Humans Exhibit both Parochialism and Nastiness within Groups

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Abstract: Like other group-living species, humans often display parochial cooperation, that is they cooperate with ingroup members more than with outgroup members and strangers. Theoretically, parochial cooperation should imply that people also compete less with ingroup members than with outgroup members and strangers. However, in situations where people could invest to take other's resources, and invest to protect against such exploitation, we observed the opposite pattern. Akin to what in other species is known as the 'nasty neighbour effect', in such dyadic contests people invested more (rather than less) with ingroup members than with out-group members and strangers across 51 nations (study 1, *N*=12,863), in different communities in Kenya (study 2, *N*=552), and in on-line samples from the United Kingdom (study 3, *N*=401; study 4, *N*=300; pre-registered replications). This 'nasty neighbour' behaviour emerged independent of parochial cooperation and trust towards others that have the same (versus different) nationality (study 4) and, fitting field-observations in other species, neighbour nastiness emerges when people perceive within-group resource scarcity, and especially towards low-ranking ingroup members (study 3-4, and study 5, *N*=552). That humans can exhibit both parochialism and nastiness within groups is difficult to reconcile with existing theories on the evolution of cooperation in structured populations.

One sentence summary: Humans not only cooperate but also compete more with ingroup members, than outgroup members and strangers.

Across the behavioural and biological sciences, there is empirical evidence that people treat members of one's language, political or national group more favourably(*1*, *2*). This phenomenon, known as ingroup favouritism(*2–5*) or parochialism(*6–15*), is widespread around the world(*5*, *6*). From this observation, it should follow that people also compete more readily with outsiders than insiders, making conflict more likely and intense between than within groups(*3*, *12*, *16–19*).

Existing evidence for parochialism is, however, largely based on measures of within- and between-group cooperation(*20*), or measures that combine cooperation and competition(*3*, *10*, *11*). In these situations, people can extend a benefit to others at some cost to themselves, and parochial cooperation implies that people more readily extend benefits and create joined welfare when interacting with ingroup members. It should follow that people in interactions with ingroup members rather than outgroup members, therefore, also extend less resources when this imposes a cost on others at a benefit to oneself (i.e., competition). Psychologically, however, lack of cooperation – extending a benefit to others at some cost to oneself – cannot simply be equated with the presence of competition – imposing a cost on others to benefit oneself(*21*). For example, it has been observed that people are often more cooperative but can likewise be more competitive than rational choice theory would assume(*22–24*). By implication, evidence for parochial cooperation cannot be taken as evidence for parochial competition(*16*, *22*, *25*). The few studies that considered parochialism in both cooperation and competition revealed mixed results, with some reporting that people compete more with distant others and outgroup members(*10*, *12*) and others reporting no or even counter-evidence(*22*, *26–29*) (for an overview see (*2*, *29*, *30*)).

Whereas parochialism in cooperation is well-documented, we lack robust and uncontested evidence for the presence of parochialism in competition(*11*, *12*, *28*, *31*). To address this gap, we focused on parochialism in humans across two aspects of conflict: when trying to out-compete others (*viz.*, attack), and when trying to avoid being out-competed (*viz*., defence)(*32–34*) (**Fig. 1a**; *Methods*). In these contest games, cooperation means that individuals do not invest anything, as any investment imposes a cost on their partner and reduces joint welfare(*34*, *35*). From the extant research on parochialism(*2*, *9*, *13*, *36*), we initially hypothesized that people would be less competitive – or more likely to not invest anything – with ingroup members compared to outgroup members and strangers. Theoretically, if people are more pro-social towards, and create more joined welfare, when interacting with ingroup members, it should follow that they also shy away from 'wasting' personal and collective resources on competitions with ingroup members.

However, and to our surprise, we found – across three independent experiments – that people invested more in contests with ingroup members than with outgroup members and strangers. Relatedly, individuals invested more in contests with opponents from geographically closer, than more distant countries.

Whereas these results are puzzling from a theoretical perspective(*37*, *38*), they are in line with what in other species is known as the nasty-neighbour effect, the observation that animals can be more aggressive towards conspecific neighbours than to unfamiliar conspecifics(*39–44*). Furthermore, follow-up experiments revealed that humans can behave as parochialists and, independently thereof, as nasty neighbours, and that neighbour nastiness emerges especially when individuals perceive within-group resource scarcities and a need to secure within-group status.

Humans as nasty neighbours. In study 1, participants from 51 different countries made 27 decisions to attack and 27 decisions to defend, in a within-subject design. In both roles, participants made one decision knowing that their opponent was a participant from the same country (ingroup treatment), 25 decisions with opponents from the pool of nations included in the study (outgroup treatment), and one decision with an unidentified stranger (stranger treatment). Contrary to pre-registered predictions, participants invested more resources in conflict with ingroup members compared to outgroup members and strangers (**Fig. 1b**), both when investing in attack (mixed-effects regression model, $b = 0.346$, $p < .001$) and when investing in defence ($b = 0.283$, $p < .001$). Results remain robust when considering outgroup members and strangers separately, across various analytic strategies, and after controlling for gender, age, and education (*Supplement* Tables S1-S3 and Fig. S4-S4). The effect was in the same direction in all countries (**Fig. 1b**), and independent of country-level factors that were associated with parochial cooperation in earlier work, like the quality of institutions, pathogen stress, and economic wealth(*45*) (*Supplement* Fig. S5). As a result, participants wasted more resources on conflict and earned less when interacting with ingroup members rather than outgroup members or strangers (attack: $b = 0.467$, $p < .001$; defence: $b = 0.396$, $p < .001$).

If competition is indeed stronger for closer than distant others, intensity of competition may also systematically decrease with geographical distance between opponents. To test this, we retrieved secondary data on geographical distance(*46*), and assigned a score that represented the bilateral

distance between the biggest cities of the participant's and their opponent's countries (*Methods*). Extending the finding that individuals competed more with ingroup than with outgroup members and strangers, greater bilateral geographical distance was associated with lower conflict expenditure for both attack (b = -0.066, p < .001) and defence (b = -0.063, p < .001). Controlling for relevant individual and cross-societal differences, such as GDP, did not change results (*Supplement* Table S4).

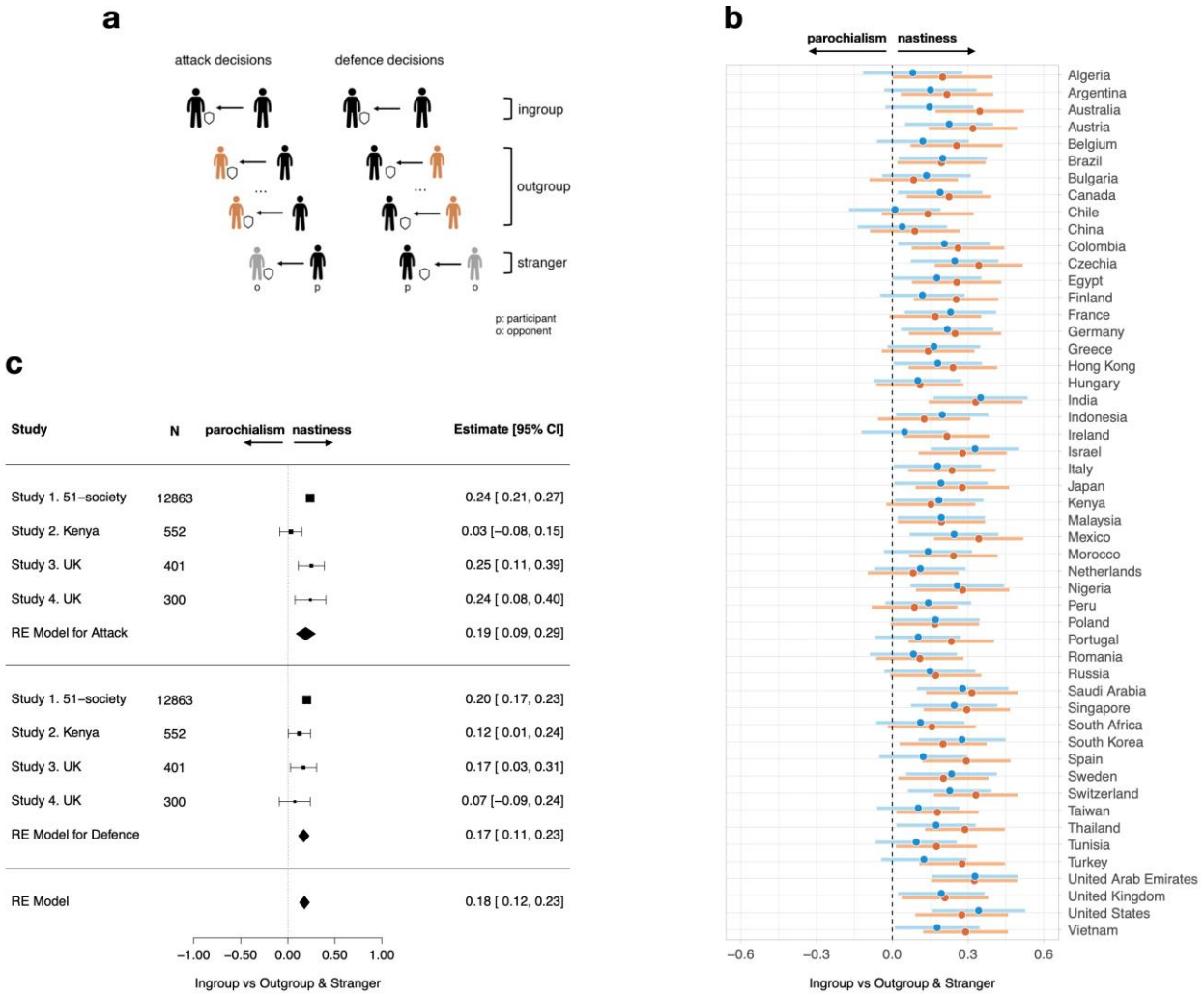

Figure 1. The nasty neighbour effect in humans. (a) Design for study 1-4. Participants (p) invested resources in the attacker-defender contest across two randomized blocks. In one block (shown on the left), participants could invest their money to take money from an opponent (sampled from the pool of countries participating in the study). In the other block (shown on the right), they could invest to defend themselves against their antagonist' attempt to take their money. In each block, they made one decision with an opponent from the same nation, 25 (in study 1; 16 in study 3 and 4) decisions with foreigners from different nations, and one decision with an unidentified stranger (in random order). (**b)** Conflict investments towards ingroup versus outgroup/stranger across 51 nations. The forest plot displays the effect sizes (Cohen's *d*) of the difference in conflict investments between ingroup members and outgroup members/strangers across countries. Positive deviations from zero indicate stronger competition (i.e., more conflict investments) with an ingroup member than an outgroup member/stranger. Per country,

outgroup/stranger investments were calculated by averaging the investments towards outgroups + the average investments towards strangers. Dots represents effect size estimates and lines refer to the 95% confidence intervals of the estimates. Blue lines refer to defence (i.e., trying to avoid exploitation), and red lines refer to attack (i.e., trying to exploit the opponent). **(c)** Meta-analytic estimates of conflict investments towards ingroup vs the rest across studies. The forest plot displays the effect sizes (Cohen's *d*) of the difference in attack and defence between ingroup members and all other opponents across all conducted studies.

Study 2 examined whether results from study 1 generalizes beyond between-country interactions and is also present in a lab-in-the-field experiment where individuals interacted within and between different ethnocultural groups residing within the same country (Kenya, $N = 552$; *Methods*). We used the same incentivized contest game used in study 1. Each participant made one decision with an ingroup opponent that had the same ethnocultural affiliation as the participant, one decision with an outgroup opponent that had a different ethnocultural affiliation than the participant, and one decision with a stranger whose ethnocultural affiliation was not given. We again find no support that shared group membership reduces conflict. Rather, as in study 1, people invested more in conflict with ingroup than outgroup members and strangers (**Fig. 1c**). This effect was significant for defence ($b = 0.178$, $p = .036$), but not for attack ($b = 0.046$, $p = .586$; *Supplement* Table S5). We note that this (non-significant) effect for (attack) defence replicates the findings for participants from Kenya in study 1 (see **Fig. 1b**).

Although the evidence against the parochial competition hypothesis (as the theoretical flipside of parochial cooperation) was unanticipated, research on animal behaviour documented a similar tendency to compete more with close rather than distant conspecifics – a phenomenon dubbed the 'nasty neighbour effect'(*39–44*). Accordingly, we pre-registered a replication of our findings in a representative sample of UK participants in a follow-up study (study 3; $N = 401$, stratified by age, gender, ethnicity). Participants made decisions in attack and defence with opponents from different countries (per study 1; *Methods*). In line with the nasty neighbour effect, people invested more in both attack and defence when paired to ingroup members than outgroup members and strangers (**Fig. 1c**; attack: $b = 0.285$, $p < .001$; defence: $b = 0.198$, $p < .001$). As in study 1, participants were also less competitive toward geographically distant outgroups ($b = -0.036$, $p = .01$ for attack, and $b = -0.022$, $p = .09$ for defence; *Supplement* Tables S6-S7).

The attacker-defender contest in study 1-3 has its equilibrium in mixed-strategy, meaning that what investment is in the individual's best interest depends on what the other contestant does – investing in attack is, from the perspective of individual payoffs, wasteful or attractive when the

defending party does invest much or nothing, respectively(*32*, *35*, *47*). These properties allow to more closely examine what individuals paired with ingroup and outgroup partners were doing (for the mathematical underpinnings, see *Supplement* section 1.2). First, we see that the likelihood of not investing anything – akin to cooperating, or not engaging in competition – is not different for ingroup compared to outgroup partners and strangers (*Supplement* Figure S2.a – S2.d). This suggests that in the decision to cooperate or not, or to compete or not, people can be neither classified as parochialists or nasty neighbours (*48*). In line with this analysis, people were not nasty neighbours when asked to select a political ingroup or outgroup partner to compete with in a dot estimation task (for more detail, see section 5 of the *Supplement*). Second, when we examined how much people invest relative to the mean expected investment assuming rational and risk-neutral agents that aim to maximize their expected payoffs, we see that individuals overinvest more with ingroup partners than with outgroup partners and strangers in both attack and defence (*Supplement* Figure S2.a – S2.d). In sum, these additional analyses suggests that the nasty neighbour effect (*i*) is not about preferentially competing (or cooperating) with in-group rather than out-group individuals, but rather (*ii*) about how much individuals compete within rather than between groups.

The nasty neighbour effect co-exists with parochialism. Considering past research documenting ingroup favouritism in cooperation, we further wanted to test if and how higher nastiness towards ingroup (vs. outgroup) members is related to parochialism towards ingroup (vs. outgroup) members(*22*). In the dyadic contests, parochialism in cooperation could have revealed itself in a greater likelihood of not investing anything in attack and defence when paired with in-group members, something we did not observe. However, as noted at the outset, parochialism has often been observed when individuals can invest to the benefit of others.

In study 4 (N = 400), we examined whether parochialism and neighbour nastiness co-exist within the same human population across situations. Individuals interacted with someone from their own country (here United Kingdom) and 14 individuals from foreign countries (*Methods*(*9*)). For each interaction, we assessed investment in the attacker-defender contest (**Fig. 1a**), and transfers and back-transfers in a standard trust game that measures forward-paying trust towards another person, and trustworthiness (*Methods*, and *Supplement* section 3.1). Both transfers (trust) and back-transfers (trustworthiness) were larger when paired to a fellow citizen than to a foreigner (**Fig. 2a**; trust: b = 0.327, p < .001; trust: b = 2.330, p < .001; *Supplement* Table S8), showing

parochialism in trust and trustworthiness. We also replicated the nasty neighbour effect in conflict investment: Individuals invested more in attack (b = 0.24, p = 0.003) and (non-significantly more) in defence (b = 0.071, p = 0.31) when paired to someone from their own, rather than a foreign country (**Fig. 2b**; *Supplement* Table S8 and Figure S2d).

Trust as operationalized in the trust game creates higher joint benefits for the actors while reciprocity of trust leads to a fairer distribution of resources. Higher investments in attack and defence, on the other hand, reduce joint benefits and more likely increase inequality between parties. Importantly, at the sample-level, investment in competition (the aggregate of attack and defence investments in the contest game) was not correlated with investment in cooperation (the aggregate of transfers and back-transfers in the trust game) (r = 0.023, p = 0.695). More specifically, the (nasty neighbour) difference in ingroup versus outgroup attack did not predict parochial trustworthiness (return to ingroup – outgroup partner) (**Fig. 2c**) and the (nasty neighbour) difference in ingroup versus outgroup defence was uncorrelated with parochial, forward-paying trust (**Fig. 2d**).

Instead, we observe quite some heterogeneity in our representative sample, with some individuals being parochial in the trust game and nasty neighbours in the contest game, some being parochialists but not nasty neighbours, and some being neither parochial nor nasty neighbour (**Fig. 2cd**). This opens the possibility that neighbour nastiness and parochialism can also co-exist as strategies in situations where parochialism is typically observed. To address this question, we re-analysed a cross-cultural dataset (N = 18,411; 42 societies) where, on average, individuals were more cooperative with national ingroup members, than outgroup members and strangers (*6*). In line with Study 4, we observe substantial individual heterogeneity. While a majority of individuals were parochial (higher cooperation with ingroup than outgroup and stranger: 48%, N = 8577), a large fraction of individuals were nasty neighbours (higher cooperation with outgroup and stranger than ingroup: 32%, N = 5736), and this fraction was significantly higher than the fraction of people that did not discriminate between ingroup and outgroup members (20%, N = 3714, See SI, section 3.2). Taken together, these results underscore that parochial cooperation does not imply parochial competition and that, within and across individuals, parochialism does not predict how ‘nasty’ one is towards an ingroup member.

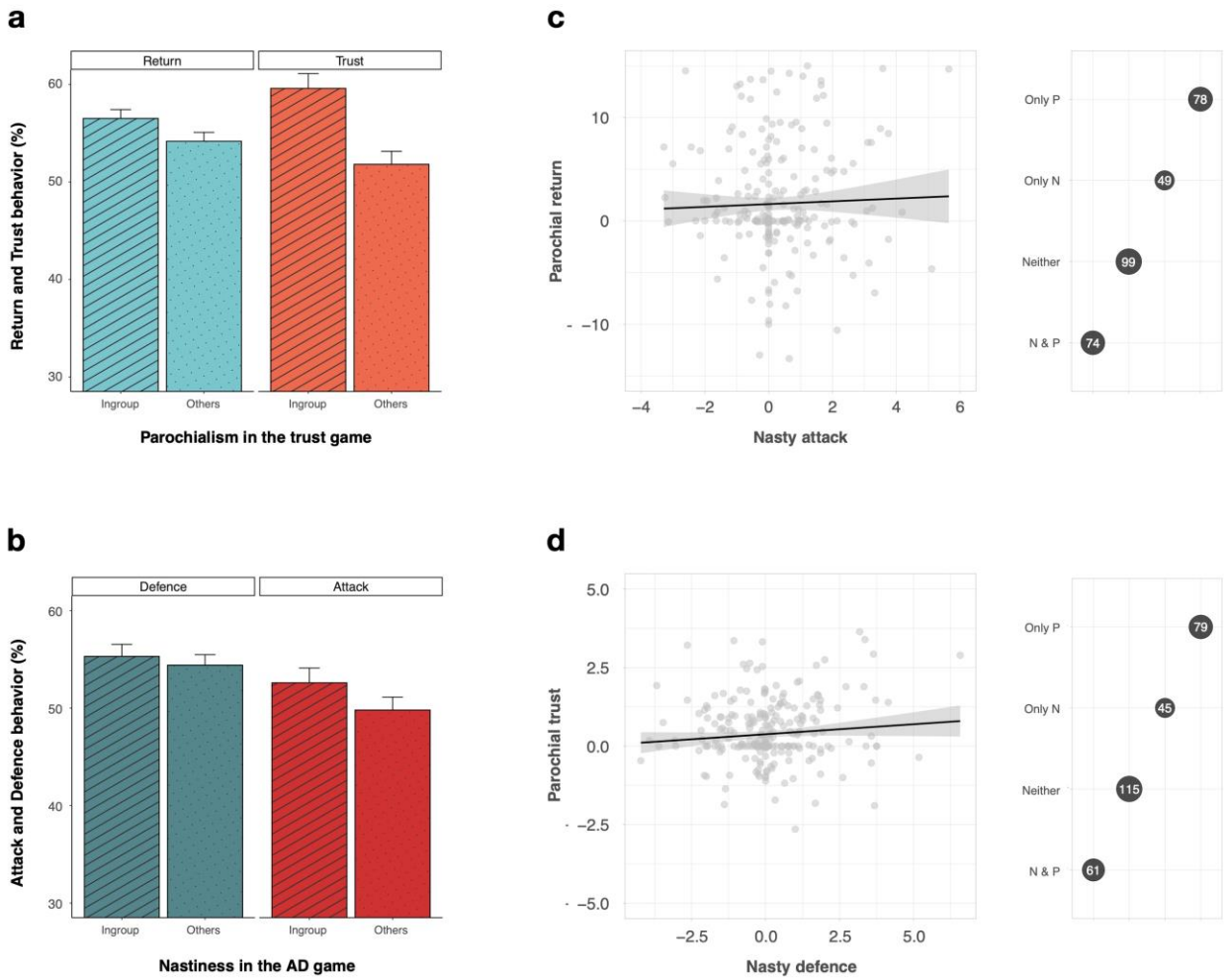

Figure 2. Parochialism co-exists with neighbour nastiness. (a) Parochialism in the trust game. Bar chart showing mean differences in percentage between ingroup partners and others (outgroup and strangers) for transfers (*viz.* parochial trust) and back-transfers (*viz.* parochial trustworthiness). **(b)** Nastiness in the attacker-defender contest. Bar chart showing mean differences in percentage between investments with ingroup opponents in attack and defence vs. others (outgroup and strangers). **(c)** Parochial trustworthiness is not associated with nastiness in attack. Scatterplot of the relation between conflict investments in attack towards ingroup minus outgroup members and strangers (nasty attack) and ingroup minus outgroup return of trust (parochial trustworthiness). Bubble plot on the right shows the number of participants that can be classified as only parochial ('only P'), as only nasty ('only N'), as neither nasty nor parochial ('neither') or as both nasty and parochial ('N & P') based on their return and attack decisions. **(d)** Parochial trust is also not associated with nastiness in defence. Scatterplot of the relation between conflict investments in defence towards ingroup minus outgroup members and strangers ('nasty defence') and trust behaviour towards ingroup minus outgroup members and strangers ('parochial trust'). Bubble plot on the right shows the number of participants that can be classified as only P, only N, as neither or as N & P based on their trust and defence decisions.

Within-group status and resource scarcity bring forth nasty neighbours. In study 4, we show that people can be nasty neighbours and parochial cooperators at the same time, only nasty neighbours, only parochial cooperators, or neither. One possible explanation for this pattern is that within-group nastiness serves different and independent functions than parochialism. Social

interactions are often multifaceted and involve competition over cooperatively produced rewards. For example, some animals cooperate for hunting, but in the process of the division of hunted prey they often compete with each other(*21*, *49*). And indeed, whereas parochialism in humans correlates with pro-social preferences and group affiliation(*4*, *5*), the literature on the 'nasty neighbour effect' in other animal species suggests, among species-specific features, that neighbour nastiness can help individuals to secure status-ranking within their group(*40*, *44*) and (access to) a personal share of group resources(*39*, *44*, *50*).

We preregistered status-concerns and resource scarcity as two plausible proximate reasons for the nasty neighbour effect in study 3 and 4. Consistent with the non-human animal literature, study 3 finds that neighbour nastiness was stronger, the more people perceived lower status within their nation (**Fig. 3a**; ingroup vs outgroup/stranger × perceived ingroup status: $b = 0.187$, $p = .015$; *Supplement* Table S9). Moreover, the nasty neighbour effect in study 3 was fully mediated by perceived resource scarcity, when controlling for beliefs and perceived similarity with the nation of the opponent (indirect effect: $b = -0.232$, $p <. 001$; total effect: $b = -0.254$, $p < .001$; direct effect: $b = -0.022$, $p = .740$; *Supplement* Table S10). In fact, differences in how people perceived competition for scarce resources with ingroup members compared to foreigners and strangers were positively associated with neighbour nastiness ($b = 0.037$, $p = 0.027$). Neither beliefs nor perceived similarities fully mediated or significantly interacted with the nasty neighbour effect (see Supplement, section 4.1). We also found no evidence that the nasty neighbour effect interacted with individual-level characteristics that are often associated with parochialism (i.e., identification with one's own group or nation, risk preferences, or prosocial preferences(*2*, *4*, *5*); *Methods*, and *Supplement* Table S9).

In study 4 we directly examined how parochialism and the nasty neighbour effect were associated with social affiliation and identification on the one hand, and perceived competition for scarce resources on the other. In line with study 3, perceived resource scarcity predicted the nasty neighbour effect in attack and defence (attack: $b = 0.069$, $p = 0.035$; defence: $b = 0.053$, $p = 0.073$) but not parochialism in trust and trustworthiness (trust: $b = -0.012$, $p = 0.527$; trustworthiness: $b = 0.032$, $p = 0.875$). By contrast, national identification was associated with parochialism in trust ($b = 0.131$, $p < 0.001$) and trustworthiness ($b = 0.844$, $p = 0.01$) but was not associated with the nasty neighbour effect in attack ($b = -0.001$, $p = 0.971$) and defence ($b = 0.001$, $p = 0.999$) (*Supplement* Table S11). Together, these correlations support the possibility

that parochial cooperation and within-group nastiness co-exist because each strategy relates to different elements of group living.

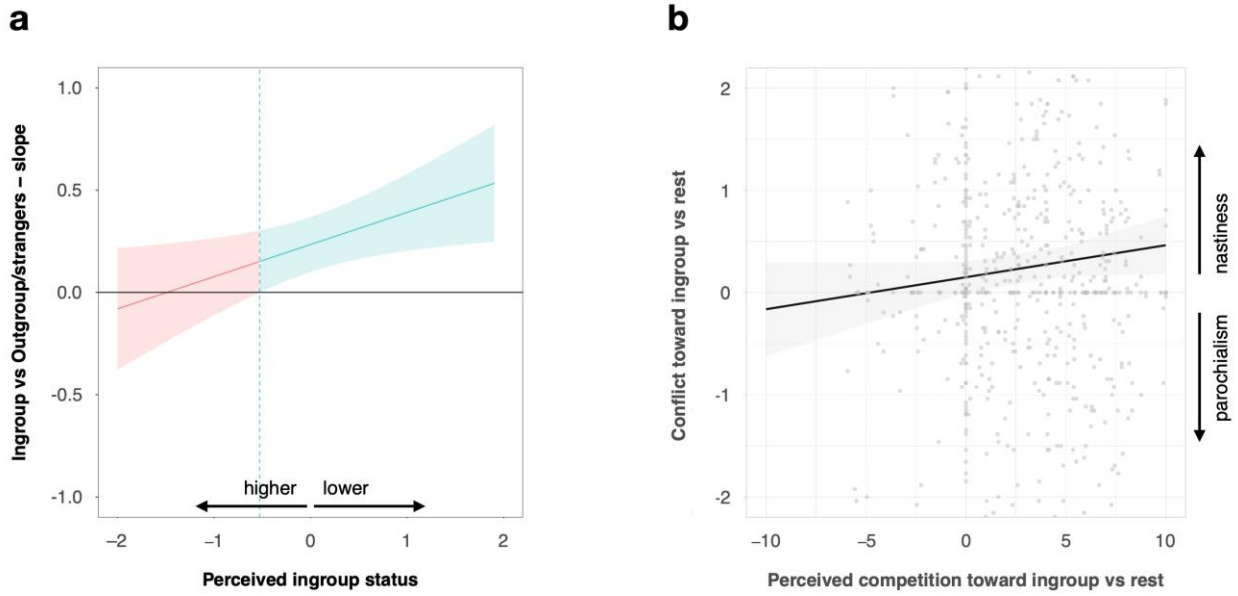

Figure 3. Ingroup status and perceived competition correlate with the nasty neighbour effect in humans. (a) Ingroup status concerns. Floodlight plot showing the regions of perceived ingroup status (*x* axis, standardized) for which the effect of ingroup versus others (*y* axis, positive values indicate support for the nasty neighbour effect) on conflict can turn significant. The vertical lines in the floodlight plot show the exact values at which significance begins and ends. Blue lines indicate significance at the 5% level. **(b)** Perceived resource scarcity. Scatterplot shows the association between perceived competition toward ingroup members (minus outgroup/strangers; rest) and the nasty neighbour effect (i.e., conflict investments with ingroup individuals minus outgroup members/strangers).

In our final study 5 (N = 552), we experimentally manipulated ingroup status concern and competition to provide further causal evidence for the correlational findings of study 3 and 4. Participants were assigned to one of two groups of four individuals each and were given an endowment for a two-stage nested social dilemma with punishment(*11*, *15*) (**Fig. 4ab**; *Methods* and *Supplement* section 4.3). In stage 1, participants distributed 5 monetary units between a private pool that benefitted themselves only, an ingroup pool that provided benefits to the ingroup, and a universal pool that benefitted in- and outgroup members alike. Participants could earn a group bonus when the total contribution to their ingroup pool exceeded that in the other group (between-group competition treatment). As predicted, we observed more parochial cooperation in stage 1 when competition for a group bonus was present rather than absent (**Fig. 4c**; $t(275) = 5.77$, $p < .001$).

In stage 2 participants could earn a personal bonus if they were the highest earning member in their own group (this treatment had no effects; *Supplement* Table S12 and section 4.3).

Participants could assign up to 5 ‘deduction points’ to an ingroup member, and to an outgroup member(*51*). Deductions reduced the target’s earnings at a 1 to 3 ratio (*52*). We operationalized member status in terms of their earnings from stage 1 relative to others in their ingroup and in the outgroup, and elicited punishment decisions in 11 possible scenarios. In five scenarios, the participant had lower earning status, in one they had equal status, and in five they had greater earning status (**Fig. 4b**; *Methods*). We find a significant earning status × target’s group membership interaction ($b = 0.353$, $p < .001$). Participants punished lower-ranked ingroup members more harshly than outgroup individuals, akin to the nasty neighbour effect observed in study 1-4. At the same time, participants punished higher-ranking outgroup individuals more harshly than higher-ranking ingroup individuals, which can be interpreted as a form of parochial competition towards higher (but not equal or lower) earning outgroup individuals (Figure S6). These results resonate with earlier work on status contests in groups (*53*, *54*), and the correlational evidence for the nasty neighbour effect in study 3 and 4. Also in line with study 3 and 4, the nasty neighbour effect in punishment was predicted by relative differences in perceived competition between ingroup and outgroup members ($b = 0.048$, $p < .001$, **Fig. 4d**).

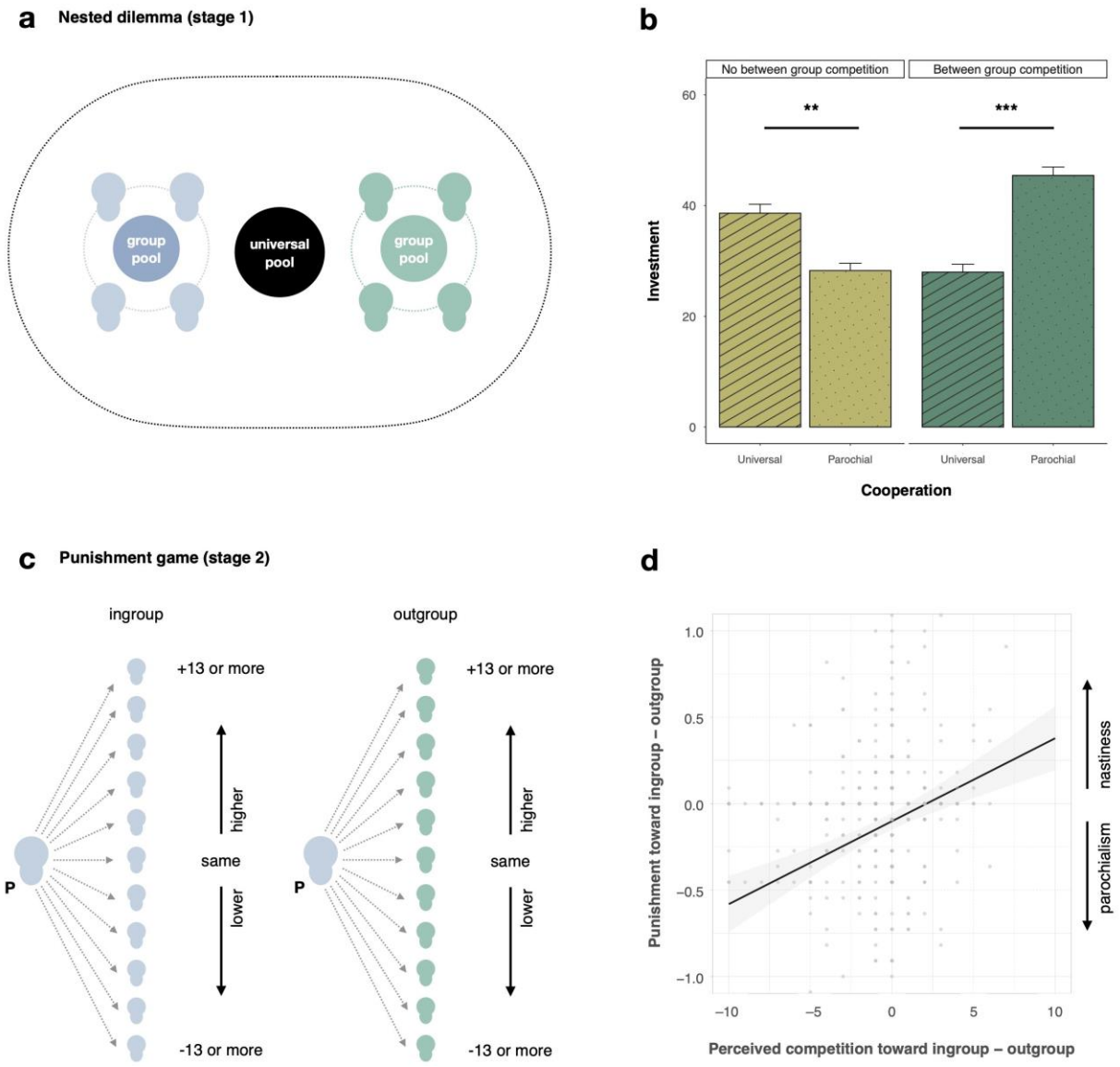

Figure 4. Parochialists and nasty neighbours in minimal groups. (a, c) Experimental set-up of the nested social dilemma (top; stage 1, a) with punishment (bottom; stage 2, c). **(b)** Between group-competition favours the emergence of parochialism. Bar chart showing parochial and universal cooperation as mean percentage of the endowment contributed when competition is absent versus present. **(d)** Relative differences in perceived competition favour the emergence of a nasty neighbour effect. Scatterplot shows the association between perceived competition toward ingroup members (minus outgroup) and the nasty neighbour effect (i.e., punishment of ingroup members minus outgroup members).

Discussion

The tendency to trust and cooperate with ingroup members more than outgroup members is both theoretically plausible (*16–18*, *36*) and empirically supported (*2*, *5*, *9–11*, *13–15*). As we showed here, however, parochialism in cooperation does not mean that humans also compete more with distant rather than close others. Under the assumption of group-serving preferences, we should have seen higher trust and trustworthiness towards ingroup members as well as lower investments when such investments hurt or protect against ingroup members (compared to outgroup members). For the latter, we observed the opposite. Participants invested more in competing when paired to individuals sharing the same group affiliation than when paired to individuals sharing an 'outgroup' affiliation or being strangers with unknown affiliation in the attacker-defender game. This 'nasty neighbour effect' emerged for investment in attacker-defender contests but also for costly punishment of lower-ranking ingroup members following public good provision (*viz*. anti-social punishment (*55*)), and show evidence that a significant fraction of people behave as nasty neighbours in the prisoner's dilemma game (see SI, section 3.2).

The nasty neighbour effect was observed when group membership was based on nationality and ethnocultural affiliation, and with an observed effect size that is in line with that for parochialism in cooperation (*2*, *6*). Moreover, we show evidence for the nasty neighbour effect following random assignment to 'minimal' groups. Finally, across studies we observed that being a nasty neighbour emerged independent from parochialism: The tendency to be more generous and trusting with individuals from one's own group was unrelated to the tendency to compete more with individuals from one's own group. In line with earlier work(*5*), parochialism was associated with ingroup affiliation and identification, whereas being a nasty neighbour was not. Instead, being a nasty neighbour was associated with (perceived) within-group resource scarcity and concerns over within-group status.

Whereas our studies show that humans can be 'nasty neighbours' across a variety of contexts and group affiliations, future research will need to further investigate the pervasiveness of the nasty neighbour effect across pure equilibrium contest games like rent-seeking, tug-of-war, and pre-emptive strike games (*27*, *35*, *56*, *57*). That said, specific features of experimental games may or may not reveal parochialism and neighbour nastiness. For example, neither within-group

nastiness nor parochial competition was observed in tournaments where participants could self-select into competition with someone from their own political ingroup or from a political outgroup (*Supplement* section 5). Our results on the potential proximate mechanisms can inform future scholars on when parochialism or neighbour nastiness can emerge and what form it takes (as, e.g., preemptive strike against someone from one's own versus another group) (*27*, *56*, *57*). Based on our results, we expect neighbour nastiness to emerge in games, group formations, and contexts that elicit status differences and competition over scarce resources.

Next to possible boundary conditions, the underlying proximate mechanisms also require further investigation. While we provide some evidence for the role of status seeking and ingroup deprivation, other socio-ecological factors, including group density and (inter)group mobility, may also explain when individuals switch from being nasty neighbours to parochial cooperators. Finally, while caution is needed when generalizing to multifaceted day-to-day conflicts and competitions with neighbours and strangers, there are some striking parallels between the nasty neighbour effect observed here and observations outside the laboratory. As mentioned, the nasty neighbour effect documented here in humans has been observed in other species and across taxa, including social insects (*58*), group-living birds (*39*, *44*) and various mammals such as Eurasian beavers (*40*), banded mongoose (*43*), Diana monkeys (*42*), and black crested gibbons (*41*). Second, for humans, intra-group disputes and competitions in mobile forager societies can be equally or more violent than coalitionary aggression against other groups (*59*), and at least since the end of WWII, conflict and violence is as prevalent, if not more, within than between nation states (*31*).

The present findings on the nasty neighbour effect are difficult to reconcile with prevailing theories on the evolution of cooperation in structured populations. For example, if we assume that groups frequently find themselves in recurrent intergroup competitions in which members of one group can benefit at the expense of members of other groups (*18*, *37*, *60*), it should be beneficial for the individual to selectively cooperate with ingroup members and cooperate less – or compete more – with outgroup members to not provide a competitive advantage to the outgroup. Alternatively, people may interact more frequently with ingroup members, making cooperation with close rather than distant others more worthwhile, also (*38*, *61*, *62*). Our data on the trust game are in line with this idea. However, if intergroup competition is indeed explaining parochial cooperation (either proximately or ultimately), we should have also observed lower

(wasteful) investments aimed at exploiting someone from one's own group. In combination, our empirical data therefore create an important open theoretical puzzle for our current understanding of the ultimate mechanisms of parochialism.

One possible answer to the conundrum emerging from observing that humans can be both parochial cooperators and nasty neighbours is that parochialism and within-group nastiness are game specific (*63*). We believe this possibility to be unlikely. As mentioned, both parochialism and within-group nastiness has been observed in a variety of experimental games, in a range of field settings, within the same experimental game (i.e., prisoner's dilemma), and in various group-living species. An alternative possibility is suggested in our finding that the nasty neighbour effect was stronger when individuals perceived within-group resource scarcity and were concerned about in-group status-ranking. Indeed, in structured populations individuals may more frequently compete for status and shares of jointly created public goods within their own group, than with distant strangers and individuals from out-groups. Recent theory on the evolution of cooperation likewise modelled cooperative interactions in conjunction with competition for the division of the cooperative rewards, showing how cooperation and competition can co-evolve (*21*), and future work could incorporate these complexities to explain when and how higher trust and cooperation towards ingroup members can co-evolve with propensity to compete more within than between groups. Possibly, individuals may optimize own benefits by flexibly switching whether to cooperate or compete, how much to cooperate or compete, and with whom to cooperate and with whom to compete.

Alongside open questions on the evolution of cooperation and social behaviour, findings challenge the idea that parochialism is a general and pervasive human tendency. Especially parochialism in competition may be confined to specific cases where groups experience zero-sum competition for scarce resources with other groups (*12*), or when histories of intergroup conflict and violence fuel spitefulness and revenge (*12*, *31*). Parochialism in cooperation makes groups wealthier and more likely to emerge victorious when competing with outgroups for scarce resources (*12*, *14*, *18*) yet contrary to a widespread assumption, humans can also more fiercely compete with individuals that are close and part of their own group. While behaving as a nasty neighbour is costly and can undermine within-group solidarity, it can also secure the individual's within-group status and privileged access to group resources. Rather than being

either parochial or nasty, humans serve their groups or themselves by flexibly switching between being parochial cooperators or nasty neighbours.

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Methods

Study 1. The research and procedure were approved by the Psychology Research Ethics Committee of Leiden University (application number: 2020-02-03-A. Romano-V1-2068).

Participants. We collected data from 12,863 participants across 51 countries (Algeria, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Czech Republic, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Korea, Malaysia, Mexico, Morocco, Netherlands, Nigeria, Peru, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, Vietnam). Participants were recruited through the Toluna Panel, including members of its third-party panel providers. Participants were stratified by age and gender. Our goal was to recruit 12,750 participants (~250 per society; *Supplement* section 2.1). A sensitivity power analysis showed that 250 people can detect a small effect size of $d = 0.16$ with 80% power (within-subjects difference in conflict between ingroup and outgroup members/strangers).

***Procedure and general design*.** The study was preregistered at https://osf.io/nf7ks/?view_only=1562f490520f4b5b90320185b2bbd445. The design consisted of two within-subject treatments related to the role of the participant (participant's role: 'attacker' vs. 'defender', see below) and the opponent that the participant was interacting with (identified by the opponent's nationality). The experiment was administered through an online survey. We wrote an English version of the survey and asked experts and professional translators to translate the survey. The procedure of the experiment was the same across all countries. After giving their informed consent, participants were asked to make 54 independent decisions, facing different opponents across the world. No feedback about others' decisions was provided. Thereafter, participants also responded to several additional questionnaires, unrelated to this project, and asked to give information about their gender, age, and education. We note that throughout the instructions, we used neutral language and avoided terms like competition, defence, opponent or conflict. Some of the data from study 1 have been used in another paper that examined different research questions and a different set of pre-registered hypotheses(*64*). Specifically, the current paper tested preregistered hypotheses 2_a, 2_b, 3_a, 3_b, and 4_b.

Investing in attack and defence. We assessed competition towards and defence against foreigners in the context of economic contests. The contest models conflict and competition

between an ‘attacker’ and a ’defender’ (attacker-defender contest; AD-C)(*32*, *34*), allowing to disentangle distinct components and goals of conflict (i.e., investing resources to exploit versus investing resources defend against such attempts; *Supplement* section 1.2). Participants are given an initial endowment *e* of 10 monetary units (MU) and are assigned a role (attacker or defender; in the instructions labelled as ‘person A’ and ‘person B’, respectively). Both attacker and defender decide how many of the 10 MU they want to invest into a so-called challenge pool (investment = i_x $0 \leq i_x \leq 10$) or keep for themselves. If the investment of the attacker is higher than the investment made by the defender ($i_{att} > i_{def}$), the attacker’s final earnings (π_{att}) are the remaining endowment not invested into conflict plus the endowment the defender kept for themselves: $\pi_{att} = (10 - i_{att}) + (10 - i_{def})$. In other words, the attacker takes the remaining resources of the defender and the defender ends up with nothing: $\pi_{def} = 0$. However, if the investment to the challenge pool of the defender is equal or greater than the investment of the attacker ($i_{att} \leq i_{def}$), both attacker and defender simply end up with the MU they did not invest in the challenge pool in the first place: $\pi_{att} = e_{att} - i_{att}$; $\pi_{def} = e_{def} - i_{def}$. In other words, the defender successfully defends their remaining resources from the attack of the opponent. Hence, participants, depending on their role, can attempt to take away resources from the other person or defend against such attempts. Note that each point invested in the challenge pool is spent. It follows that the socially optimal outcome in which both attackers and defenders, together, earn the most is only obtained when both the attacker and defender would not spend any MU on conflict.

Treatments. For each decision, participants were assigned to interact with a person that was randomly selected from the pool of 51 nations included in the study. Before making their decision, they were informed about their partner’s nationality. We collected 54 decisions divided in two (randomized) blocks of 27 decisions, varying whether the decision was made in the role of attacker (attacker treatment), or in the role of defender (defender treatment). For each block, one decision involved interacting with a person of the same nationality, 25 decisions involved persons with a different nationality, and one decision involved an unidentified stranger (also this order was randomized). Each nationality was randomly extracted once, such that participants could only make one decision as attacker and one decision as defender with a person of a specific nationality. The nationalities of the persons encountered in the second block matched those presented in the first block. Overall, the frequency of extracting persons’ nationalities was

balanced across participants, such that we had an equal number of nation-nation pairs across the sample. We collected a total of 694,602 decisions among 12,863 participants from 51 countries.

Game-theoretic properties. Assuming rational selfish play, the AD-C has a unique Nash equilibrium in mixed strategies, such that players should randomize their investment (up to a certain threshold) to maximize their payoff. This means that there is not a single action that is clearly advantageous in the AD-C. The benefits of investing in conflict depend on the investments made by defenders and vice versa(*32*) (also see *Supplement* section 1.2).

Incentives. To make decisions comparable across nations in terms of earnings, each MU was worth 1 minute of the average hourly wage in their country. Therefore, each participant started with an amount corresponding to 10 minutes wage in their nation. Information of wage in each nation were retrieved from https://tradingeconomics.com/country-list/wages. Participants were paid for one role and one of their decisions in that role. Participants were told that they would make decisions in both roles and that, at the end of the experiment, we would randomly match each participant with another participant from the respective country and that their decisions would both affect their own earnings as well as the earnings of their randomly selected other party.

Geographical distance. Geographical bilateral distances measure city-level data to account for the geographic distribution of population inside each nation. Geographical distance is available for 225 countries and consists of the distance between two countries based on bilateral distances between the biggest cities of those two countries(*46*). We assigned a score to each decision interaction that represented the geographical distance between the participant and their opponent (*Supplement* section 2.1.3).

Analytic strategy. For the main treatment effect (attack vs. defence), we used mixed-effects models in which participants (level 2) and nations (level 3) are two random factors. These models consider random intercepts for participants nested in nations. We analysed data with *R* (lme4 package)(*65*). Individual differences variables (e.g., age and gender) were entered as level-2 controls.

Study 2. The research and procedure were approved by the Psychology Research Ethics Committee of Leiden University (application number: 2020-12-03-A. Romano-V2-2772) and by

a local ethics committee, Strathmore University Institutional Ethics Review Committee (application number: SU-IERC0958/20).

Participants. We collected data from 552 participants (M_{age} = 33.65, 27.71% female) in Nairobi, Kenya. Participants were recruited through the Busara Center for Behavioral Economics (https://busaracenter.org/). The design consisted of two within-subject treatments related to the role of the participant (Participant's role: attacker versus defender) and the opponent that the participant is interacting with (identified by the opponent's ethnocultural affiliation). The experiment was conducted with a mobile lab with interactive tablets across diverse areas of Nairobi (Viwandani and Babadogo). We wrote an English version of the survey that was then translated to Swahili. As in study 1, instructions used neutral language and we avoided terms like competition, defence, opponent, or conflict.

***Procedure and general design*.** We recruited people from four ethnocultural communities: Kikuyu, Luo, Kamba, Luhya. Participants gave their informed consent and were asked to make three independent decisions, facing different opponents (same, different, or unknown ethnocultural affiliation). No feedback about others' decisions was provided. For members of the Kikuyu, the outgroup member was always a Luo and vice versa. For members of the Kamba, the outgroup member was always a Luhya and vice versa. Results are the same when controlling for type of pairing (*Supplement* Table S5).

Study 3. Study 3 was a pre-registered replication (https://osf.io/j973y/?view_only=0d9bef6731364abbba068c199541f423) of study 1 performed in the United Kingdom. The research and procedure were approved by the Psychology Research Ethics Committee of Leiden University (application number: 2022-09-26-A. Romano-V1-4261).

***Participants*, *procedure and general design*.** We collected a representative sample (based on age, gender, ethnicity) of 401 participants from Prolific (M_{age} = 35.43, women = 51.62%). Procedure and general design were the same as of study 1. To pay participants, we matched their decisions with the decisions made by the participants in study 1. The only difference with study 1 was the assessment of potential psychological mechanisms related to the nasty neighbour effect. After participants made their choices in the attacker-defender contest, they were asked to respond to questions related to generosity, national identity, risk preferences, perceived status, and perceived competition over scarce resources.

Generosity/altruism. We elicited generosity using two items of the global preference survey(*66*). In the first question we asked participants how willing they were to give to good causes without expecting anything in return (0 = completely unwilling to do so, 10 = very willing to do so). The second question was a scenario in which participants were asked how much of a certain amount of money (700 GBP), unexpectedly received from a lottery, they would donate to a good cause.

Identity. We used the SISE scale to measure national identity(*67*). Participants were asked how much they identify with their nationality on a 7 points Likert scale.

Perceived similarity. We administered a scale of perceived similarity. We used the definition of socio-psychological distance and asked participants about their perception of similarity of outgroup countries ("*For each country, please indicate to what extent you perceive this country similar in terms of values, beliefs, and behaviours*; 0 = very dissimilar, 10 = very similar").

Risk preferences. We elicited risk preferences using one qualitative item from the global preference survey(*66*). The qualitative item asks for the respondents' self- assessment of their willingness to take risks on a 11-point scale (0 = completely unwilling to take risks, 10 = very willing to take risks).

Perceived status. We administered a measure of social insecurity with both ingroup and outgroup members(*68*). The scale is composed of three items (Cronbach's alpha = 0.78) and participants were asked how much they agree with each statement on a 5 points Likert scale (1 = strongly disagree, 5 = strongly agree; example: "I feel that my status in my country (among foreigners) is threatened").

Perceived competition over scarce resources. We administered a scale of perceived competition by asking participants to rate how much they think their own well-being is influenced by competition with that country (0 = not at all, 10 = very much).

Study 4. Study 4 was designed to assess whether parochialism and the nasty neighbour effect could be observed in the same set of individuals. The general research design and procedure were approved by the ethics committee of the Faculty of Arts and Social Sciences at the University of Zurich (22.10.5) and preregistered at https://osf.io/qt7zy/?view_only=9f0ae5877024489daca434b08aba7c3c.

Participants, design and procedure. We recruited 300 participants through *Prolific*, stratified by age, gender, and ethnicity. Participants made decisions in a 2 (situation: competitive vs cooperative) × 15 (partner's nationalities) × 2 (role in competition: attacker vs defender) × 2 (role in cooperation: trustor vs trustee) within-subjects design. Participants provided informed consent and read instructions of the 2-player attacker-defender contest or of the trust game (the order of the two games was randomized). In the attacker-defender contest, after responding to comprehension and attention questions, participants made 16 independent decisions as attackers and 16 independent decisions as defenders in randomized order (methods were identical to those in study 3). In the trust game, after responding to comprehension and attention questions, participants made 16 independent decisions as trustors and 16 independent decisions as trustees in randomized order. Roles were labelled with a neutral term (i.e., 'invest person', 'return person'). As trustors, they were endowed with 5 monetary units (MU), with each MU worth 1 minute of average wage in the UK (0.20 GBP). Trustors were informed that they could send some or all of their MU to the trustee. The MU sent by the trustors were multiplied by 3. The trustees could then decide whether to return some of the MU received. As interactions were not simultaneous, trustees were asked to state how much they would return for each potential investment made by trustors.

In each game and for each role, participants made 16 decisions. Each decision was made with a partner of a different country (including the own country). The specific nationality of the partner were selected from the pool of participating countries in the previous 15-society studies: Argentina, Brazil, China, Germany, Indonesia, Italy, Japan, Korea, Poland, Russian Federation, Spain, Taiwan, Turkey, United Kingdom, United States(*9*). All participants also interacted once with a person of the own nation and an unidentified stranger. We incentivized decision-making in both games by selecting, at the end of the data collection and for each participant, one game and matched pairs of participants by randomly selecting one decision and paying them based on the outcome of that decision.

Measures. Following decision-making, we collected measures of demographics, perceived ingroup status, perceived competition of scarce resources, and national identification, using the same measures as used in study 3.

Study 5. The research design and hypotheses were pre-registered (https://osf.io/qrw5x/?view_only=447b15e646e74623acd2af3e04066060) and received ethics approval from the ethics committee of the Faculty of Arts and Social Sciences at the University of Zurich (22.10.5). The experiment involved no deception and was fully incentivized.

Research design and experimental procedures. We examined contribution decisions in a two-stage nested social dilemma with punishment(*11*, *15*), with participants being randomly assigned to the conditions of a 2 (between-group competition: absent/present) × 2 (within-group competition: absent/present) between-subjects factorial. We collected data from a representative sample (based on age, gender, ethnicity) of 552 participants from Prolific (M_{age} = 35.43, 51.62% women). Participants were organized in two groups of four each (henceforth "your group" and "the other group"). Participants were informed that they would receive monetary units (MU) for a two-stage decision-making task, that decisions would affect personal earnings alongside those of others in their own group, and in the other group, and that their identity would never be revealed to other participants. The rules and procedures of stage 1 and stage 2 were thoroughly explained and comprehension was verified before participants could proceed with decision-making. Following decision-making, participants responded to a short survey, were debriefed and paid.

Nested social dilemma (stage 1) with punishment (stage 2). For stage 1, participants distributed 5 MU (1 MU = 0.1 GBP) across a private pool, their group pool, and a universal pool. Each MU in the private pool was worth 1 MU to them, and 0 MU to any other member in their own, or in the other group. Each MU in the group pool would return 0.5 MU to each member in their own group, themselves included, and 0 MU to the members of the other group. Each MU in the universal pool (labelled 'general pool' in the experiment) would return 0.5 MU to each member in their own group, themselves included, and 0.5 MU to each member in the other group. Accordingly, it was in the participant's best interest to keep their 5 MU in the private pool (*viz.* free-riding); contributions to the group pool were personally costly and benefitted the ingroup (*viz.* parochial cooperation), and contributions to the universal pool were (equally) personally costly and benefitted the ingroup and outgroup alike (*viz*. universal cooperation)(*11*, *15*). For stage 2, participants received another 20 MU and could use up to 5 MU to deduct earnings from someone else in their own group and in the other group. Each MU assigned to someone else would cost the participant 1 MU and reduce the target's earnings by 3 MU(*52*). Earnings from

stage 2 would thus be the total of 20 MU received, minus the deduction points assigned, minus the deduction points received × 3.

Between-group competition (stage 1). Before decision-making, we explained that participants could earn a group bonus for stage 1 and a personal bonus for stage 2. The group bonus introduced the presence (versus absence) of competition between one's own group and the other group. Specifically, participants in the 'intergroup competition absent' treatment were informed that the group bonus of 4 MU would be decided based on a lottery with 50% chance of getting the bonus (giving each group member one additional MU). In contrast, participants in the 'intergroup competition present' treatment were informed that the stage 1 group bonus would be earned by the group who had made the largest investment in their respective group pool (or a coin flip in case of a tie). If their group put more in the group pool than the other group, each member in their group would thus earn one additional MU.

Within-group competition (stage 2). Participants in the 'within-group competition absent' treatment were informed that after stage 2, one member in each group would be randomly selected to earn a personal bonus of 4 MU. In contrast, participants in the 'within-group competition present' treatment were informed that after stage 2, the individual in each group who earned the most from stage 1 and 2 combined would earn a personal bonus of 4 MU.

Measuring cooperation in stage 1. Following instructions, participants received a short summary of the stage 1 and stage 2 decision-making, alongside the (treatment-dependent) rules for earning the group and personal bonus. They then distributed 5 MU across their private, group and universal pool, and estimated how much the other three members of their group combined invested into their group pool (range 0 – 15), and into the universal pool (range 0 – 15). Beliefs were incentivized with 0.25 GBP for each correct estimate.

Measuring punishment in stage 2 conditional on earning status. Next, participants assigned up to 5 MU as deduction points to an individual in their own group, and to an individual in the other group (order counter-balanced). For each target individual, we asked participants to assign deduction points between 0 and 5 MU given that this other person, in the first stage, earned: (1) "13 or more than you," (2) "10 – 12 more than you," (3) "7 – 9 more than you," (4) "4 – 6 more than you," (5) "1 – 3 more than you," (6) "the SAME as you," (7) "1 – 3 less than you," (8) "4 – 6 less than you," (9) "7 – 9 less than you," (10) "10 – 12 less than you," and (11) "more than 13

less than you." We explained that we would match participants and implement the deduction decision to the actual earning configuration that applied. At the end of this task, participants estimated how much deductions they would receive from ingroup and outgroup members. They were paid 0.25 GBP if they were correct.

Measuring perceived competition. Perceived competition was measured as in study 3 and 4.

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Data and materials availability: All data, code, and materials will be made available upon publication. Data and code are currently available for peer-review.

Supplementary Materials

Humans Exhibit both Parochialism and Nastiness within Groups

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1. Behavioural games for parochialism in cooperation and competition

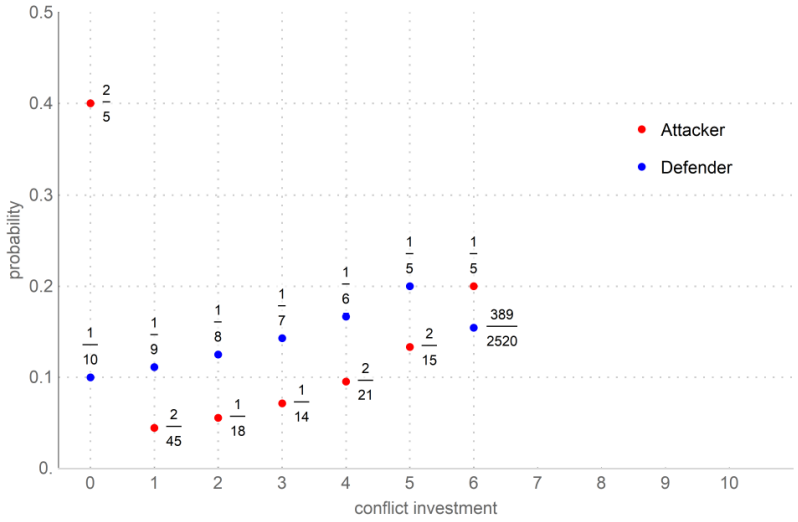
1.1. Introduction

A variety of experimental games have been employed to identify parochialism(*1*, *2*). In its simplest form, a game involves two agents A and B each with a binary choice that is taken simultaneously and after which the game ends. Individual payoffs are a function of the combination of both agents' choices. As an example, consider the Prisoner's Dilemma (PD). In the two-player PD, each player must choose between an action often labelled as cooperation (C) and another action labelled defection (D). Each player benefits personally most from choosing D rather than C, and the unique pure Nash Equilibrium is reached when both players choose D. In equilibrium, however, each player earns less compared to when both had chosen C. In the PD, the C-C combination maximizes joint payout and is 'pareto efficient'(*3*), but is not an equilibrium of this game. Choosing D in the Prisoner's Dilemma is a dominant strategy. Parochialism is revealed as a stronger propensity to choose C than D when interacting with an ingroup rather than an outgroup member or stranger.

1.2 Attacker Defender Contest Game

The attacker defender contest (AD-C) is special case of a class of Tullock contest games that model competition, or 'rent-seeking' between individual and groups and has strong similarities to related games like tug-of-war and pre-emptive strike games(*3–6*). The contest has two players A (for attacker) and D (for defender) each with an endowment e from which they can invest x in a contest. As is typical for contest games, any investment is wasted. Similar to the Prisoner's dilemma game, there is a pareto efficient state where both agents do not invest anything (Attacker x_A = Defender x_D = 0). However, when investments in attack exceed those in defence ($x_A > x_D$), the attacker earns the non-invested resources from the Defender ($e - x_D$) leading to a payoff of $2e - x_A - x_D$; in this case the defender earns 0. In all other cases, where $x_A \leq x_D$, attacker and defender earn their non-invested resources (i.e., $e - x_A$ and $e - x_D$, respectively). For rational selfish players, the peaceful solution ($x_A = x_D = 0$) does not constitute a Nash equilibrium. When $x_D = 0$, an Attacker should simply invest one unit ($x_A = 1$) to win the conflict (in other words, $x_A = 0$ is strictly dominated by $x_A = 1$ in this case). Yet, if $x_A = 1$, the Defender should respond with $x_D = 1$, which then changes the optimal response of the Attacker to $x_A = 2$. Note that because of these properties, the AD-C is an asymmetric game in that a player's incentives for a particular strategy change when they change roles (this is not the case in symmetric games like, e.g., the PD).

Figure S1. Equilibrium strategies in the attacker-defender contest for equal endowments (e = 10). Adopted from Meder et al.(*7*).



A formal analysis of the equilibrium properties of the AD-C reveal its Nash equilibrium in mixed strategies ((*4*, *7*); Figure S1). Compared to the PD, there is no pure Nash equilibrium. With an equal starting endowment of e = 10 for attackers and defenders, we denote p(X) as the probability of investing X by attackers, and p(Y) the probability of investing Y by defenders. A strategy assigns a probability value for each possible action (i.e., investment). In equilibrium attackers should choose:

$p(X = 1) = 2/45$,
$p(X) = p(X - 1)*[(12 - X)/(10 - X)]$ for $2 \leq X \leq 6$,
$p(X = 0) = 1 - [p(X = 1) + \ldots p(X = 6)] = 0.4$,
$p(X) = 0$ for $X \geq 7$

i.e.; $P(0) = 0.4$, $P(1) = 0.0\overline{4}$, $P(2) = 0.0\overline{5}$, $P(3) \approx 0.0714$, $P(4) \approx 0.0952$, $P(5) = 0.1\overline{3}$, $P(6) = 0.20$, $P(7) = 0$, $P(8) = 0$, $P(9) = 0$, $P(10) = 0$.

Defenders should choose:

$p(Y) = 1/(10-Y)$ for $0 \leq Y \leq 5$,
$p(Y = 6) = 1 - [p(Y = 0) + \ldots + p(Y = 5)] = 0.15$,
$p(Y) = 0$ for $Y \geq 7$

i.e.; $P(0) = 0.1$, $P(1) = 0.1\overline{1}$, $P(2) = 0.125$, $P(3) = 0.1428$, $P(4) = 0.1\overline{6}$, $P(5) = 0.2$, $P(6) = 0.15$, $P(7) = 0$, $P(8) = 0$, $P(9) = 0$, $P(10) = 0$.

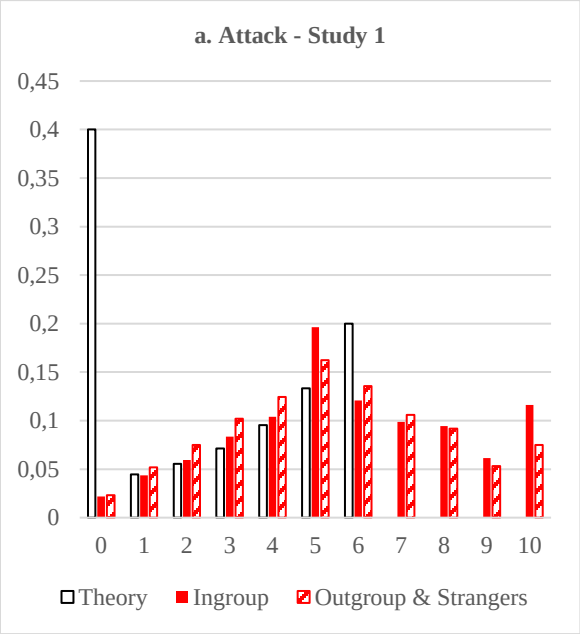
This means that, contrary to the PD, in the AD-C there is not a clearly advantageous action. The personal earnings from investing in conflict depend on the investments made by the opponent, and vice versa. The best-response of defenders is to match attackers' investments, whereas for attackers, the best response would be to invest exactly either one unit more than the defenders or to not invest in attack at all, depending on whether the remaining capital not invested by attackers and defenders is large enough to make an attack investment worthwhile. Parochialism in the AD-C would mean stronger conflict investment when interacting with an outgroup individual or stranger, than with an ingroup member. In sum, unlike the prisoner's dilemma, the attacker-defender game does not have a pure Nash equilibrium, and it is characterized asymmetric payoff functions for attacker and defender.

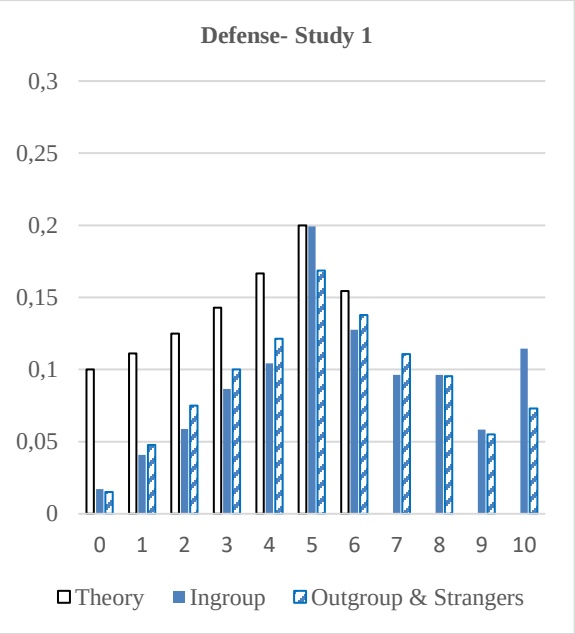
The equilibrium properties of the attacker-defender game allow to identify that rational, risk-neutral, expected payoff maximizing agents on average invest i_{att} = 2.62 in attack, and i_{def} = 3.38 in defense. Furthermore, we can identify that for rational payoff maximizing agents, $i > 6$ (with e = 10, as in the current studies) are out-of-equilibrium and should never be played. With these game-theoretic 'benchmarks', we can conclude that in Study 1, people 'over-invested.' The mean investment in attack with in-group (out-group; strangers) is 5.70 (5.34; 5.09 MU), and the mean investment in defense with in-group (out-group; strange) is 5.71 (5.42; 5.27).

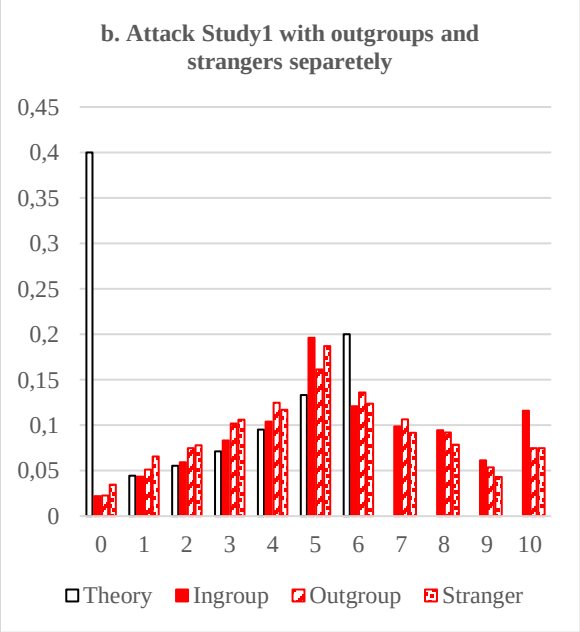
The mixed-strategy equilibrium of the attacker-defender contest implies that mean investments, across trials and with different opponents, emerge because of some mixing of investments (for the game-theoretic probabilities with which investments are played, see Figure S1 here above). In our studies 1, 3 and 4 (where, in contrast to Study 2, participants made a number of investment decisions and distributions can be meaningfully assessed), we indeed see that the average 'over-investment' in attack and defense emerges because out-of-equilibrium investments are played more than expected under the assumptions of rational payoff maximization (Figure S2.a to S2.c).

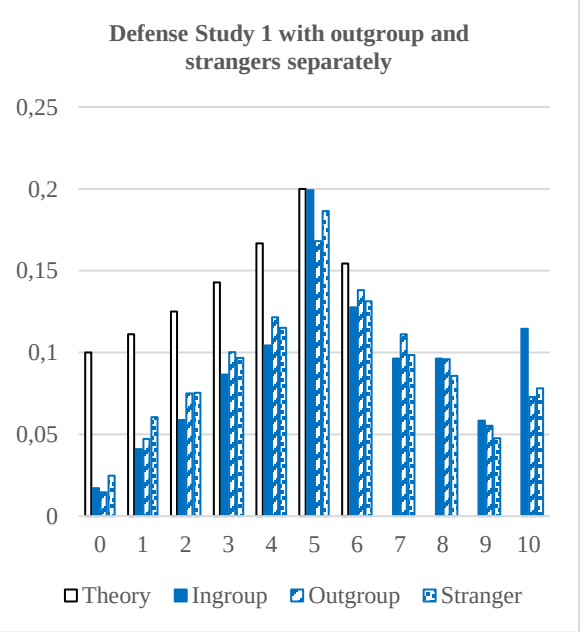
Recall that not investing at all in conflict, $i_{att} = i_{def} = 0$ is preserving social welfare and can be considered the maximally cooperative action to choose (i.e., it is pareto-efficient). Rational agents are expected to choose $i = 0$ and also in our studies, we observe $i = 0$. However, both i_{att} and i_{def} are above 0 more often than would have been expected under the assumptions of game theory. Moreover, and crucially, we observe $i = 0$ in equal proportions when individuals are paired with an opponent from their in-group, an out-group or with a stranger. This suggests that the nasty neighbour effect is not so much about whether someone competes (or cooperates), but rather about how much one invests in competing. We return to this when reporting the complementary 'tournament' study in section 5 here below.

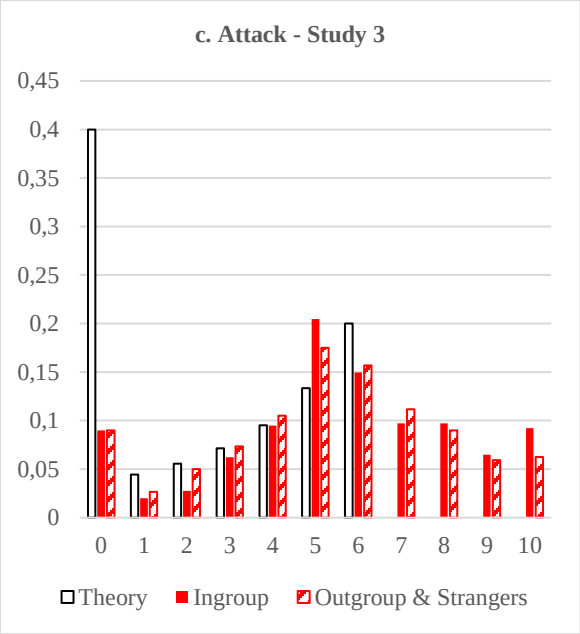
Figure S2. Proportions of investments made for each possible investment level (0, 1, 2, … 10) when agents play in equilibrium (open bars), and when participants are paired with an ingroup member (solid bars), or an out-group member or stranger (dashed bars). (a) Study 1 for attack (left) and defence (right) with out-group and stranger combined; (b) Study 1 with out-group and strangers separated for attack (left) and defence (right); (c) Study 3 for attack (left) and defence (right); (d) Study 4 for attack (left) and defence (right).










c. Attack - Study 3
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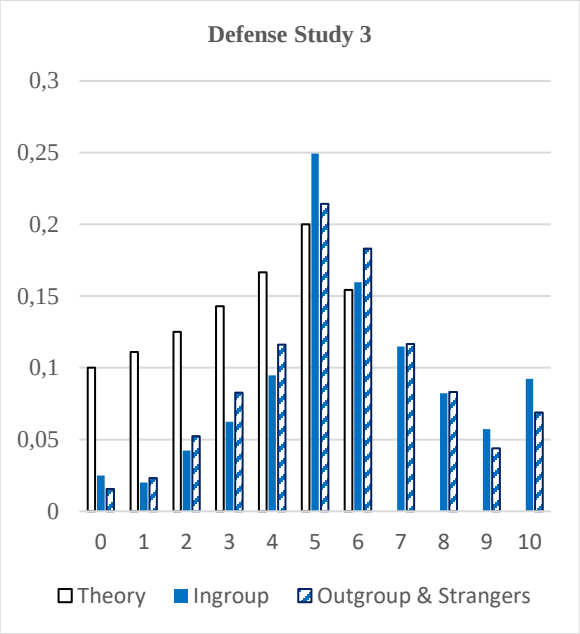
Theory
Ingroup
Outgroup & Strangers


Defense Study 3
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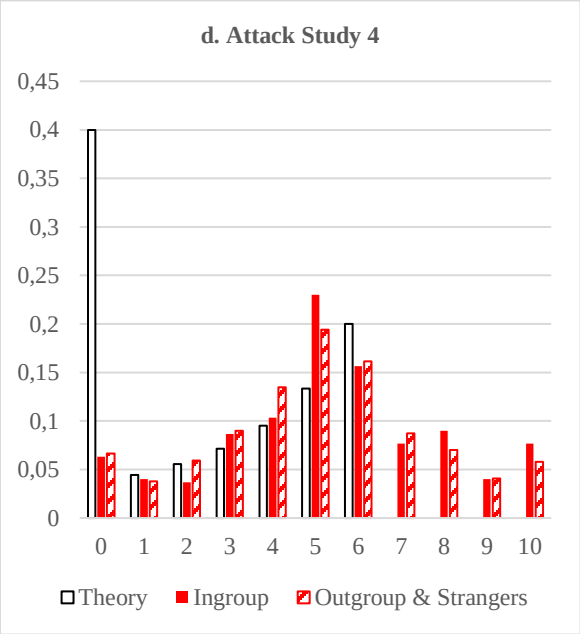
Ingroup
Outgroup & Strangers


d. Attack Study 4
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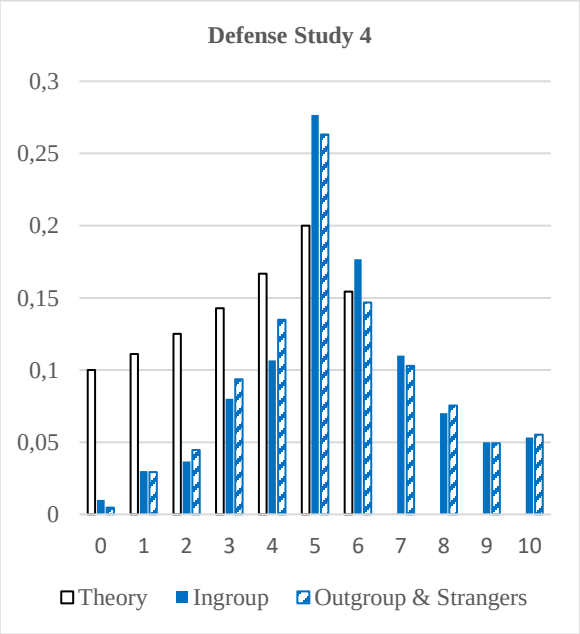
Outgroup & Strangers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Outgroup & Strangers

1.3 Trust Game

In its standard form(*8*), the TG has two players, the investor (I) and the trustee (T), and involves two stages. In Stage 1, the investor decides how much out of endowment *e* to transfer to the trustee. Transfer *x* (with $0 \leq x \leq e$) is tripled and, in Stage 2, the trustee decides how much to transfer back (*y*) to the investor (with $y \leq 3x$). This ends the game, with the investor earning $e - x + y$, and the trustee earning $3x$ - y. Strict payoff maximizing, rational players in the TG should neither transfer ($x = 0$) nor back-transfer ($y = 0$).

Transfers are assumed to reflect how much the investor trusts the trustee. Back-transfers are assumed to reflect the trustee's generosity or concerns for reciprocity. Parochialism in the TG would manifest in larger transfers and/or back-transfers when interacting with an ingroup partner, than with an outgroup individual or stranger(*1*). Stronger parochialism in transfers reflect investors trusting and/or being more generous towards ingroup partners more than outgroup partners or strangers. Stronger parochialism in back-transfers reflect trustees are more generous towards ingroup partners compared to outgroup partners and strangers(*9*).

1.4. Nested-Social Dilemma

Like the classic prisoner's dilemma, the attacker-defender contest and trust game are so-called one-level games between two individuals. Parochialism has been examined also in two-level games, where individuals are nested in groups and groups are nested in an overarching collective (for a review, see(*10*)). One example is the nested social dilemma(*11*, *12*) (NSD). Individuals (e.g., 8) are organized in two groups of (usually) equal size, an ingroup and an outgroup, and are given an endowment *e* which they distribute at their own discretion across three pools – private, club, and universal. Allocations to private benefit the individual only and no one else (in our Study 5, one unit in private was simply worth 1 unit for payout). Allocations to club benefit all ingroup members, the individual included, and no one else. In our Study 5, one unit in club returned 0.5 to each ingroup member, and 0 to outgroup members. Allocations to universal benefit all individuals in the in- and outgroup alike. In our Study 5, one unit in collective returned 0.5 to each individual in the in- and the outgroup. Contributions to club are sometimes referred to as parochial, or ingroup cooperation, and to universal as universal cooperation.

Because allocations to both club and universal are (equally) costly to the individual (i.e., their marginal return is lower than allocations to private), strict payoff maximizing agents in the NSD should allocate their entire *e* to private, and nothing to club or collective. Like the PD, the NSD thus has a single pure Nash equilibrium in choosing D (i.e., allocating all units to private). And like the PD, it is pareto efficient and collectively most beneficial to allocate the entire *e* to collective. Under the current parameters, allocating to club is intermediate between strict payoff maximization and pareto efficiency, and reflects parochialism.

In the NSD, parochialism, among other things, maximizes ingroup welfare, increases the probability that the ingroup emerges as wealthier than the outgroup, and prohibits that the ingroup is being 'exploited' by the outgroup.

1.5 Costly Punishment

Punishment, conditional on observed actions or outcomes, has been widely investigated in the social dilemma literature (e.g.,(*13*)). In economic games, punishment is often operationalized as a costly action that a player can take to reduce the earnings of another player after observing their choice ('peer punishment'). If punishment is costly for the punishing party, rational-selfish players should not dedicate any resources to punishment in one-shot games since punishment reduces own earnings. Nevertheless, peer punishment is often observed in the laboratory(*13*). In the NSD, parochial punishment can be revealed by looking at the willingness to punish conditional on the outcome or earnings of the punished. If punishment choices differ for the same outcome depending on the group membership of the punished, it shows that punishment is not impartially used but influenced by what group the person belongs to ((*14*), 'parochial punishment'). Importantly, punishment can be employed to decrease or increase the gap between own earnings (after Stage 1) and others' earnings. Higher punishment towards ingroup or outgroup members can thus change the relative standing (in terms of earnings) within or between groups.

2. Humans as nasty neighbours

2.1 Study 1

The study comprised a total of 51 nations, and a sample size of 12,863 subjects. There was no specific screening for the selection for countries, other than trying to diversify the variability in terms of the economic, institutional, and cultural context as much as possible. We selected all countries that were available in the Toluna panel. The full list is presented on the following page.

List of countries included in Study 1

Country	*N*	*% Women*	M_{age} *(SD)*	*Language*
Algeria	198	29.29	36.77 (10.76)	Arabic
Argentina	231	55.41	37.21 (12.52)	Spanish
Australia	254	53.94	44.18 (12.71)	English
Austria	254	52.36	39.39 (13.38)	German
Belgium	232	52.16	41.25 (13.16)	French & Dutch
Brazil	253	50.99	37.72 (12.26)	Portuguese
Bulgaria	251	43.03	38.73 (11.96)	Bulgarian
Canada	277	53.79	44.68 (12.72)	French & English
Chile	234	62.82	34.49 (12.06)	Spanish
China	244	47.54	37.77 (11.34)	Simplified Chinese
Colombia	231	50.22	38.73 (12.77)	Spanish
Czechia	257	50.97	39.41 (13.65)	Czech
Egypt	247	41.30	35.08 (11.03)	Arabic
Finland	276	51.81	41.69 (12.72)	Finnish
France	234	52.56	43.66 (11.88)	French
Germany	232	51.95	45.54 (12.35)	German
Greece	229	54.15	38.42 (12.17)	Greek
Hong Kong	252	50.00	38.69 (12.47)	English & Chinese
Hungary	260	51.92	40.84 (14.29)	Hungarian
India	225	50.22	37.65 (12.41)	English
Indonesia	231	48.05	37.90 (11.89)	Indonesian
Ireland	266	57.14	40.67 (11.76)	English
Israel	254	47.03	40.07 (13.11)	Hebrew
Italy	258	50.78	40.91 (12.98)	Italian
Japan	226	39.38	42.98 (11.18)	Japanese
Kenya	249	58.23	31.38 (9.32)	English
Korea	260	45.00	40.59 (11.85)	Korean
Malaysia	258	45.35	37.28 (11.98)	English & Malay
Mexico	250	50.80	37.57 (12.01)	Spanish
Morocco	253	35.17	30.77 (9.39)	Arabic
Netherland	239	53.56	42.5 (12.51)	Dutch
Nigeria	226	71.24	30.3 (10.63)	English
Peru	267	52.43	34.09 (11.11)	Spanish
Poland	252	48.81	38.45 (13.05)	Polish
Portugal	271	51.29	40.25 (13.16)	Portuguese
Romania	258	49.22	39.41 (13.51)	Romanian
Russia	237	51.05	40.77 (12.43)	Russian
S. Arabia	236	47.88	34.03 (9.76)	Arabic & English
Singapore	265	47.55	39.78 (12.53)	English
S. Africa	253	52.57	37.48 (12.86)	English
Spain	254	46.46	40.45 (12.22)	Spanish
Sweden	241	50.21	43.59 (13.26)	Swedish
Switzerland	283	53.71	41.59 (12.97)	German & French
Taiwan	290	46.55	36.88 (12.06)	Chinese
Thailand	311	50.16	39.84 (13.02)	Thai
Tunisia	299	39.46	40.51 (11.91)	French & Arabic
Turkey	270	52.96	35.33 (11.41)	Turkish
UAE	270	46.67	34.24 (10.28)	Arabic & English
UK	262	53.82	43.02 (13.29)	English
USA	229	51.53	44.00 (14.04)	English
Vietnam	274	51.46	33.42 (9.68)	Vietnamese
Total	**12.863**	**50.04**	**38.86(12.29)**	

2.1.1. Treatment effects. First, we present the models with the main treatments: ingroup (vs outgroup & stranger) for both attack and defence. We excluded participants that did not responded correctly to the comprehension checks in their first attempt and that failed an attention check in which they were asked to respond 0 to a Likert-style question (~23%). The ingroup (vs outgroup & stranger) variable is a dummy variable with decisions with outgroup members and undefined strangers coded as 0, and decisions with ingroup members coded as 1. In these models, participants and countries were random intercepts. Contrary to our pre-registered hypotheses, we find that people invested more in attack and defence with opponents from the same country, compared to opponents from foreign (i.e., outgroup) countries and strangers (Table S1). Results remain the same even when we separately consider decisions with outgroup members (attack: b = -0.343 p < .001; defence: b = -0.283, p < .001) and decisions with strangers, only (attack: b = -0.606, p < .001; defence: b = -0.447, p < .001). Including excluded participants in the analyses do not meaningfully affect the results.

In Table S1 we also show whether investments in attack or defence towards outgroup members differ from investments toward strangers. In the cooperation literature, such contrast is often used to disentangle whether parochial cooperation is driven by ingroup favouritism or outgroup derogation(*9*). However, given that we find that parochial competition does not occur in the first place, this contrast can no longer be interpreted in relation to the difference in competition between ingroup and others. Nonetheless, we find that people invest more in both attack and defence with opponents from outgroup countries compared to unidentified strangers.

Table S1 Mixed-effect model of treatment effects on investment decisions. Tests are two-sided. $N_{observations}$ = 363,231; $N_{subjects}$ = 12,863, $N_{countries}$ = 51. Ingroup = 0, Outgroup & stranger = 1.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.346	0.015	<0.001	0.283	0.014	<0.001
Outgroup vs stranger	-0.269	0.014	<0.001	-0.171	0.014	<0.001

One potential concern related to the results of the main regression model presented in the manuscript and in Table S1 is that people made several decisions with different outgroup members, and this might have affected our results. We run two different models to test the robustness of the nasty neighbour effect, and to shed more light on its pervasiveness. In one model, we added a *random intercept for country of the opponent* that considers the dependencies in the choices made with opponents of outgroup countries. This is a very conservative approach as our main hypothesis pertains to the effect of ingroup vs outgroup

members, independently of stereotypes. Nonetheless, we find that even with such conservative specification, people still significantly invest more in attack and defence with ingroup members, than outgroup members and strangers (Table S2).

Table S2 Mixed-effect model of treatment effects on investment decisions. Tests are two-sided. $N_{observations}$ = 363,231; $N_{subjects}$ = 12,863, $N_{countries}$= 51, $N_{opponents}$= 53. Ingroup = 0, outgroup & stranger = 1.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.347	0.014	<0.001	0.288	0.014	<0.001
Outgroup vs stranger	-0.269	0.014	<0.001	-0.171	0.014	<0.001

In the second alternative approach, we ran all possible regressions with investments in attack and defence predicted by the variable ingroup vs outgroup$_x$ and stranger, with *x* being one of the 50 outgroup countries. We ran these regressions for all the 51 countries, giving a total of 2,550 regressions. Then, we compared the results of these regressions with the distribution of outputs of the same number of regressions where we randomly allocated subjects to the variable ingroup or outgroup/stranger (also known as permutation tests; shown on the left panels in Fig S2). As shown, the patterns between the random allocation (left) and our actual treatment (right) look quite different, with our actual treatment showing most of the estimates above 0 (indicating the presence of the nasty neighbour effect), and with most contrasts to be significant at 5% level (blue dots). Results do not meaningfully change if we only consider ingroup vs outgroup$_x$ differences.

Fig S3. **Distribution of significant p-values for attack (top panels) and defence (bottom panels) investments.** Plot showing the direction and frequency of significant estimates for the ingroup vs outgroup/stranger dummy predicting attack investments, considering each country independently as a potential outgroup. On the left, distribution of the estimates when we randomly assign decisions into the ingroup or outgroup/stranger dummy variable. On the right, the actual distribution of the estimates is shown.

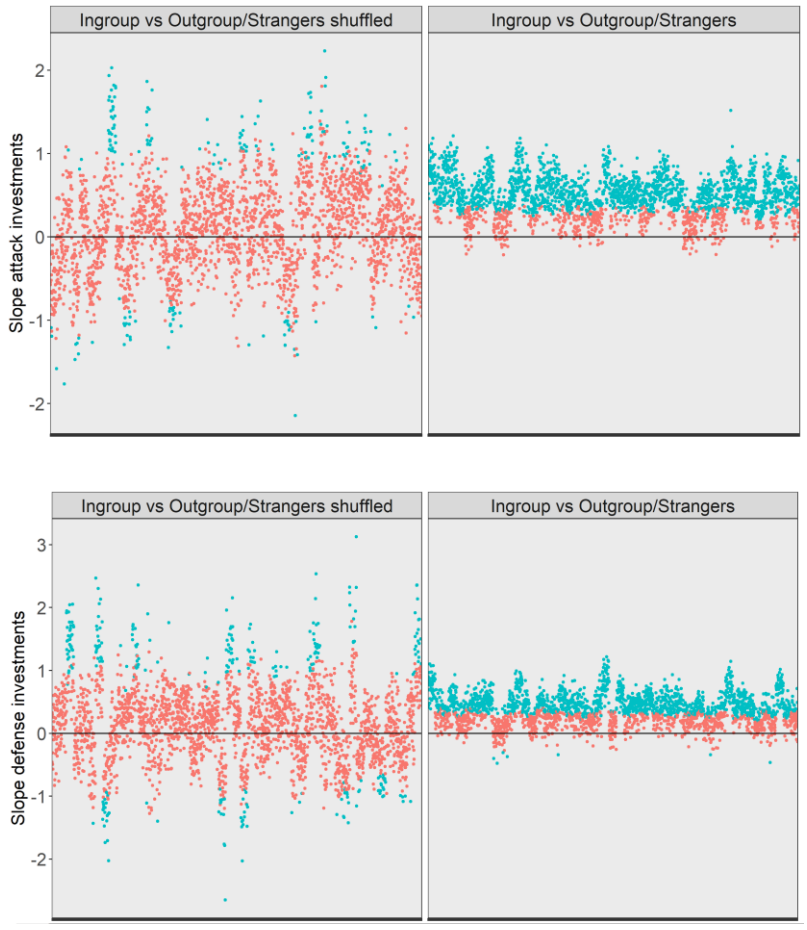
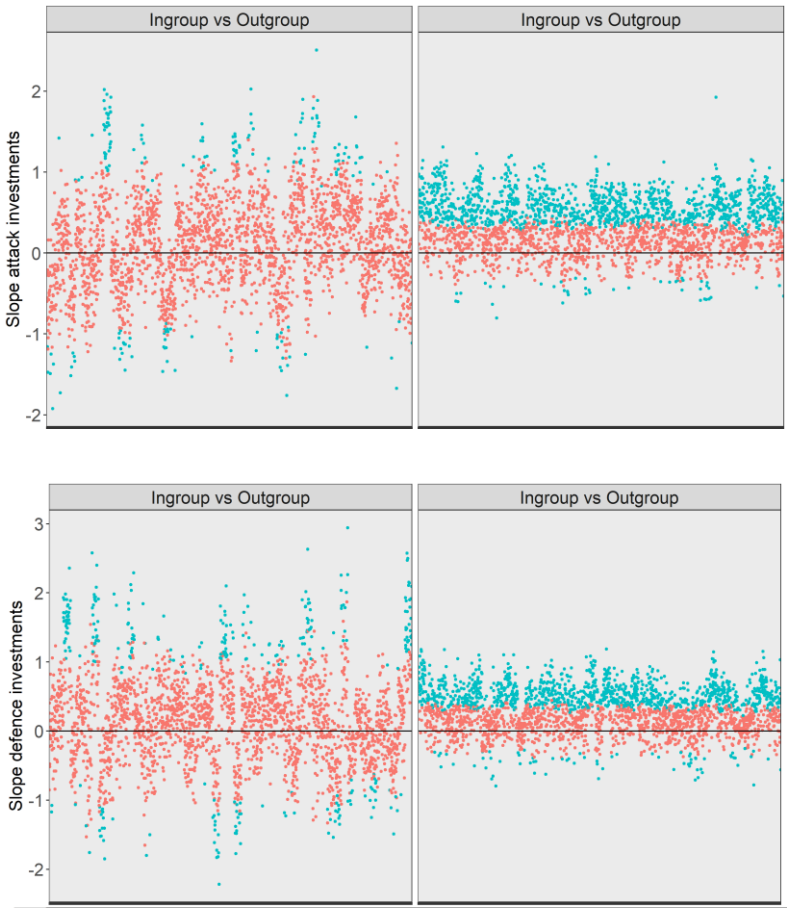


Fig S4. **Distribution of significant p-values for attack (top panels) and defence (bottom panels) investments.** Plot showing the direction and frequency of significant estimates for the ingroup vs outgroup dummy predicting attack investments, considering each country independently as a potential outgroup. On the left, distribution of the estimates when we randomly assign decisions into the ingroup or outgroup dummy variable. On the right, the actual distribution of the estimates is shown.



Finally, in Table S3 we control for several factors that could affect the extent to which people invested in attack and defence toward ingroup members (vs outgroup members and strangers). We find that the main predictor remains significant: people invest more in competing with opponents from the same country, compared to opponents from outgroup countries and strangers. Overall, we find that the effect is independent of age, gender, and education (i.e., lack of significant interaction effects). Only for defence, we find a significant interaction between gender and the extent to which people discriminate between ingroup members and outgroup members/strangers. The difference in attack between ingroup vs outgroup/stranger is larger for women compared to men (but still significant for both men and women). In line with results reported in previous research(*15*), men invested more resources in attack and defence than

women, older people invested less than younger people, and people with higher education invested more in conflict than people with lower education.

Table S3 Mixed-effect model of ingroup (vs outgroup & stranger) with controls predicting investment decisions. Tests are two-sided. $N_{observations}$ = 362,365; $N_{subjects}$ = 12,833, $N_{countries}$= 51. The variable age is standardized.

	Attack			Defence		
	b	***SE***	***p***	***b***	***SE***	***p***
Ingroup vs outgroup & stranger	0.283	0.06	<0.001	0.248	0.058	<0.001
Gender	-0.312	0.035	<0.001	-0.260	0.035	<0.001
Age	-0.088	0.018	<0.001	-0.116	0.018	0.001
Education	0.084	0.017	<0.001	0.085	0.016	<0.001
Ingroup vs outgroup & stranger × gender	0.079	0.029	0.007	0.052	0.029	0.071
Ingroup vs outgroup & stranger × age	0.009	0.015	0.533	-0.002	0.014	0.533
Ingroup vs outgroup & stranger × education	0.005	0.013	0.702	0.002	0.013	0.702

2.1.2. Cross-societal models. As already suggested by the little variation shown in Fig. 1b (Main Text), we find no evidence that greater investments in conflict with ingroup members (vs outgroup members and strangers) between countries are associated with prominent cross-societal factors that are typically hypothesized to co-vary with parochial cooperation(*16*, *17*) (globalization, GDP per capita, rule of law, government effectiveness, historical prevalence of pathogens, and patriotism) (Figure S3). Only GDP per capita is significantly associated with differences in attack investments between ingroup and outgroup & stranger (r = 0.29, p = 0.04).

Figure S5 Bivariate correlations between prominent cross-societal factors and the difference between ingroup vs outgroup & stranger conflict investments across countries (cells with an × indicate non-significant associations).

2.1.3. Geographical and cultural distance. In this section, we report the results on geographical and cultural distance. Such analyses can provide additional support that people are more competitive toward ingroup than outgroup members and strangers. Geographical bilateral distances measure city-level data to account for the geographic distribution of population inside each nation(*18*). Geographical distance is available for 225 countries and consists of the distance between two countries based on bilateral distances between the biggest cities of those two countries. Socio-psychological distance (or cultural distance) is a measure of the overall psychological differences between societies. To build this index, we retrieved bilateral cultural distances data from http://culturaldistance.muth.io/ (all dimensions). This indicator is calculated from data on beliefs, values and behaviours that people have about or associate with their own nation retrieved from the world value survey (two waves: 2005-2009; 2010-2014; for a complete report of the analytic strategy to calculate this indicator see (*19*)). The world value survey dataset is composed of 170,247 participants from 80 nations (which altogether covers 85% of the world population). The list of

measures used to calculate the socio-psychological distances can be found here: https://michael.muthukrishna.com/cultural-distance-data/.

Table S4 shows results from independent models of geographical and cultural distance predicting attack and defence decisions, and geographical and cultural distance in the same model with GDP per capita as a control. Across independent models, and models controlling for GDP, results remain the same: people invest more resources in attack and defence with opponent from geographically or culturally closer countries, compared to opponents from more distant countries. Moreover, results remain robust even when removing the most distant countries (i.e., removing countries above the third quartile of geographical distance; attack: b = -0.096, p < .001, defence: b = -0.084, p < .001). That said, it is important to note that, although the effect of geographical distance seems robust, the study was not specifically designed to test for geographical distance and future research is warranted to more precisely test the relation between distance and competition.

Table S4 Mixed-effect model of distance on investment decisions. Tests are two-sided. For geographical distance: $N_{observations}$ = 330,926, $N_{subjects}$ = 12,605, $N_{countries}$ = 50; For cultural distance: $N_{observations}$ = 216,138; $N_{subjects}$ = 10,345, $N_{countries}$ = 41. Models controlling for GDP (bottom three rows): $N_{observations}$ = 205,652, $N_{subjects}$ = 10,087, $N_{countries}$ = 40.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Geographical distance	-0.066	0.003	<0.001	-0.063	0.003	<0.001
Cultural distance	-0.039	0.004	<0.001	-0.023	0.004	<0.001
Controlling for GDP						
Geographical distance	-0.037	0.004	<0.001	-0.035	0.004	<0.001
Cultural distance	-0.034	0.003	<0.001	-0.017	0.004	<0.001
GDP per capita 2019	0.171	0.004	<0.001	0.148	0.003	<0.001

2.2. Study 2

Participants were recruited through the Busara Center for Behavioral Economics. Groups were selected based on the prevalence of these communities in Nairobi (Kikuyu, Luo, Kamba and Luhya).

2.2.1. Treatment effects. Table S5 shows results from models of the ingroup (vs outgroup & strangers) contrast predicting attack and defence decisions. We excluded participants that failed simple attention checks in the lab (~27%). We also control for the community pairing (see Methods). Again, we find no support for the parochial competition hypothesis. In line with the cross-cultural study, people invested more resources in defending against ingroup members, compared to outgroup members and strangers. When we explore whether investments in attack or defence towards outgroup members differ from investments toward strangers we find, contrary to the cross-cultural Study 1, no significant differences in attack and defence with opponents from outgroup communities, compared to unidentified strangers. The exclusions do not meaningfully affect the overall interpretation of the results: Participants still invest more in attacking and defending from ingroup than outgroup members and strangers, yet the effect of defence investments becomes not significant.

Table S5 Mixed-effect model of treatment effects on investment decisions. Tests are two-sided. $N_{observations}$ = 1,656; $N_{subjects}$ = 552. Community pair: 1 = Luhya and Kamba; 0 = Kikuyu and Luo. For outgroup vs stranger contrast: $N_{observations}$ = 1,104; $N_{subjects}$ = 552. Outgroup = 0, Stranger = 1.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.046	0.085	0.586	0.178	0.085	0.036
Pair (Kikuyu/Luo; Luhya/Kamba)	-0.019	0.184	0.915	0.002	0.182	0.990
Outgroup vs stranger	-0.029	5.940	0.996	-6.379	5.779	0.270

2.3. Study 3

2.3.1. Treatment effects. Table S6 shows results from models of the ingroup (vs outgroup & strangers) contrast predicting attack and defence decisions, and models with geographical and cultural distance predicting attack and defence investments. All participants were included in the analyses. In line with Study 1, we find that individuals invest more resources in both attack and defence towards ingroup members, compared to outgroup members and strangers. Moreover, as in Study 2, we find no significant differences in both attack and defence with opponents from outgroup countries compared to unidentified strangers. Finally, and in line with Study 1, we find that geographical and cultural distance are negatively associated with conflict, suggesting that people invest more resources in attack and defence when interacting with opponents from geographically and culturally closer countries than more distant countries (Table S7). Altogether, these results replicate and support the conclusions from our first two studies.

Table S6 Mixed-effect model of treatment effects on investment decisions. Tests are two-sided. $N_{observations}$ = 363,231; $N_{observations}$ = 10,827; $N_{subjects}$ = 401. Ingroup = 0, Outgroup & stranger = 1.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.285	0.073	<0.001	0.198	0.069	0.007
Outgroup vs stranger	0.136	0.073	0.062	-0.061	0.068	0.372

Table S7 Mixed-effect model of distance on investment decisions. Tests are two-sided with $N_{observations}$ = 10,030; $N_{subjects}$ = 401. For cultural distance: $N_{observations}$ = 8,466; $N_{subjects}$ = 401.

	Investment in Attack			Investment in Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Geographical distance	-0.036	0.014	0.013	-0.022	0.014	0.099
Cultural distance	-1.114	0.178	<0.001	-0.54	0.169	0.001

3. The nasty neighbour effect emerges independent of parochialism

3.1. Study 4

3.1.1. Treatment effects. Table S8 shows the results from mixed effect models of decisions in the trust game and in the attacker-defender contest. All participants were included in the analyses. We see that people trust ingroup members more than outgroup members and strangers, and return more resources when paired with ingroup members, compared to outgroup members and strangers. We also find, as in Study 1-3, that people invest more resources in attacking ingroup members than outgroup members and strangers. We do not replicate this treatment effect on defence investments, although the direction of the effect is in line with the nasty neighbour effect.

Table S8 Mixed-effect model of treatment effects on investment decisions. Tests are two-sided. $N_{observations}$ = 4,800; $N_{subjects}$ = 300. Ingroup = 0, Outgroup & stranger = 1.

	Trust			Trustworthiness		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.327	0.046	<0.001	2.330	0.501	<0.001
Outgroup vs stranger	0.136	0.073	0.062	-0.061	0.068	0.372

	Attack			Defence		
Contrast	*b*	*SE*	*p*	*b*	*SE*	*p*
Ingroup vs outgroup & stranger	0.236	0.079	0.003	0.071	0.070	0.311
Outgroup vs stranger	0.136	0.073	0.062	-0.061	0.068	0.372

3.1.2. Association between parochialism and nastiness. In this section, we report the analyses regarding the relation between parochialism in the trust game and the nasty neighbour effect in the attacker-defender contest game. To do so, we calculated the difference between trust (return) toward the own country and trust (return) toward others and averaged these two indicators into one overall indicator of parochialism in cooperation. Likewise, we calculated the difference between attack (defence) towards the own country vs others and created a measure of overall (ingroup) nastiness by averaging nastiness in attack and defence. We found no evidence that parochialism and (ingroup) nastiness are correlated ($t(298) = 0.392$, $p = 0.695$).

Second, we show the relation between the aspects of parochialism and (ingroup) nastiness that are conceptually related (Main Text, Fig 2b and 2c). Whereas parochial trust and parochial return were

positively and significantly associated (r = 0.425, p < .001) as well as nastiness in attack and defence (r = 0.33, p < .001), there is a positive but insignificant correlation between (ingroup) nastiness in defence and parochial trust (r = 0.097, p = .093; Fig. 2, Main Text) and a positive yet insignificant correlation between nastiness in attack and parochial returns (r = 0.10, p = .082; Fig 2, Main Text). If parochial cooperation is the flip side of parochial competition, we should have seen negative (and arguably more substantial) correlations.

3.2. Re-analysis cross-cultural study from Romano et al. (2021)

In this section, we report a re-analyses of a cross-cultural dataset that contains data on national parochialism in cooperation in the prisoner's dilemma (*16*). In this cross-cultural study (N = 18,411, sample stratified by age, gender, and income), participants across 42 societies made several independent decisions to cooperate in a prisoner's dilemma with ingroup members (same nation), outgroup members (operationalized by an opponent extracted from a pool of 16 outgroup nations), and an unidentified stranger. In this study, the authors found that, on average, people cooperated more with ingroup members, compared to outgroup members and strangers.

Yet, as results from Study 4 suggest that parochial cooperation and neighbour nastiness are independent behavioural strategies, we can expect substantial individual heterogeneity, with people being nasty neighbours even in situations where parochial cooperation is typically observed. To run this individual heterogeneity analysis, we divided participants in three types. *Parochial* types were defined as people that invested more resources in cooperating with ingroup members, compared to outgroup members and strangers. *Nasty neighbours* types were defined as people that invested more resources in cooperating with outgroup members and strangers, than ingroup members. *Neither parochial nor nasty* types were defined as people that did not discriminate between ingroup, outgroup members, and strangers.

Overall, we found that 8577 individuals (48%) could be categorized as parochial, 5,736 individuals (32%) could be categorized as nasty neighbours, and 3174 individuals (20%) could be categorized as neither parochial nor nasty. The difference in proportion of types was statistically significant, $X^2(2) = 1986.4$, p < .001. A pair-wise chi-square test, testing whether the proportion of nasty neighbours types was higher than the 'neither parochial nor nasty' types, was also significant (p < .001). In sum, results from the re-analysis reveal that (*i*) neighbour nastiness can also be observed in other experimental paradigms, such as the prisoner's dilemma game and that (ii) people can be classified as nasty neighbour or parochialists in the same situation.

4. Within-group status and resource competition can turn humans into nasty neighbours

4.1. Moderators and mediators in Study 3

Table S9 shows results from independent interaction models between a moderator variable (see *Methods*) and the ingroup (vs outgroup & strangers) variable. In the previous analyses we did not find substantial differences in the observed patterns between attack and defence investments, and for the current analyses aggregated across both attack and defence. The only significant interaction in the model is perceived status within a group; people that self-report to have lower status in their nation are the ones that discriminate more in their conflict investments between ingroup vs outgroup members and strangers (also see Fig. 3a, Main Text).

Table S9. Independent mixed-effect models predicting conflict decisions (attack & defence combined). Tests are two-sided. $N_{observations}$ = 21,654; $N_{subjects}$ = 401.

Investments in conflict (attack and defence)	*b*	*SE*	*p*
Ingroup (vs outgroup/strangers) × Perceived status ingroup	0.188	0.077	0.015
Ingroup (vs outgroup/strangers) × Perceived status outgroup	0.091	0.079	0.251
Ingroup (vs outgroup/strangers) × Perceived financial scarcity	0.011	0.04	0.788
Ingroup (vs outgroup/strangers) × Reputational concern ingroup	0.018	0.039	0.634
Ingroup (vs outgroup/strangers) × Reputational concern outgroup	-0.056	0.039	0.152
Ingroup (vs outgroup/strangers) × Generosity (qualitative item)	-0.029	0.025	0.249
Ingroup (vs outgroup/strangers) × Generosity (quantitative item)	0.001	0.001	0.474
Ingroup (vs outgroup/strangers) × Risk preferences	-0.031	0.026	0.243
Ingroup (vs outgroup/strangers) × Identification with nation	-0.001	0.04	0.979

We also explored the role of potential mediators: expectations, perceived competition over scarce resources and perceived similarity. We assessed these measures for each country participating in the study and ran multilevel mediation models (with subjects as random intercepts) using the causal mediation package(*20*). While we find that all three measures can account for the effect of national membership on conflict (Table S10), perceived competition over scarce resources is the only variable that fully mediates this association and that explains the highest proportion of variance. Perceived competition over scarce resources was assessed by the following question: “Competition plays an important role within and across countries. At a global and local stage, individuals, companies, and governments compete for scarce resources, like access to natural resources, access to new technology, participation in the labour market, or transnational agreements that govern the rights and obligations of citizens from different countries. Such competition can directly or indirectly also influence your own well-being. Please rate below, how much you think your own

well-being is influenced by competition with people from different countries (0 = not at all, 10 = very much)". Participants responded for all opponent countries, including their own country. The model with perceived competition over scarce resources as mediator and the other variables as controls is the only model that fully explains the nasty neighbour effect and the only one that explains a significant proportion of mediation in a multi-level mediation model (Table S10). Neither perceived similarity nor expectations explain a significant proportion of the mediation, when controlling for the other mechanisms. Moreover, we also ran models that included interactions between beliefs, perceived competition, and similarity with group membership predicting conflict expenditure in the attacker defender game. The conclusions do not change if we treat all variables as moderators: only perceived ingroup status and perceived competition over scarce resources show a significant interaction predicting conflict investments towards ingroup (vs outgroup & stranger) members (i.e., expectations and similarity do not significantly interact with the nasty neighbor effect in the attacker-defender game). In summary, we find that perceived competition over scarce resources fully mediates the effect of national membership (ingroup vs outgroup/strangers) on conflict. This result sheds light on the potential mechanisms related to the nasty neighbour effect we observed.

Table S10. Multi-level mediation models.

	b	*95% CI (LL; UL)*	*p*
Expectations			
Indirect effect	-0.241	-0.033; -0.02	<0.001
Direct effect	-0.226	-0.334; -0.11	<0.001
Total effect	-0.250	-0.357; -0.14	<0.001
Proportion mediated	0.094	0.060; 0.22	<0.001
Perceived Similarity			
Indirect effect	-0.065	-0.110; -0.03	<0.001
Direct effect	-0.182	-0.294; 0.05	<0.001
Total effect	-0.247	-0.359; -0.12	<0.001
Proportion mediated	0.264	0.109; 0.64	<0.001
Perceived Competition			
Indirect effect	-0.234	-0.266; -0.20	<0.001
Direct effect	-0.014	-0.157; 0.10	0.78
Total effect	-0.248	-0.382; -0.13	<0.001
Proportion mediated	0.943	0.594; 1.70	<0.001
Perceived Competition (controlling for perceived similarity and expectations)			
Indirect effect	-0.230	-0.263; -0.20	<0.001
Direct effect	-0.021	-0.163; 0.13	0.66
Total effect	-0.252	-0.383; -0.10	<0.001
Proportion mediated	0.911	0.581; 2.24	<0.001
Expectations (controlling for perceived similarity and competition)			
Indirect effect	-0.018	-0.027; -0.01	<0.001
Direct effect	-0.018	-0.129; 0.10	0.82
Total effect	-0.036	-0.147; 0.08	0.64
Proportion mediated	0.176	-2.445; 3.17	0.64
Perceived Similarity (controlling for perceived competition and expectations)			
Indirect effect	-0.020	-0.023; -0.01	0.26
Direct effect	-0.022	-0.148; 0.10	0.74
Total effect	-0.042	-0.170; 0.08	0.94
Proportion mediated	0.173	-1.830; 3.97	1.00

4.2. National identity and perceived competition in Study 4

Table S11 shows how observed parochialism in the trust game and (ingroup) nastiness in the attacker-defender game were predicted by different psychological mechanisms. In line with research on parochialism, social identification was significantly associated with parochialism in trust and trustworthiness but was not related to the nasty neighbour effect in attack and defence. In contrast, differences in perceived competition toward ingroup vs outgroup members were significantly associated with the nasty neighbour effect in attack and defence but not with parochialism in trust and trustworthiness.

Table S11. Independent regression models predicting parochialism in the trust game or the nasty neighbour effect in the attacker-defender game.

	b	***SE***	***p***
Social identification predicting parochial trust	0.131	0.031	<0.001
Social identification predicting parochial return	0.844	0.326	0.010
Social identification predicting nasty attack	-0.001	0.052	0.971
Social identification predicting nasty defence	0.001	0.047	0.999
Perc. competition ingroup minus outgroup predicting parochial trust	-0.012	0.019	0.527
Perc. competition ingroup minus outgroup predicting parochial return	-0.032	0.021	0.875
Perc. competition ingroup minus outgroup predicting nasty attack	0.069	0.032	0.035
Perc. competition ingroup minus outgroup predicting nasty defence	0.052	0.029	0.073

4.3. Study 5

In Study 5, our aim was to test whether we could observe the nasty neighbour effect in minimal groups by experimentally manipulating two mechanisms that emerged to be associated with the nasty neighbour effect: resource scarcity and status concerns. All participants were included in the analyses.

4.3.1. Within vs between group competition. We introduced two competitive treatments. In the *between-group competition* conditions (present vs absent), we expected people to become more parochial once the opportunity to compete for a bonus in Stage 1 was introduced (see *Methods*). Our treatment was successful in manipulating perceived competition with ingroup vs outgroup members, as people perceived a relative higher competition with outgroups compared to ingroup members when between-group competition was present (vs absent: Welch two-sample t-test, $t(472.66) = -4.475$, $p < 0.001$). Moreover, in line with our preregistered hypothesis, we find that people were more parochial (i.e., higher investments towards the group-exclusive club pool) when between-group competition was present, compared to when between group competition was absent (paired t-test, $t(275) = 5.773$, $p < 0.001$). In the between-group competition conditions, people also invested more resources to the parochial compared to the universal pool (paired t-test, $t(275) = 4.694$, $p < 0.001$).

In Study 5, we also aimed to implement within-group competition by adding the possibility to get a bonus in Stage 2. In the within-group competition present condition, people were informed that they would get a bonus if, at the end of the experiment, they would earn more than their group members (in the control condition, the bonus was randomly allocated). Contrary to the between-group competition condition, this treatment was not successful in increasing the relative perceived competition with ingroup vs outgroup members (Welch two-sample t-test, $t(543.57) = -1.201$, $p = 0.231$). We suspect that this failure to implement within-group competition (vs not) may be due to the competitive nature of Stage 1, or some misunderstanding among participants about the allocation of the bonus in Stage 2. Indeed, we find that the within-group competition treatment was not significantly associated with the nasty neighbour effect in punishment (linear regression, $b = -0.034$, $p = 0.489$). In contrast, the nasty neighbour effect was observed among people who perceived higher competition with ingroup relative to outgroup members, regardless of the treatment (linear regression, $b = 0.048$, $p < 0.001$).

4.3.2. Status differences. In Stage 2, we manipulated the earning status of the target of punishment. Participants could assign up to 5 MU as ‘deduction points’ to an ingroup member and to an outgroup member. Deductions reduced the target’s earnings at a 1 to 3 ratio. We operationalized member status in terms of their earnings relative to others in their group and in the outgroup, and elicited punishment

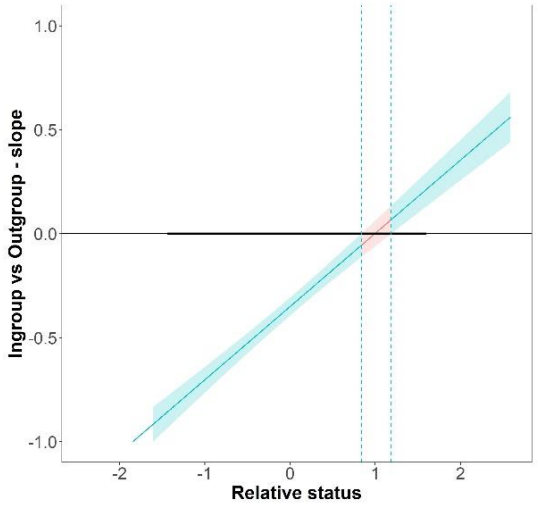
decisions in 11 possible scenarios. In five scenarios, the participant had lower earning status, in one they had equal status, and in five they had greater earning status.

Across all conditions, we find a significant interaction between status of the target and group membership (see Table S12). In particular, from the Johnson Neymann plot shown in Figure S6, people were parochial in their punishment (more punishment to outgroup vs ingroup members) when the targets of their punishment were high earning status individuals and were nasty neighbours (more punishment to ingroup vs outgroup members) when the target of their punishment were low earning status individuals. In this study, we also included measures of beliefs for Stage 1 and 2. When replacing behaviour with beliefs, the results for both Stage 1 and 2 remain the same.

Table S12. Independent mixed effect models with subjects as random intercept and the interaction between status of the target and group membership predicting punishment. Tests are two-sided with N = 552. Results remain robust when applying Bonferroni correction for multiple hypotheses testing.

	b	***SE***	***p***
Within competition No / Between competition No	0.256	0.037	<0.001
Within competition No / Between competition Yes	0.463	0.046	<0.001
Within competition Yes / Between competition No	0.323	0.045	<0.001
Within competition Yes / Between competition Yes	0.368	0.048	<0.001
Across all treatments	0.353	0.022	<0.001

Figure S6. Status differences favour the emergence of within-group nastiness. Floodlight plot showing the regions of differences in status of the target of punishment (x axis, standardized) for which the effect of ingroup vs outgroup (y axis) on punishment becomes significant. The vertical lines in the floodlight plot show the exact values at which significance begins and ends. Blue lines indicate significance at 5% level.



5. Complementary study

Next to the experiments reported in the Main Text we performed an additional study to examine the possibility that parochialism or neighbour nastiness emerges also in preferences for whom to compete with(*21*). The literature on parochialism suggests that when given a choice, individuals prefer to compete with those in outgroups, rather than within their own group. The nasty neighbour effect identified in our main experiments may counter-act or even reverse this preference. A secondary aim of this complementary study was to examine whether and how preferences for competing within or between groups relate to parochialism in dictator giving[1].

5.1. Sample, design, and procedure

The study was approved by the ethics committee of the Faculty of Arts and Social Sciences at the University of Zurich (22.10.5) and preregistered at https://osf.io/qt7zy/?view_only=9f0ae5877024489daca434b08aba7c3c. We recruited 300 participants through Prolific, stratified by age, gender, and ethnicity. Participants made decisions in a 2 (situation: competitive vs cooperative) × 2 (political ideology: leftist vs rightist) within-subjects design. They first read and were asked if they agreed to the consent form. Participants were then informed that they would make decisions in two tasks. Then, they were asked a question about their political identification (leftist or rightist). In the decision-making phase, they read instructions of the dictator game and of the tournament game (the order of the two games was randomized). In the dictator game, participants made three decisions in the role of allocators. In the tournament game, participants performed a task where they needed to estimate the number of dots across 11 trials. After that, we administered one block of questionnaires and socio-demographics. At the end of the survey, participants were shortly debriefed about the scope of the study. After data collection, we randomly selected one game, and paid participants for the decisions made in that game.

*Dictator game***.** Participants made three decisions in the dictator game, one with an ingroup member, one with an outgroup member, and one with an unidentified stranger. In the dictator game, there was an allocator and a recipient. Allocators could freely distribute an amount of 10 MU between themselves and the recipients. Participants made decisions as allocators knowing that each MU was worth 1 minute of average wage in the UK (0.20 GBP). Participants were informed that if the game was selected for payment, they would be matched with another participant, randomly assigned the role of allocator or recipient and paid accordingly.

Tournament game. In the tournament game, participants performed a dot estimation task. This task required participants to estimate several images that differ in the number of yellow dots. Each image contained 100 dots and is shown for 2 seconds. They were asked to estimate the number of dots across 11 trials. Before starting with the 11 trials, participants were informed that they could decide to be paid according to two options: in the first option they competed with people that identified themselves as leftists, knowing that if they selected this option, they would be randomly paired with a person from the leftists group, and that they would receive 1 MU each time they are closer to the correct answer than this person. The second option was the same, except that in this case they would be compared with people that identified themselves as rightists.

5.2. Results

In line with the trust game results from Study 4, participants in this complementary study gave more resources to ingroup members (M = 3.86, SD = 1.90), compared to outgroup members and strangers (M = 3.24, SD = 1.93, $t(299)$= 8.45, $p < .001$). Parochial generosity also correlated with social identification (b = 0.254, $p < .001$).

Regarding self-selection into the tournament, we find that 39% of the participants decided to engage in the tournament with ingroup members and 61% of the participants decided to engage in the tournament with outgroup members ($X_{squared}$ = 14.52, $p < .001$). This higher fraction of people selecting into a tournament with outgroup members was not predicted by social identification (generalized linear model of ingroup vs outgroup frequency predicted by social identification: b = -0.005, p = 0.96). In fact, we found that this pattern was mostly explained by stereotypes of intelligence and skills – when excluding participants that did not select based on such stereotypes, the difference between self-selection into ingroup or outgroup competition indeed disappears (when participants did not consider the outgroup unintelligent: $X_{squared}$ = 1.07, p = 0.30; when they did not consider the outgroup unskilled: $X_{squared}$ = 0.04, p = 0.85). Accordingly, the preference for competing against an outgroup member likely results from a stereotypical belief that political outgroups are unintelligent and unskilled, rather than from parochialism in competition. Indeed, across the 11 trials we also checked whether people were more accurate in their dot estimation when competing with ingroup vs outgroup: we found no significant differences in competitive performance: $t(262.97)$ = 0.899, p = .37. Furthermore, in previous studies that implemented an option where participants were indifferent to ingroup and outgroup members, such option was chosen by the majority of the participants(*22*). We conclude that these results support neither the nasty neighbour effect nor parochialism.

Relation between parochial generosity and self-selection into tournament. As a further test, we also checked whether parochialism in generosity could explain or was associated with self-selection in competition with outgroup members. If that was the case, we should see that people opting to compete with outgroup members were also the ones that give more to ingroup members in the dictator game. This was, however, not the case. Selecting to compete with an ingroup vs outgroup individuals did not predict differences in generosity between ingroup and outgroup members: $t(249.86) = -1.19$, $p = 0.24$). This provides additional support that self-selecting into competition was not driven by parochialism, and that competitive motivation can co-exist with parochialism.

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