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Prosocial preferences can escalate intergroup conflicts by countering selfish motivations to leave

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When defending against hostile enemies, individual group members can benefit from others staying in the group and fighting. However, individuals themselves may be better off by leaving the group and avoiding the personal risks associated with fighting. While fleeing is indeed commonly observed, when and why defenders fight or flee remains poorly understood and is addressed here with three incentivized and preregistered experiments (total $n = 602$). In stylized attacker-defender contest games in which defenders could stay and fight or leave, we show that the less costly leaving is, the more likely individuals are to abandon their group. In addition, more risk-averse individuals are more likely to leave. Conversely, individuals more likely stay and fight when they have pro-social preferences and when fellow group members cannot leave. However, those who stay not always contribute fully to group defense, to some degree free-riding on the efforts of other group members. Nonetheless, staying increased intergroup conflict and its associated costs.

Among humanities' most pressing problems are the intergroup conflicts that destroy social welfare, cripple economies, and create persistent and large-scale refugee flows around the globe[1]. When drawn into conflict, individuals directly or indirectly contribute to raids against other groups or to protect against such enemy hostilities[2,3]. In the latter case, when defending against hostile outgroups, groups need to ensure that (enough of) their members contribute to conflict. This is non-trivial, as fighting entails myriad risks to individual participants, including economic losses, physical injury and, in extremis, death. Accordingly, rather than actively contributing to collective defense against outgroup hostilities, individuals may abandon their group and flee from conflict. Such decisions to leave rather than stay are indeed commonly observed. During intergroup conflict, armies experience desertion and refugees abandon their homes[4,5], possibly leaving behind fellow group members. As a case in point, archival data have shown that conflicts increase migration, especially in low-income countries[1].

At the same time, there are also numerous examples of individuals who could have left easily and at low cost yet decided to stay and fight for their group. When and why individuals decide to stay or flee from conflict situations is poorly understood, and the psychological and economic mechanisms underlying such decisions remain unknown. Filling this gap is important, as stay-or-leave decisions can have important effects on how intergroup conflict develops and shapes individual and group outcomes. Individuals who leave may be considered less brave and heroic, yet these individuals increase their probability to survive compared to those who stay. However, whether those who stay indeed are more likely to incur costs to protect themselves and their group remains an open question. Moreover, and all else equal, the more people leave upon impending outgroup attacks, the less is needed to settle the conflict—leaving conflict, rather than staying and fighting, can reduce the intensity of intergroup conflict and preserve collective welfare.

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Here we address the micro foundations of stay-or-leave decisions during conflict using a newly developed Intergroup Attacker-Defender Contest with an Exit option (IADC-E; Fig. 1) allowing to test predictions on voluntary conflict participation in a controlled and stylized experimental setting. The contest models individuals nested in two groups, one being designated attacker and the other defender[3,6,7]. Attackers can individually contribute to conflict, as can defenders. Contributions to conflict are non-recoverable and can never be earned back. However, when attackers' contributions combined exceed those of the defender group, the attackers win the conflict and earn the defenders' non-invested Experimental Money Units (henceforth EMU); otherwise, both sides keep what they did not invest in conflict. Importantly, defenders have two options: (i) stay and defend themselves and their group (as in previous studies on attacker-defender contests), or (ii) leave their group to evade the attack from the opposing group. Having these two options creates a social dilemma for defenders: should they prioritize personal earnings and survival by leaving their group behind, or should they stay and fight, also for the sake of fellow group members?

Because our task clearly specifies the different actions and underlying incentives of conflicting parties in a controlled environment[8–10], we can observe whether, when, and why individuals stay and help with collective defense or, alternatively, leave and abandon their group. We anticipated, first, that defenders' willingness to abandon their group depends on the personal (economic) cost of leaving and we hypothesized that defenders leave when its personal benefits outweigh the expected benefits of conflict participation[11,12]. Relatedly, we expected that, if the cost of leaving is not at a maximum, individuals who are more risk averse may be more inclined to leave, given that staying in a conflict involves a risk of defeat—an outcome to which risk-averse individuals are particularly sensitive[12–14]. Loss aversion could also increase defenders' willingness to leave: the possibility that defenders could lose everything if they stay may loom larger than any potential gains[15,16].

An individual-level cost-benefit analysis of staying or leaving can be considered selfish, since it only considers own outcomes and can result in other group members being left behind. Consequently, group members who are left behind need to (and are expected to[17]) fight harder to not be defeated and, as a result, have to waste more resources on conflict. In the decision to leave, people may therefore not only be motivated by self-centered cost-benefit considerations but also (to different degrees) by social considerations of solidarity—the psychological bond felt with and commitment to fellow in-group members[18]—and the concern for others' welfare (henceforth pro-sociality)[19]. Archival data indeed revealed that the likelihood of deserting groups (negatively) correlates with the presence of group norms of cooperation and solidarity[5], and past experiments have shown that pro-social preferences influence how much people

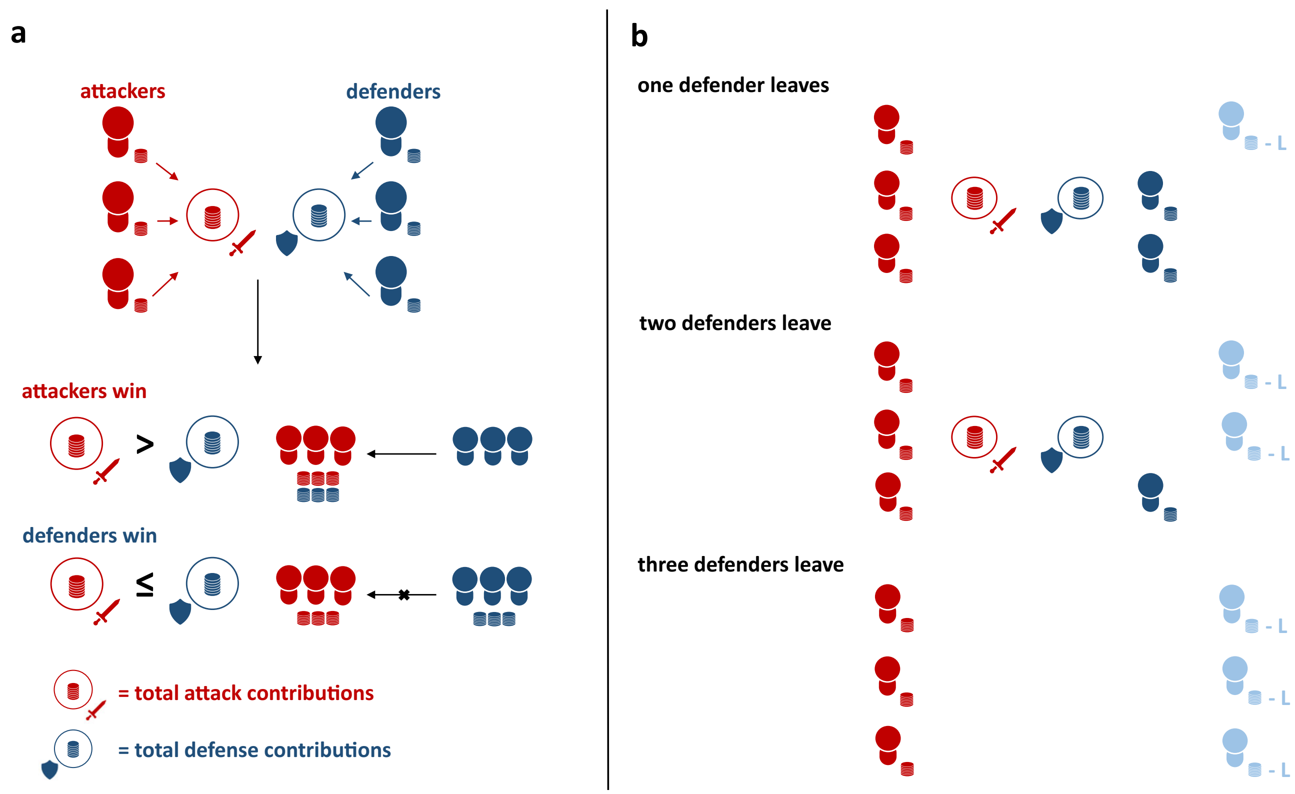

Fig. 1 | The Intergroup Attacker-Defender Contest with Exit (IADC-E). **a** Participants were either assigned the role of attackers (red) or defenders (blue). In each round, participants decided how many of their 20 Experimental Money Units (EMU) to contribute to their conflict pool (the sword symbolizes the total EMU contributed by the attackers to the conflict pool, while the shield symbolizes the total EMU contributed by the defenders). If contributions to the attacker pool exceeded contributions to the defender pool, attackers won the conflict and received all non-contributed EMU from the defenders (i.e., defenders earned nothing). If defenders contributed more or equal EMU, they defended themselves successfully and everyone earned their non-contributed EMU. **b** In each round, defenders were simultaneously given the option to leave. If defenders left (light blue), they evaded the attack by the other group. However, leaving was costly, such that defenders who left earned 20 EMU minus the cost of leaving (L). If defenders did not leave (dark blue), they faced the attackers and decided how many of their 20 EMU to contribute to their conflict pool. Defenders always faced three attackers. Before deciding how many EMU to contribute to conflict, everyone learned how many defenders left. If no defenders left, they played the 3 vs 3 attacker-defender game shown in (**a**). However, if one or two defenders left, the attackers outnumbered the defenders, thereby increasing the chances of defeat for the remaining defenders. If everyone in the defender group left, there was no possibility to contribute to conflict. Consequently, everyone in the defender group earned 20 EMU (their endowment) minus the cost of leaving (L), and attackers earned 20 EMU (i.e., they simply kept their endowment).

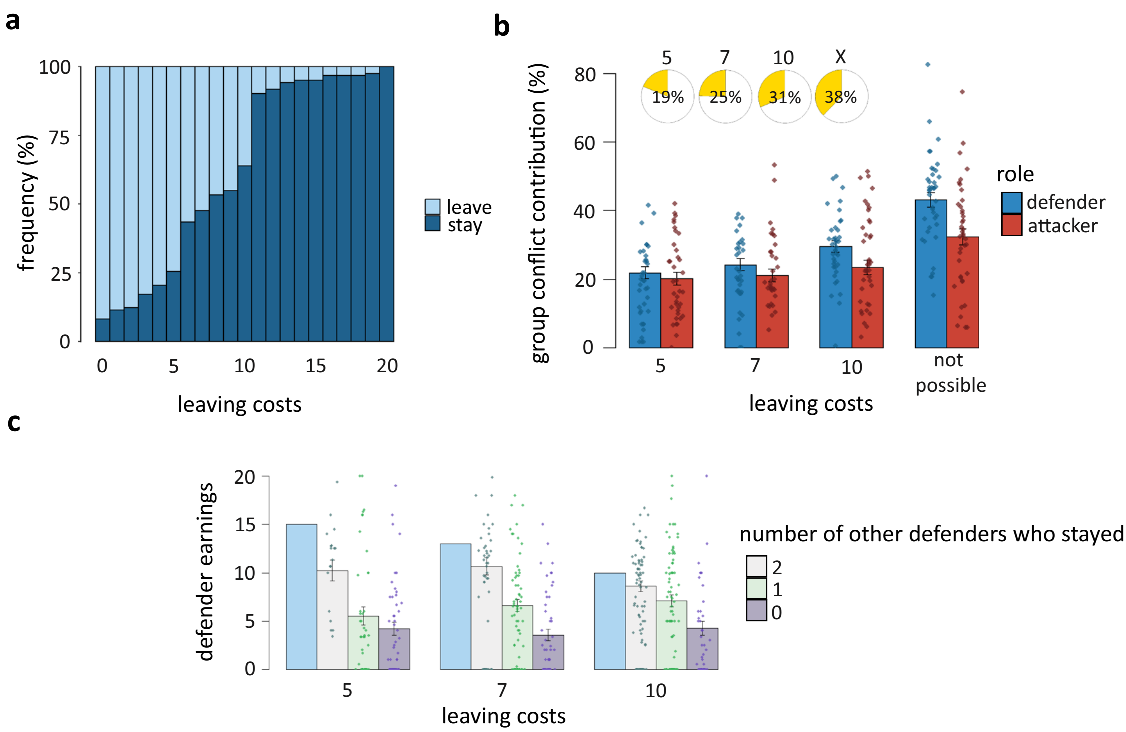

Fig. 2 | Defense participation was impacted by the economic costs of leaving. **a** Participants ($n = 122$) indicated if they wanted to leave the conflict for each possible cost of leaving, with costs varying between 0 and 20 EMU. Defenders were less likely to leave as the cost of leaving increased. **b** Average group-level contributions ($n = 40$ groups) to the conflict pool of attackers (red) and defenders (blue) per block. Groups contributed more EMU to conflict as the cost of leaving increased. Contributions were highest when leaving was not possible. Yellow pie charts show overall EMU wasted on conflict as a percentage of participants' endowment for each leaving cost. More EMU were wasted as the cost of leaving increased. Most EMU were wasted when leaving was not possible (see pie chart X). Error bars indicate the standard error of the mean. Dots show averages per groups. **c** Leaving was the superior strategy for defenders ($n = 40$ groups). Defenders earned more EMU when they left (light blue), regardless of the cost of leaving and the number of other defenders who stayed. Error bars indicate the standard error of the mean. Dots show averages per participants who stayed in the conflict.

contribute to group defense[3,20–23]. Interestingly, there is some evidence suggesting that individuals with pro-social preferences may invest in collective defense especially to protect vulnerable others who lack the financial means, social capital, or physical ability to defend themselves[24]. Possibly, individuals who can leave, even at low cost, may therefore be less likely to leave when others in their group cannot.

Here, we show across three studies in which participants were confronted with the IADC-E (Fig. 1), that higher economic costs of leaving reduce the likelihood that defenders abandon their group, in line with a self-centered cost-benefit account. Yet even when the cost of leaving is low, people are likely to stay and defend especially when they have pro-social preferences and some fellow group members cannot leave. This has adverse consequences, however. When more defenders stay, both attacker and defender groups increase their contributions to conflict, wasting more EMU and lowering collective welfare on both sides. Outside of conflict situations, pro-social concerns for others play an important role to uphold cooperation and social relations in groups[25–27]. Our findings show that in intergroup conflicts, these pro-social concerns not only decrease conflict exit but also increase the overall economic waste and cost associated with intergroup conflicts, at least in the short run.

Results

All studies embedded participants in the IADC-E (Fig. 1): Six participants were randomly divided in three-person attacker and defender groups and made decisions across a series of contest rounds. On each round, defenders were simultaneously given the option to leave at some cost (which varied across rounds and individuals). If defenders left, they evaded the attack by the other group. If they did not leave, they decided how much of their EMU to contribute to conflict. On each round, attackers and defenders were first informed how many defenders decided to leave, and then decided whether and how much to invest in conflict. Whereas EMU contributed to conflict were always wasted and could never be earned back, attackers appropriated the non-contributed EMU of the defenders who did not leave when the collective investment in attack exceeded the collective investment in defense (in that case, defenders who stayed earned nothing). When defenders who stayed contributed equal or more to conflict than attackers, they successfully defended themselves, and both the attackers and defenders (who stayed) earned their non-contributed EMU. Defenders who left earned their original endowment minus the cost of leaving, regardless of the outcome of the conflict between their attackers and the (remaining) defenders in their group.

We designed study 1 to specify at what (financial) costs defenders were willing to leave their group. Participants ($n = 122$), in the role of defenders, were given 20 EMU to use in the IADC-E and indicated if they wanted to leave for cost levels varying between 0 and 20 EMU.

As predicted, defenders were less likely to leave when leaving became increasingly costly (Fig. 2a). When leaving did not cost anything, the majority (92%) of participants left. However, when leaving costed more than half of their endowment, more than 90% of participants decided to stay. This shows that (i) defenders are sensitive to leaving costs in line with a simple individual-level cost-benefit account. At the same time, when we compare decisions to game-theoretic benchmarks and prior data, (ii) defenders seem to overestimate the value they can gain from staying in the conflict. That is, when we fit a simple model using maximum likelihood to defenders' stay-or-leave decisions, we see that defenders' decisions in study 1 were consistent with expected earnings of 12.7 EMU from staying in the conflict. However, the mixed strategies Nash Equilibrium in the Intergroup Attacker-Defender Contest without exit options (IADC-NE) implies expected earnings of 11.4 EMU for those who stay in conflict[6,28]. In addition, past studies revealed a weighted average earning of only 6.13 EMU (see Methods section for more information)[6,29,30]. Thus, in our one-shot IADC-E, defenders chose to stay for costs at which, based on game-theoretic benchmarks and prior data, leaving would have been the economically superior choice.

Next, we conducted an interactive behavioral study in fixed groups faced with the IADC-E to test the impact of conflict dynamics, such as conflict history. In study 2 ($n = 240$ participants), groups of attackers and defenders interacted in four blocks of ten rounds each. Between blocks, we manipulated the cost of leaving, with costs varying between 5, 7, and 10 EMU (out of their endowment of 20). We also introduced one block in which leaving was not possible. Decisions were incentivized such that participants were paid out based on the average of eight randomly selected rounds (i.e., two decisions per block; see Methods section for more information).

In line with study 1, defenders were less likely to leave when leaving became increasingly costly (multilevel logistic model [MLLM], $z = 3.18$, $b_{\text{leaving cost 5 vs leaving cost 7}} = 0.50$, $p = 0.001$, 95% CI [0.22, 0.82], see online Supplementary Information Table S1; MLLM, $z = -4.03$, $b_{\text{leaving cost 7 vs leaving cost 10}} = -0.58$, $p < 0.001$, 95% CI [−0.87, −0.30], see Table S1). This was also in line with participants' beliefs: they expected that fewer defenders would leave under higher leaving costs (multilevel model [MLM], $t(6958) = 9.57$, $b_{\text{leaving cost 5 vs leaving cost 7}} = 0.20$, $p < 0.001$, 95% CI [0.16, 0.24], see Table S2; MLM, $t(6958) = -25.51$, $b_{\text{leaving cost 7 vs leaving cost 10}} = -0.53$, $p < 0.001$, 95% CI [−0.57, −0.49], see Table S2). Defenders were also more likely to leave if they were more risk averse (as measured with a separate task[31]; MLLM, $z = -2.70$, $b_{\text{risk taking}} = -0.05$, $p = 0.007$, 95% CI [−0.09, −0.02], see Table S1). Importantly, success dynamics across rounds played an important role for leaving decisions. Defenders were more likely to leave if they were defeated on the previous round (MLLM, $z = -8.72$, $b_{\text{previous success}} = -1.13$, $p < 0.001$, 95% CI [−1.41, −0.88], see Table S1). These findings corroborate that defenders are sensitive to individual costs and benefits when deciding to leave or stay, and integrate past success or failure experiences in such decision-making.

Leaving decisions also influenced the intensity of conflict and group-level outcomes. Group-level contributions to conflict increased when fewer defenders left (both for attacker and defender groups; MLM attackers, $t(1104.76) = 7.69$, $b_{\text{num defenders}} = 3.13$, $p < 0.001$, 95% CI [2.33, 3.92], see Table S3; MLM defenders, $t(1110.36) = 12.20$, $b_{\text{num defenders}} = 4.34$, $p < 0.001$, 95% CI [3.64, 5.03], see Table S4). On the group level, leaving was economically the best choice: Fewer EMU were wasted on conflict when more defenders decided to leave (see also Fig. 2b). However, defender groups contributed more to conflict (MLM, $t(1113.09) = -7.58$, $b_{\text{leave possible}} = -4.69$, $p < 0.001$, 95% CI [−5.91, −3.48], see Table S4) and were most successful in their defense against the attackers when they could not leave (MLLM, $z = -3.57$, $b_{\text{leave possible}} = -0.71$, $p < 0.001$, 95% CI [−1.10, −0.32], see Table S6; see also Fig. 2b). Hence, forcing defenders to stay led to the highest economic waste of conflict (i.e., 38% of EMU were wasted on conflict) yet also made enemy attacks least successful (i.e., defenders successfully defended themselves in 77% of rounds when leaving was not possible). This illustrates the social dilemma that the option to leave created: while fewer EMU were wasted on conflict when defenders could leave, it came at the expense of a lower defense success rate.

On the individual level, leaving was likewise the economically superior decision for defenders (Fig. 2c). Across all cost levels, and regardless of the number of defenders who stayed, participants who left earned the most (MLM, $t(3416.64) = -33.67$, $b_{\text{stay}} = -6.03$, $p < 0.001$, 95% CI [−6.38, −5.67], see Table S7). As a result, the ability to leave created, besides a social dilemma, a coordination problem for defenders: defenders should either all leave, or should all stay, as any mixture of some staying and some leaving resulted in lower individual earnings overall (MLM, $t(3310.09) = 14.12$, $b_{\text{dummy coordination}} = 2.60$, $p < 0.001$, 95% CI [2.24, 2.96], see Table S8).

Whereas defenders earned more when they left, and avoiding conflict increased individual and collective welfare even when leaving was very costly, a non-trivial proportion of defenders who could exit nevertheless decided to stay and confront their attackers. These defenders' decisions were clearly not only driven by personal cost-benefit considerations. Indeed, and even when leaving was cheap, defenders in study 2 were less likely to leave if their fellow group members stayed on the previous round (MLLM, $z = -8.72$, $b_{\text{previous others stayed}} = -1.08$, $p < 0.001$, 95% CI [−1.33, −0.84], see Table S1), showing that over and beyond previous group success or failure, defenders were also influenced by others' decisions. Furthermore, defenders were less likely to leave when they had a higher social value orientation angle (indicating stronger pro-social preferences, as measured with a separate task[19]; MLLM, $z = -3.14$, $b_{\text{svo angle}} = -0.03$, $p = 0.002$, 95% CI [−0.04, −0.01], see Table S1). Finally, defenders who stayed reported higher ingroup solidarity after the contest (MLM, $t(3505) = 12.76$, $b_{\text{stay}} = 0.36$, $p < 0.001$, 95% CI [0.30, 0.41], see Table S9; replicated in study 3, MLM, $t(2307) = 10.91$, $b_{\text{stay}} = 0.41$, $p < 0.001$, 95% CI [0.34, 0.49], see Table S20). In short, these results suggest that economic incentives to leave are counteracted by pro-social considerations, including solidarity with and imitation of fellow group members who stayed and general pro-social preferences.

To more directly investigate the influence of pro-social considerations in the decision to leave or stay, we introduced asymmetric leaving opportunities ($n = 240$ participants). In study 3, the cost of leaving was fixed to 5 EMU (i.e., 25% of the individual's endowment), a cost level at which most participants, under equal leaving opportunities, decided to leave the conflict in study 1 (74.59%) and in study 2 (77.67%). In study 3, however, leaving was not always possible for all group members. Specifically, we compared four conditions in which (i) no defenders could leave, (ii) one defender could leave, (iii) two defenders could leave, or (iv) all three defenders could leave (decisions were again incentivized based on the average of eight randomly selected rounds; see Methods section for more information). Thus, for those conditions in which only one or two defenders could leave, the decision to leave also meant leaving others behind.

In these asymmetric scenarios, defenders who were able to leave were significantly less likely to do so compared to when all defenders could leave (Fig. 3a; MLLM, $z = -16.07$, $b_{\text{asymmetric leave}} = -1.94$, $p < 0.001$, 95% CI [−2.19, −1.71], see Table S10). That is, when all defenders could leave, defenders left in 71.58% of the cases. When one or two defenders could not leave, however, leaving decreased to 38.75% and 39.00%, respectively. Furthermore, defenders who could leave under asymmetric leaving opportunities earned less EMU compared to when everyone could leave (MLM, $t(3556.78) = -6.89$, $b_{\text{dummy could leave}} = -1.47$, $p < 0.001$, 95% CI [−1.90, −1.04], see Table S17). These defenders thus stayed and contributed to conflict at the expense of their own earnings when one or two fellow group members could not leave. Decisions to stay also contributed to group survival, as defender groups were more successful in their defense against the attackers when groups consisted of more defenders under asymmetric leaving abilities (MLLM, $z = 4.58$, $b_{\text{num defenders}} = 0.52$, $p < 0.001$, 95% CI [0.30, 0.75], see Table S15).

The increased likelihood to survive enemy attack under asymmetric leaving emerged mainly because those defenders who could not leave fought harder. On average, defenders under asymmetric leaving abilities who could not leave contributed more than when leaving was not possible for anyone (MLM, $t(2358.98) = 6.59$, $b_{\text{dummy could leave}} = 1.07$, $p < 0.001$, 95% CI [0.75, 1.39], see Table S12) and compared to those who could leave but decided to stay (MLM, $t(1341.53) = -5.72$, $b_{\text{stayed | could leave}} = -1.44$, $p < 0.001$, 95% CI [−1.93,

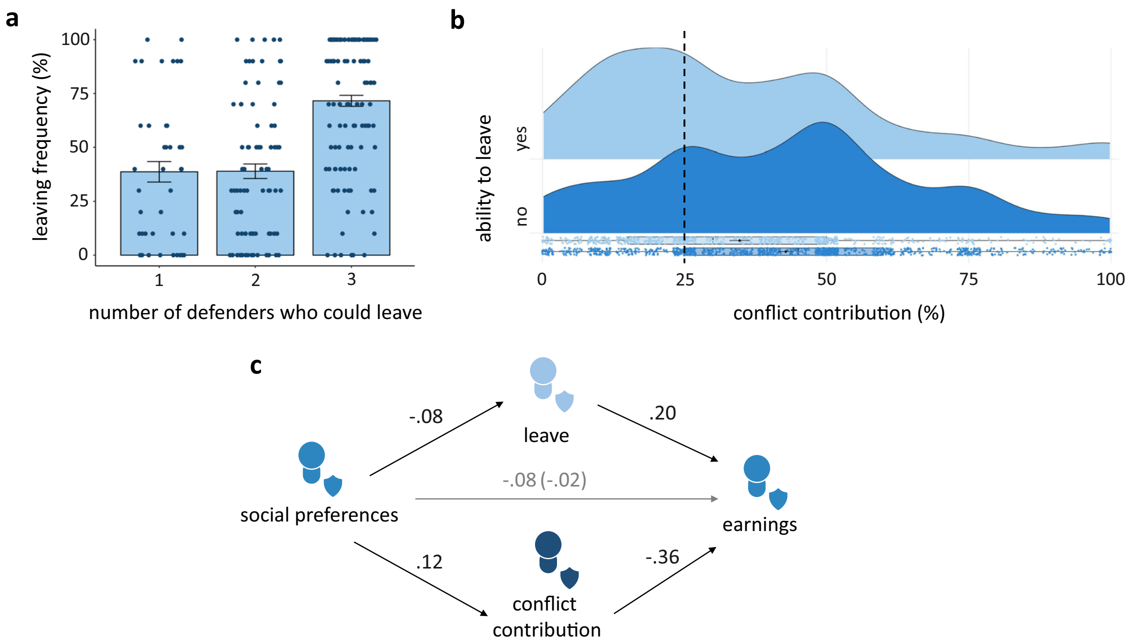

Fig. 3 | Defense participation was also impacted by social factors. a Defense participation was driven by concerns for others. Defenders ($n = 40$ groups) were less likely to leave once one (38.75%) or two (39.00%) defender(s) lacked the ability to leave, compared to when everyone could leave (71.58%). Assumption-based 95% confidence intervals for the proportion of defenders leaving were calculated using the standard error of the mean. Dots show averages across participants. **b** Raincloud plot illustrating the contributions to conflict for defenders who stayed exclusively for blocks in which leaving abilities were asymmetric (i.e., when one or two defenders could not leave). Defenders, who could leave, contributed more than the cost of leaving (34.69% on average). However, 35.74% of defenders who stayed voluntarily contributed less to conflict than the leaving cost. Defenders, who could not leave, contributed more than defenders who could leave (42.80% on average). The dotted line shows the cost of leaving (25%). Dots show individual contributions across participants. **c** Social preferences (measured by the social value orientation angle) predicted defenders' conflict contributions, leaving propensity, and individual earnings (mediation model based on regressions with bootstrapped confidence intervals, coefficients show standardized path coefficients). Social preferences directly predicted earnings ($p = 0.029$). Social preferences also predicted conflict leaving ($p = 0.034$), and conflict leaving predicted earnings ($p < 0.001$). Furthermore, social preferences predicted conflict contributions ($p = 0.001$), and conflict contributions predicted earnings ($p < 0.001$).

−0.94], see Table S13; Fig. 3b). As a result, defenders forced to stay in the conflict earned significantly less compared to the situation in which no defenders could leave and groups had to fight together (MLM, $t(39) = -12.49$, $b_{\text{dummy could leave}} = -5.45$, $p < 0.001$, 95% CI [−6.31, −4.58], see Table S16). Thus, when some defenders can leave, those who cannot leave invest more and earn less.

Although defenders who could leave but stayed under asymmetric leaving opportunities did not contribute fully to group defense, they seemed to stay predominantly out of social concerns. First, 51.43% of all defenders who stayed under asymmetric leaving opportunities invested more EMU than the cost of leaving (Fig. 3b). Hence, they clearly sacrificed EMU and earned less than when they would have left, regardless of the outcome of the conflict. Furthermore, 12.82% of the defenders who stayed under asymmetric leaving opportunities invested exactly 25% of their endowment (i.e., the cost of leaving), thereby staying but cooperating under the risk of possible defeat. Second, and as a result, defenders who stayed under asymmetric leaving opportunities earned less than those who left, on average (i.e., thereby making a net loss when staying; MLM, $t(1133.69) = -17.18$, $b_{\text{stay}} = -5.99$, $p < 0.001$, 95% CI [−6.67, −5.30], see Table S19). Third, defenders with pro-social preferences (i.e., a higher social value orientation angle, measured with a separate task[19]) were more likely to stay and help their fellow group members (MLLM, $z = -3.16$, $b_{\text{svo angle}} = -0.06$, $p = 0.002$, 95% CI [−0.09, −0.03], see Table S11). Moreover, pro-social defenders contributed more to conflict under asymmetric leaving opportunities (MLM, $t(101.34) = 2.76$, $b_{\text{svo angle}} = 0.06$, $p = 0.007$, 95% CI [0.02, 0.11], see Table S13), whereas there was no statistically significant effect of social preferences on conflict contributions when all defenders could leave (MLM, $t(51.78) = 1.45$, $b_{\text{svo angle}} = 0.06$, $p = 0.153$, 95% CI [−0.02, 0.13], see Table S14). We also found no statistically credible evidence that social preferences impacted conflict contributions in study 2 when all defenders could leave (i.e., under different costs; MLM, $t(86.20) = 1.48$, $b_{\text{svo angle}} = 0.03$, $p = 0.143$, 95% CI [−0.01, 0.08], see Table S5). Together, this shows that defenders (stayed and) contributed to conflict under asymmetric leaving opportunities primarily due to the presence of fellow group members who could not leave, and that these choices are moderated by individual social preferences.

However, the fact that defenders who could not leave invested more EMU to conflict can create opportunities for those who could leave to stay and free-ride on the increased fighting efforts by those who cannot leave. Defenders who could leave but stayed may therefore not always do so because of pro-social concerns for their group, but sometimes because of selfish attempts to exploit their fellows' inability to leave and being forced to fight (see also Fig. 3b). This is indeed what we found, at least for some individuals: 35.74% of defenders who stayed voluntarily contributed less to conflict than the leaving cost, suggesting that they tried to earn more than their outside option of leaving. And, indeed, in 69.85% of the cases in which defenders who stayed voluntarily but invested less than the leaving cost, they managed to earn more than the cost of leaving (i.e., successfully free-rode). Overall, pro-social defenders earned less than defenders with selfish preferences (MLLM, $t(118) = -2.67$, $b_{\text{svo angle}} = -0.06$, $p = 0.009$, 95% CI [−0.11, −0.02], see Table S18; also see Fig. 3c). Compared to selfish defenders, pro-social defenders committed more to collective defense, prioritizing group interests over personal gain.

Discussion

Extant work has investigated when and how people decide to participate in and contribute to conflict[32,33]. Here we considered a complementary perspective. Across three studies we used stylized experiments

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modeling the asymmetric structure of intergroup conflicts to investigate the causal dynamics of leaving conflicts. We found that individual-level cost factors increased the likelihood that defenders abandoned their group. Defenders were more inclined to leave when it was less costly for them to do so, when they were risk averse, and after they experienced defeat, resonating with the idea that they were primarily concerned with maximizing personal gains (also see refs. 34–36; also resonating with findings on the emergence of coalitionary violence[13,14]). Asymmetric leaving opportunities increased voluntary conflict participation at a personal cost and increased waste on conflict, showing that people may stay to help others who cannot leave. Follow-up analyses suggest that staying, however, can be driven by mixed motivations under asymmetric leaving abilities. Some participants (35.74%) stayed due to strategic concerns. These individuals attempted to free-ride, benefiting from the conflict contributions of those who did not have the ability to leave (also see refs. 37, 38). Most participants (64.26%), however, stayed at a personal cost, thereby helping to successfully defend fellow group members that could not leave (also see refs. 3, 23).

Concerns for others are crucial for groups to uphold cooperation and building and maintaining public goods[25–27]. While cooperation is often celebrated for its role in fostering collective well-being, it is important to recognize that mechanisms enabling cooperation—such as concerns for others—can also provide impetus for escalating intergroup conflicts. Because people care about others, they may be more likely to stay, fight, and (inadvertently) contribute to conflict spirals. In a similar vein, it has been argued that social concerns can foster corruption[39,40], likewise highlighting how cooperative behaviors can sometimes lead to increased, possibly unintended, social costs.

People may perceive the choice to defend rather than leave also as a social norm or moral obligation. If strong enough, this could help groups to coordinate on collectively taking part in the conflict. In the long-run, well-coordinated, voluntary conflict participation could actually reduce the likelihood of conflicts, as attackers may shy away from attacking groups with a reputation of strong solidarity. Future work could investigate whether credible signals of commitment can lead to a de-escalation of conflict and to which degree such commitment can be explained by moral preferences and specific moral dimensions, such as heroism and helping one's group[41,42].

Our model of intergroup conflict captures some of the basic principles of coalitionary conflict and intergroup warfare[8–10]. Examples include mass migrations from Syria following the outbreak of the civil war in 2011 and, more recently, following the invasion of Russian forces into Ukrainian territory. Our study suggests that economic factors tend to motivate people to abandon their group. Conversely, social concerns such as solidarity and concerns for fellow group members reduce leaving, thereby increasing the ability of groups to successfully defend themselves. And yet, while our stylized game-theoretic context allows to manipulate exit costs and leaving opportunities to reveal their causal impact on conflict participation and escalation relative to baseline treatments, generalizing findings to migration and desertion during these and other real-world conflicts requires caution. Outside experimental laboratories, in-group members share certain features with each other that may increase their feelings of group identity[43]. In our study, groups were formed randomly between anonymous participants, likely leading to comparatively low levels of ingroup identification. While this may result in an underestimation of defenders' willingness to stay, even in our minimal setting, a significant proportion of participants chose to stay, especially those who were prosocial and who experienced more ingroup solidarity. In real-life situations, where group solidarity and care for fellow members are presumably stronger, defenders may be even more committed to stay and fight, potentially escalating intergroup conflict beyond what our studies indicate.

Our experiments did not provide attackers with the option to leave (or not enter) a conflict, because attackers in the standard intergroup contests already can opt out by simply not investing any EMU (which we observe in 36.78% of the cases in study 2, and in 40.08% of the cases in study 3). Nevertheless, giving attackers the option to actively abstain, which would also mean forgoing any benefits from victory, would allow individual attackers to send a strong (costly) signal of, for example, condemning attacks. The (in)ability to leave on the attacker-side could, thus, allow attackers to tacitly coordinate on developing social norms of fighting or abstaining and could provide valuable insights into attackers' motivation and fighting capabilities, rendering this an interesting avenue for future studies.

Attackers and defenders in our experiments were fully aware of the number of defenders who had left and leaving decisions were made simultaneously. This might not always be the case—in many conflicts misinformation and a lack of transparency are common and of strategic value. For example, attackers and defenders may want to conceal the true number of deserters to maintain an appearance of strength and to deter their opponents[44,45] and people may closely observe what others do and conditionally decide whether to leave or stay. Future work could investigate the effect of ambiguity of how many defenders left on attackers' investment and the role of sequential play (given our data only includes conditional choices across rounds, regarding the latter case).

One limitation to our experimental set-up is that leaving came at a financial cost to participants. While applying a financial cost to leaving allowed us to infer how people integrate costs and benefits in their decision-making, in many conflicts the costs of leaving can be much more substantial and multifaceted, including non-economic costs like leaving loved ones behind, social capital costs like losing one's social network, or reputational costs like losing trust of fellow group members[46,47]. Future research could expand on the Intergroup Attacker-Defender Contest with Exit to investigate how such factors influence leaving dynamics.

Questions for future research and limitations aside, our findings shed light on the persistence of intergroup conflict and why, in particular, people stay-or-leave when facing hostile outgroups. When exiting is possible, solidarity and pro-social concerns make some individuals stay and fight, and considerations of personal payoffs make others leave. At the same time, some individuals seemingly stayed because of selfish reasons—they contributed less to conflict than those who could not leave and thereby increased their own earnings. This is a non-trivial finding, as it means someone's decision to stay cannot be taken as unequivocal evidence for their solidarity and pro-social concerns for fellow group members.

While humans are characterized as a remarkable cooperative species, intergroup conflicts, that likewise require cooperation and coordination, is a pervasive and unfortunate constant in human history. Groups frequently attempt to dominate and take advantage of other groups, that are forced to defend themselves against such hostilities. Defenders, under the threat of attack, encounter a social dilemma: the decision to either prioritize personal gain and survival by leaving their group behind, or to stay and fight, also for the sake of fellow group members. Outside of conflict situations, social concerns are important for sustaining cooperation and create mutual benefits. Somewhat paradoxically, as we showed here, social concerns can, however, also exacerbate the intensity and cost tied to intergroup conflicts, at least in the short run.

Methods

Study 1

Participants and ethics. Study 1 was approved by the Ethics Committee of the Institute of Psychology at Leiden University (2021-09-04-C.K.W. de Dreu-V3-3374) and did not involve deception. The study was programmed in Qualtrics. Participants were recruited via Prolific ($n = 132$, 48% were female; sample size was determined based on previous research, no statistical method was used to predetermine sample size). We excluded 10 participants who displayed signs of unserious participation or incorrect task understanding (see Design section for details). Our final sample thus consisted of 122 participants. These participants were between 18 and 61 years of age (M = 24.66, SD = 6.50), provided informed consent, and received full debriefing after participating. They received a standard fee of £3.00 and their decisions were fully incentivized (see Incentives section for details). Participation took ~30 min.

Design. Participants entered their Prolific ID, read the information letter, and signed the online informed consent. Participants then read instructions for the Intergroup Attacker-Defender Contest with Exit (Fig. 1). The experimental instructions used neutral language throughout (e.g., terms like in-group defense and out-group attack were avoided). Participants were instructed that after the experiment they would be randomly assigned to three-person attacker and defender groups, and their decisions (i.e., with regards to leaving if they were a defender, and conflict contributions for both roles) were implemented and incentivized (see Incentives section for details). After the rules of the task were explained, participants answered 10 practice questions to probe their understanding of the task. Only after all practice questions were answered correctly, participants could continue with the task.

When passing the instructions, participants were first assigned to the role of defender and asked to predict the total number of EMU that attackers would contribute to attack. Thereafter, participants' willingness to pay (WTP) for leaving was assessed using an open-ended question, to determine the upper-bound cost at which they were willing to leave. Following this, participants indicated for each possible cost of leaving (0, 1, 2, … 20) whether they would leave their (defender) group, and how much they would contribute to defense ($0 \le g \le 20$) when they would stay and 0, 1, or 2 other defenders would leave. Once these measures were taken, participants were assigned to the attacker role and were reminded of what this role entailed. They indicated their contribution g ($0 \le g \le 20$) to attack for each possible number of defenders who stayed (0, 1, 2, or 3). Finally, participants filled in their demographics (age, gender, education, and country) and were debriefed.

To determine serious participation, we included three attention checks. First, after the practice questions, participants were asked to select the option correct in response to the multiple-choice question: please select correct with the options correct and incorrect. Second, after participants indicated their contribution to the defender conflict pool, there was an attention check during which participants were asked to enter the (obviously incorrect because impossible) number 150 in response to the question how many EMU they wanted to contribute to a conflict pool. Finally, before the demographics questionnaire started, participants were asked to type the word green in a response box. The first and third attention checks were answered correctly by all participants. Only the second attention check was missed by one participant. No participants were excluded from the final analyses based on the attention checks. We did exclude two participants who, when indicating for each possible cost of leaving whether they would stay-or-leave, had more than two switching points (e.g., they left when the cost of leaving was 5 EMU, they stayed when the cost of leaving was 6 EMU, they left when the cost of leaving was 7 EMU, etc.), three participants who filled in their stay-or-leave decisions the other way around (i.e., they left when the cost of leaving was 20 EMU and stayed when the cost of leaving was 0 EMU), and five participants who did both.

Incentives. Participants' decisions were incentivized, with the potential to earn up to £5.00 based on their decisions. If participants correctly predicted the total number of EMU that attackers would contribute to their conflict pool, they received a bonus of £1.00. To incentivize the Intergroup Attacker-Defender Contest with Exit, half of the participants were randomly assigned to the defender role, while the other half was assigned to the attacker role. Thereafter, participants were randomly divided into groups of six, consisting of three defenders and three attackers. Once the groups were formed, the cost of leaving was randomly determined for each group via a random number generator. For this cost of leaving, we implemented participants' decisions. Participants could earn up to £4.00 (i.e., each EMU they received was worth £0.10). On average, participants received £1.04 (SD = 0.81, range: £0.0–2.5) for their choices in study 1.

Statistical analyses. First, we compared the findings of study 1 to the Nash Equilibrium in mixed strategies in the IADC-NE[6]. Taking the groups as units, each being endowed with $20 \times 3 = 60$ EMU, and assuming individuals are risk-neutral rational selfish payoff maximizers, the strategies played in the Nash Equilibrium imply an average contribution of 7.25 EMU to in-group defense, defender success in 62.5% of rounds, and an expected earnings of 11.4 EMU[28]. These numbers are based on identifying the symmetric mixed-strategy equilibrium of a six-player game (three attackers against three defenders) with individual endowments between 2 and 15 extrapolated to endowment levels of 20.

Second, we compared stay-or-leave decisions to prior data. Past IADC-NE studies revealed varying earnings for defenders: 7.63 (72 participants in study 1)[6], 5.72 (66 participants in study 2)[6], 4.26 (105 participants)[29], and 7.59 EMU (80 participants)[30]. We calculated a weighted average with regards to defenders' earnings based on the sample size of each study with Eq. (1).

$$\bar{E} = \frac{7.63 \times 72 + 5.72 \times 66 + 4.26 \times 105 + 7.59 \times 80}{72 + 66 + 105 + 80} = 6.13 \quad (1)$$

Thus, based on previous data, defenders are expected to earn 6.13 EMU when deciding to stay in conflict.

Finally, we fit a maximum likelihood model to defenders' stay-or-leave decisions to investigate how much they discount the stay option. Akin to risk-aversion models[48], we modeled discounting of staying with a power-function (20^α). Hence, our model assumes that, for each stay-or-leave decision, participants compare the value of leaving (20 minus costs) with the expected value of staying (20^α), where α is the individual's discount rate of staying. Since decisions are binary, the (expected) values are transformed by a soft-max function to receive (predicted) values for choosing to stay-or-leave, given cost (c) via Eq. (2).

$$p(\text{stay}|c) = \frac{e^{\phi \times 20^\alpha}}{e^{\phi \times 20^\alpha} + e^{\phi \times (20-c)}} \quad (2)$$

The two free parameters α and ϕ were estimated for each individual separately, using maximum likelihood. Average α was estimated at 0.82 (SD = 0.18).

Interactive behavioral studies 2 and 3

Participants and ethics. Both studies were approved by the Ethics Committee of the Institute of Psychology at Leiden University (study 2: 2021-12-23-C.K.W. de Dreu-V1-3642, study 3: 2022-06-07-C.K.W. de Dreu-V1-4063). Both studies were programmed in oTree (version 3.4.0)[49] written in Python (version 3.7.9.). Participants were recruited at Leiden University (The Netherlands; $n = 240$ per study; study 2: 71% were female, study 3: 77% were female; sample size was determined based on previous research, no statistical method was used to predetermine sample size). No participants were excluded, and both studies did not involve any deception. Participants were between 17 and 49 years of age (study 2: M = 22.20, SD = 3.66, study 3: M = 21.25, SD = 3.67), provided informed consent, and received full debriefing after participating. They received a standard fee of €5.00 or 2 course credits for participation, and their decisions were fully incentivized (see Incentives section for details). Participation took ~60 min.

Study designs. In each experimental session of study 2, six individuals were invited and randomly assigned to one of the individual cubicles within the laboratory. Participants read the information letter and signed the informed consent once seated. After giving informed consent, participants were instructed that their decisions, and those of other participants, would influence both their own payment and that of others.

Participants first completed the social value orientation slider measure[19] to measure their social preferences. In this measure, participants decide how to allocate EMU between themselves and an unknown other person. EMU could be allocated self-servingly or prosocially (sacrificing EMU to benefit the other person). Based on the decision pattern, participants can be classified as prosocial or selfish. This was followed by the iterative multiple price list task[31] to measure participants' risk preferences. In this task, participants were presented with five choices between a guaranteed payment and a lottery. The lottery offered a 50% chance of receiving 300 EMU and a 50% chance of receiving 0 EMU. While the lottery remained consistent across all decisions, the guaranteed payment varied based on participants' choices. That is, selecting the lottery resulted in an increased guaranteed payment for the subsequent choice, whereas opting for the guaranteed payment led it to subsequently decrease.

Participants then read instructions for the Intergroup Attacker-Defender Contest with Exit (Fig. 1) from the perspective of their (randomly) assigned group role (either attacker or defender). After the rules of the task were explained, participants answered 14 practice questions to probe their understanding of the task. Only after all practice questions were answered correctly, participants could continue with the task.

The task consisted of four blocks and each block consisted of ten rounds. At the start of each new round, participants received 20 EMU. Thereafter, all defenders could decide if they wanted to leave. If defenders left, they evaded the attack by the other group. However, defenders had to pay a cost to leave that was deducted from their 20 EMU (their endowment). There were three blocks in which the cost of leaving was manipulated. These costs of leaving were 5, 7 (in line with the mixed-strategy Nash equilibrium for individual defender contributions[6]), or 10 EMU (in line with the Nash equilibrium for defender contributions when treating groups as single agents[6]). There was also one block in which leaving was not possible (i.e., our baseline condition), to be able to compare results to the original attacker-defender game[6]. The order of blocks was counterbalanced across groups.

Once all defenders had made their decision, everyone was informed how many defenders left. If everyone in the defender group decided to leave, there was no possibility to contribute to one's group's conflict pool C. Consequently, everyone in the defender group earned 20 EMU (their endowment) minus the cost of leaving (L), while attackers retained their 20-EMU endowment.

If at least one defender stayed, the defenders who stayed (d) and all attackers simultaneously determined their individual contributions (g) to their group's conflict pool C, with $0 \leq g_i \leq 20$. Individual contributions to the conflict pool were wasted meaning that these could never be earned back, but when $C_{attacker} > C_{defender}$, the attackers won the remaining EMU of the defenders who stayed ($d \times 20 - C_{defender}$). These spoils of conflict were divided equally among the attackers and added to the attackers' remaining endowments ($20 - g_i$). Defenders who stayed thus earned nothing when attackers won. However, when $C_{attacker} \leq C_{defender}$, defenders who stayed defended themselves successfully. In this case, both attackers and defenders earned their remaining endowments ($20 - g_i$). Thus, individual contributions in attacker (defender) groups reflected out-group aggression (in-group defense).

At the end of each round, all participants were informed about the total contribution their group made to their conflict pool, the total contribution made by the other group to their conflict pool, and everyone's resulting earnings. With regards to this, participants were identifiable such that participants of both groups knew which specific individuals in the defender group left and knew how much everyone (from both groups) earned.

Before the start of each block, participants in study 2 were asked to predict the decisions of others. In the blocks in which defenders could leave, participants were asked to predict how many defenders would, on average, leave per round. When leaving was not possible, participants predicted how many EMU both groups would, on average, contribute to their conflict pool per round. At the end of each block, participants were asked how close, bonded, committed, and how much solidarity they felt towards members of their own group on a scale from 1 to 7. Because ratings exhibited good internal consistency, we aggregated ratings into one single score representing ingroup solidarity (Cronbach's $\alpha = 0.897$ for study 2, and 0.911 for study 3).

Following the Intergroup Attacker-Defender Contest with Exit, participants filled in their demographics (age, gender, education, study field, country). Finally, participants were informed about their earnings and debriefed.

Study 3 was similar to study 2, with a few exceptions. First, in study 3, the cost of leaving was fixed to 5 EMU. Second, between blocks, we manipulated how many defenders could leave (order counterbalanced across groups); either no defenders could leave, one defender could leave, two defenders could leave, or all defenders could leave. Leaving abilities were fixed within blocks (i.e., the same person could (not) leave). To minimize reciprocity concerns between blocks, leaving abilities were also kept constant across blocks: the defender who could leave when only one defender could leave also could leave when two defenders could leave, and vice versa for defenders who could not leave. Finally, we did not ask participants to predict the decisions of others in study 3.

Incentives. Participants' decisions were incentivized, such that they could earn up to €21.50 based on their decisions in study 2, and up to €19.00 euros in study 3. In both studies, participants could (1) earn EMU in the social value orientation slider measure[19], (2) earn EMU in the iterative multiple price list task[31] (our risk preference measure), and (3) earn EMU in the Intergroup Attacker-Defender Contest with Exit. In study 2, participants could also earn EMU (4) by correctly guessing the decisions of other participants. Earnings were paid out via bank transfer immediately after the study.

First, to incentivize participants' decisions using the social value orientation slider measure[19], participants were randomly paired twice with another participant in their group (participants could maximally earn €1.50). The choices of both pairs were incentivized, with each participant once being selected as the allocator and once as the receiver. On average, participants received €1.28 (SD = 0.08, range: €1.07–1.43) for their choices in study 2, and €1.28 (SD = 0.07, range: €1.01–1.47) for their choices in study 3.

Second, to incentivize participants' decisions in the iterative multiple price list task[31], one of their choices was picked to determine their payoff (participants could maximally earn €1.50). If participants chose the lottery, a random draw determined whether the high outcome would constitute their payoff. Otherwise, the sure payment would constitute their payoff. On average, participants received €0.75 (SD = 0.56, range: €0.00–1.46) for their choices in study 2, and €0.71 (SD = 0.53, range: €0.00–1.46) for their choices in study 3.

Third, in the Intergroup Attacker-Defender Contest with Exit, participants were paid out based on the average of 8 randomly selected rounds (i.e., 2 decisions per block; participants could maximally earn €16.00). In both studies, each EMU that participants received was worth €0.05. On average, they earned €5.78 (SD = 1.97, range:

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€2.00–10.00) for their choices in study 2, and €5.76 (SD = 2.08, range: €1.00–11.00) for their choices in study 3.

Finally, in study 2, we compared participants' expectations with the actual, average, contributions (when leaving was not possible) and leaving frequency (when leaving was possible). For each correct expectation, participants received €0.50 and could maximally earn €2.50. Participants received, on average, €0.71 (SD = 0.50, range: €0.00–2.00).

Pre-registrations. We pre-registered the experimental design, analysis plan, sample size, and exclusion criteria of study 2 via AsPredicted (on February 2nd, 2022; #87718, https://aspredicted.org/7wk4m.pdf). There were no deviations from our pre-registration. With regards to the frequency of leaving, we pre-registered that (i) defenders would leave more frequently when the costs of leaving were low rather than high, and that (ii) defenders would leave more frequently when others in their group left as well. With regards to defender contributions, we pre-registered that (iii) defenders would contribute more to conflict when there was no possibility to leave (compared to when leaving was possible), and that (iv) defenders would contribute more to conflict when the leaving costs were high rather than low. Finally, with regards to attacker contributions, we pre-registered that (v) when more defenders left, attackers would contribute less to conflict, but with a higher success rate for winning the conflict round, and vice versa.

For study 3 we also pre-registered the experimental design, analysis plan, sample size, and exclusion criteria via AsPredicted (on September 26th, 2022, #107875, https://aspredicted.org/sh8x7.pdf). There were no deviations from our pre-registration. With regards to the frequency of leaving, we pre-registered that (i) under asymmetric leaving abilities (i.e., when only some defenders, but not all, could leave), defenders, who could leave, would leave relatively less frequently compared to when all defenders could leave. With regards to defender contributions, we pre-registered that (ii) under asymmetric leaving abilities, defenders, who could not leave, would contribute more to conflict compared to a situation in which all defenders could not leave. In contrast, defenders, who could leave, were expected to contribute less to conflict compared to a situation in which all defenders could not leave. Furthermore, (iii) when all defenders could leave, we expected contributions to conflict to be lower than when some or all defenders could not leave. Finally, with regards to defender ingroup solidarity, we pre-registered that (iv) a higher leaving rate would result in a lower self-reported ingroup solidarity.

Statistical analyses. Statistical models were fitted using the lme4 package in R[50] (version 4.0.3.). Multilevel (logistic) models included random intercepts for participants nested within their group to account for violations of independence, since participants made repeated decisions and were part of a group in which they potentially influenced each other's decisions over time. All reported statistical tests were two-tailed. We did not correct for multiple testing, as we did not test multiple contrast within models. For all models reported we checked assumptions. Assumptions were met for most models. If assumptions were not met, we still used multilevel models, as these were most appropriate for our data structure and have been found to be robust to violations of distributional assumptions[51]. Complete results for all regression models can be found in the Supplementary Information.

For study 2, we fit multilevel (logistic) regression models to examine how giving defenders the option to leave under different costs impacted defender leaving (see Table S1), expectations about defenders' willingness to leave (see Table S2), group-level contributions to conflict (see Tables S3 and S4), defenders' individual-level contributions to conflict (see Table S5), defender success (see Table S6), defender earnings (see Tables S7 and S8), and ingroup solidarity (see Table S9).

For study 3, we also fit multilevel (logistic) regression models to examine how asymmetric leaving opportunities impacted defender leaving (see Tables S10 and S11), defenders' individual-level contributions to conflict (Tables S12–S14), defender success (see Table S15), defender earnings (see Tables S16–S19) and ingroup solidarity (see Table S20).

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

The data of our experiment are publicly available in an OSF repository (https://doi.org/10.17605/OSF.IO/5SWXK)[52]. There are no restrictions to accessing the data.

Code availability

The experiment and analysis code are publicly available in the same OSF repository (https://doi.org/10.17605/OSF.IO/5SWXK)[52].

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Author contributions

L.L.S., J.G., M.S., and C.K.W.D.D. conceived of the project and designed the studies. L.L.S. programmed the experiment and coordinated data collection. L.L.S. and J.G. analyzed data with input from M.S. and C.K.W.D.D. L.L.S. drafted the manuscript and incorporated co-author revisions.

Competing interests

The authors declare no competing interests.

Additional information

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