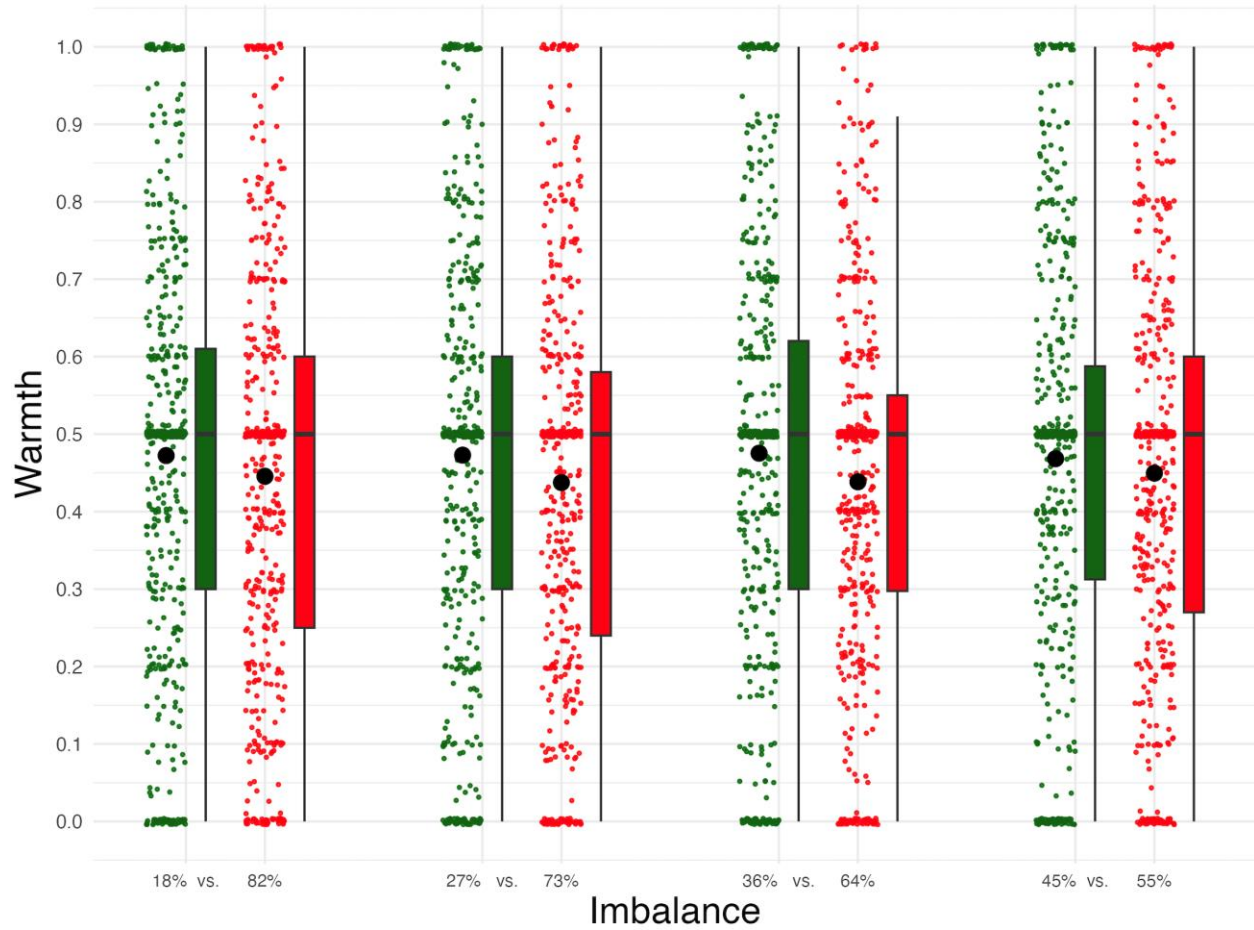
Figures SS5.1 and SS5.2.

Figure SS5.1 Expressed warmth toward minority versus majority in-groups when varying imbalance in Supplemental Study 5.
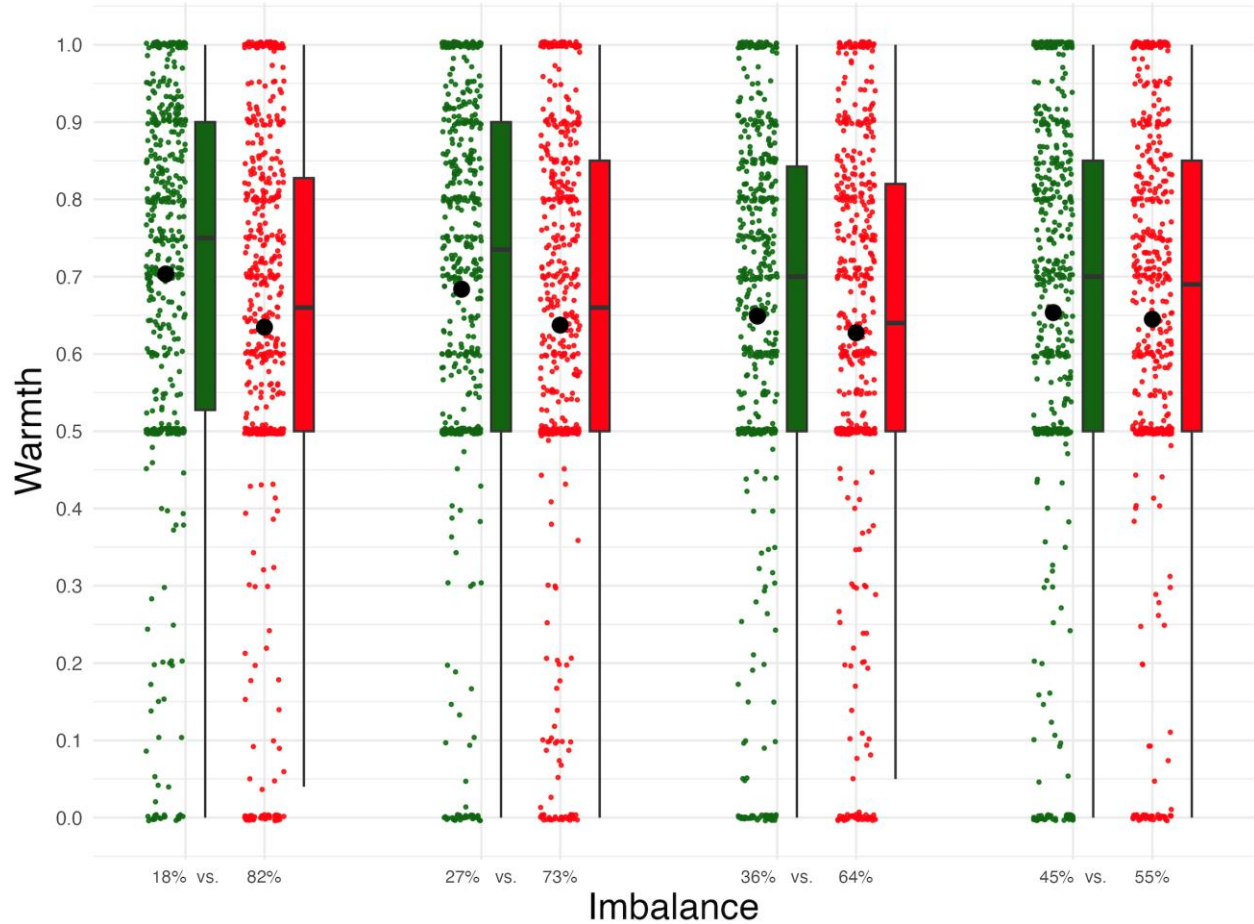
Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Table SS5.2. Expressed warmth toward minority versus majority out-groups when varying imbalance in Supplemental Study 5.

Notes. Black dot = mean; colored dots = observations; boxplots = median [2nd, 3rd quartile].

Figure 5.3. Interaction on appreciation by relative group size and membership separated by imbalance in Supplemental Study 5.

Discussion

Supplemental Study 5 replicated some findings of Study 6, showing more love toward the in-group than the out-group and more love toward the minority versus the majority. However, Supplemental Study 5 did not find a main effect of imbalance. Also, the interaction between relative group size and membership was not significant, possibly due to the introduction of the imbalance factor.

Four planned contrasts focused on perceptions toward the in-group found that greater imbalance led to more love toward the minority (vs. majority) in-group. Specifically, the minority (vs. majority) in-groups of 18% and 27% elicited more in-group love, but relative

group size did not predict love toward the 36% and 45% minority (vs. 64% and 55% majority) in-group, respectively. However, in Study 6 of the main text, we observed more love toward a 33% minority (vs. 67% majority) in-group, but no difference in love toward a 20% minority (vs. 80% majority) in-group, possibly because the 20% minority in Study 6 was a triad, whereas the 18% minority in SS5 was a dyad (i.e., dyads may be especially conducive to in-group love).

Four planned contrasts focused on perceptions of the out-group found that people expressed more love toward the 27% and 36% minority (vs. 73% and 64% majority) out-group. However, in Study 6 of the main text, people reported more love toward the 20% minority (vs. 80% majority) out-group. Given these inconsistencies, we included mediators in Study 6 to identify the possible mechanisms driving the effects when manipulating imbalance.

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