

Original Article

When to diversify, and with whom? Choosing partners among out-group strangers in lowland Bolivia

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ABSTRACT

Evidence from the ethnographic and archaeological records reveals that humans often rely on out-group relationships for access to non-local resources and resource buffering. However, little is known about how actors choose out-group cooperative partners. The existing literature suggests that (in-group) partner choice is based on characteristics associated with greater cooperation (e.g., trustworthiness and productivity). Is out-group partner choice based on the same criteria as in-group? Because out-groups may be unique sources of resource access, we suggest that out-group partner choice should track characteristics of both the candidate partner *and* the partner's group that are associated with benefits for the actor. To assess partner choice, we employed a non-anonymous, one-shot economic game where participants could allocate money towards in-group and out-group strangers. Participants were from three populations of Bolivian horticulturalists ($n = 200$) that range in their market integration and their mobility, thus capturing variation in potential benefits to out-group cooperation. We find that individual-level qualities of prospective partners, such as wealth and trustworthiness, affect allocation behavior differently for in-group vs out-group prospective partners. While we find no consistent effects of perceived group qualities on a donor's giving to in-group and out-group members, the relevance of out-group market resource access for Tsimane' donors' allocations suggests that, at least when it comes to dividing a limited resource, qualities associated with a group can affect partner preference. Taken together, results provide insight into patterns of intergroup relationship building that have been crucial in the human lineage.

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Humans have relied on cooperative resource production since at least the origin of *Homo* (Hooper, Gurven, & Kaplan, 2014). Accordingly, our evolved psychology is attuned to characteristics in others that are associated with higher returns to cooperation (Barclay, 2013; Cosmides & Tooby, 1992; Kurzban & Leary, 2001), and actors prefer to interact with cooperative partners who have these characteristics (Barclay, 2013; Baumard, André, & Sperber, 2013; Noe & Hammerstein, 1994). Through selectively forming and maintaining cooperative relationships, actors are better able to smooth access to resources, such as hunted meat, that are characterized by variable acquisition rates (Jaeggi & Gurven, 2013). Indeed, relative to cooperative dyads, groups of interconnected cooperative partners may be highly effective for smoothing resource access for an actor (Hruschka & Henrich, 2006; Levine & Kurzban, 2006; Tooby, Cosmides, & Price, 2006). These cooperative groups often engage in more than one type of cooperative endeavor (e.g., economic and political; Lyle & Smith, 2014; Moya &

Boyd, 2015; Tooby et al., 2006), which may contribute to their persistence across time (Gómez-Gardeñes, Reinales, Arenas, & Floría, 2012).

While some - including Darwin (1871) - suggest that human evolution has been characterized by intergroup competition and within-group cooperation, the ethnographic and archaeological records provide abundant evidence of intergroup cooperation (Barth, 1969; Ensminger, 1992; Gamble, 1999; Jochim, 2006; Ross & Atkinson, 2016; Whallon, 2006; Wiessner, 2001). Intergroup relationships may provide access to non-local resources, buffer shortfalls affecting local cooperative partners (Brewer & Caporeal, 2006; Pisor & Gurven, 2016), enable actors to specialize in resource production and rely on economies of scale (De Weerd & Dercon, 2006; Robinson & Barker, 2017), and provide access to alternative cooperative partners if an actor's existing group provides insufficient support (Boyer, Firat, & van Leeuwen, 2015). We previously demonstrated that actors are more interested in initiating out-group relationships when they have less access to market resources and more past exposure to out-group members (Pisor & Gurven, 2016). However, in that paper, we only gauged an actor's interest in in-group and out-group relationships *in general*. Here, we extend those findings and ask: Given that an actor shows interest in forming relationships with out-group strangers in general, how does he or she

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select *among* out-group strangers - what are the qualities of individual out-group members to which he or she attends when considering a new cooperative partner? Do actors select partners from out-groups based on the same criteria that guide in-group partner choice?

Though these questions have largely not been addressed by the existing literature, we suggest that both individual-level and group-level qualities may shape out-group partner choice. As with in-group partner choice, out-group partner choice should track individual-level characteristics associated with higher gains to cooperation, including expected competence in food production (Eisenbruch et al. 2016) or specialized labor (Brewer, 1996), anticipated generosity (Barclay, 2013; Baumard et al., 2013; Gurven, Allen-Arave, Hill, & Hurtado, 2000), and resource access (e.g., Gurven, Jaeggi, von Rueden, Hooper, & Kaplan, 2015). Additionally, by virtue of their group membership, candidate cooperative partners may offer further benefits to an actor. For example, if certain resources are not available locally, out-group partners may provide access via trade, gift giving, or delayed exchange (Whallon, 2006). Furthermore, past exposure to members of an out-group, particularly in the context of cooperative interactions with beneficial outcomes, may increase an actor's valuation of a stranger from that same group (Gaertner & Dovidio, 2001; Hewstone & Brown, 1986; Paolini, Hewstone, Cairns, & Voci, 2004; Pettigrew & Tropp, 2006).

We hypothesize that selection has favored features of human psychology that evaluate prospective out-group partners by the same criteria as in-group partners, plus characteristics of out-groups that are reliably associated with their access to resources. Specifically, we predict that if an actor perceives a prospective partner as having qualities associated with cooperativeness and perceives the prospective partner's group as having access to resources not locally available, she will be more generous towards this prospective partner in initial interactions; generosity in first interactions may often initiate longer-term cooperative relationships (Delton, Krasnow, Cosmides, & Tooby, 2011; Henrich et al., 2005; Raihani & Bshary, 2015; Yamagishi, Terai, Kiyonari, Mifune, & Kanazawa, 2007). This approach is complimentary to the idea of "plastic parochialism": while some geographic distributions of resources may result in intergroup conflict - such when crucial resources are concentrated locally and shortfalls are rare, or when long-lasting droughts affect a large region - others will not (Cashdan, 2001; Hruschka & Henrich, 2013; Smith, 1988), leaving the possibility of gains to trade via intergroup connections. Here we investigate whether perceived individual qualities of prospective partners, such as (P1.1) resource holdings and (P1.2) cooperative intent, as well as perceived group qualities, such as (P2.1) out-group resource access, predict generosity towards those prospective out-group partners. We also test whether (P3.1) donors' own past exposure to out-group individuals, which can shift baseline expectations of individual and group qualities, increases generosity towards out-group strangers. P3.1 is an extension of our previous findings that past exposures to out-group individuals modulate interest in out-groups in general (Pisor & Gurven, 2016).

Our sample includes three horticultural populations living in rural Bolivia. Bolivia is a highly multiethnic country - one of National Geographic's Ethnolinguistic Diversity hotspots (Anderson, 2014) - composed of groups with varying levels of integration to regional and national markets and society. In these three populations, there is extensive between-individual variation in opportunities for non-local market resource access and exposure to out-group members. As such, we consider the three populations jointly to take advantage of this variance. We use the allocation of money to out-group strangers in a non-anonymous experiment as a proxy for partner choice. Each participant was tasked with allocating money among three in-group strangers, three out-group strangers, and themselves. Participants knew that if they gave money, recipients would learn their full name and amount given - unless they wished to remain anonymous, a decision we discuss below. We interpret the amount of money given to each candidate recipient as an indication of a donor's interest in initiating a relationship with that particular recipient.

1. Methods

1.1. Study populations

The Mositén, the Tsimane', and the multicultural population with the pseudonym "Intercultural" are horticulturalists living in the Bolivian lowlands. The Mositén and Tsimane' are two of the 36 *pueblos indígenas* recognized by the Plurinational State of Bolivia. The two have a history of intermarriage (Corella, Bert, Pérez-Pérez, Gené, & Turbón, 2007) and speak different dialects of the linguistic isolate Mositenan (Sakel, 2007). However, Catholic clergy established schools and centralized communities for the Mositén in the 19th century (R. Godoy, 2015; Huanca, 2006; Mamani, Soria, & Huasna Bozo, 2010). Today the Mositén are more market integrated than the Tsimane', with ready access to roads, running water, electricity, and higher levels of mobility. The Mositén are fluent in Spanish, the most common Bolivian language, and often marry exogamously with non-Mositén: 57% in the Mositén sample have at least one non-Mositén parent. The Tsimane' remain primarily endogamous, occasionally intermarrying with lowland groups who have settled in Tsimane' territory. Only 14% of Tsimane' participants in this study speak fluent Spanish.

Intercultural is a population living near the boundary of Mositén territory. Most Interculturales are immigrants or the children of immigrants: they were either moved from the Altiplano (in the Andes) by government relocation programs in the 1960s or they immigrated because of the favorable growing climate and the now-dwindling logging industry. Intercultural participants were predominantly Aymara (59%) and Quechua (18%), the two most populous indigenous groups in Bolivia. Most Interculturales speak fluent Spanish and they are the most market integrated of the three populations. For additional ethnographic details, see Supplementary Methods 1.

"Groups" relevant in the Bolivian context are individuals who self-identify as the same ethnicity, religion, political party, work cooperative, or labor union. For this study, we focus on religious and ethnic groups, non-political groups large enough to contain strangers. Individuals in the Mositén population regularly interact with members of six ethnic groups. The majority of Mositenes are Catholic, but there was also a local Evangelical Friends congregation at the time of study. Interculturales have four churches and regularly interact with eight ethnic groups; we focused on five of the eight. In their language and in conversation, the Tsimane' distinguish between three native lowland ethnic groups (the Mositén, Yuracaré, and Trinitarios) but cognize Andean immigrants to the lowlands as one group (*collas*) and non-indigenous lowlanders as another (*napo* in Tsimane', *cambas* in Spanish). Three churches had an intermittent presence among the Tsimane' at the time of data collection.

1.2. Experimental and survey protocol

The present sample includes 200 individuals (52% male) from these three populations interviewed between August 2014 and March 2015. Protocols were developed based on pilot and ethnographic interviews conducted in each of the three populations (Pisor & Gurven, 2016). See Supplementary Methods 2 for details about sampling strategy, counterbalancing and randomization, and comprehension checks for the experimental game. As literacy is variable among these populations, participants gave their informed verbal consent to participate. The study protocol was approved by the University of California, Santa Barbara Institutional Review Board, the Tsimane' and Mositén governing councils (Gran Consejo Tsimane', the Organización del Pueblo Indígena Mositén), and by the local communities.

1.2.1. Allocations towards out-group strangers

Participants sorted cards representing local groups on a five-point scale from 1 = "groups I belong to most or feel most a part of" to 5 = "groups I belong to least or feel least a part of" (Fig. S1). Participants'

understanding of the scale task was supported by their narrations of their decisions: participants often spontaneously said “*muuy poco*” (“very little”) when placing cards in position 4 and “*cero*” (“zero”) when placing cards in position 5; in other words, participants interpreted position 5 as representing groups to which they did not belong at all. Accordingly, cards placed in positions 4 and 5 – groups to which participants felt they belonged very little or not at all – were classified as out-group, while cards placed in positions 1 and 2 were classified as in-group. From this sort, two groups were selected: either one religious in-group and one religious out-group, or one ethnic in-group and one ethnic out-group. If a participant did not place cards in positions 1 or 2, we selected one out-group and one “intermediate” group from position 3 with whom the participant would play; if a participant did not place cards in positions 4 or 5, we selected one in-group and one from position 3. Although we include intermediate groups in analyses for the purposes of accurate model estimation, because there are not clear predictions for how these groups are cognized, we will not discuss results for intermediate groups in the text.

A non-anonymous game inspired by the Dictator Game (Camerer & Thaler, 1995) and allocation and taking games (Gervais, 2016; Rucas, Gurven, Kaplan, & Winking, 2010) enabled participants to allocate money to strangers at a cost to the participant herself, or other candidate recipients. Because the participant could keep all the money for herself and give the candidate recipients nothing, we term any allocation of money to a recipient “generosity”; for a discussion of the limitations of the use of this term in the context of economic experiments, see Bardsley (2007). Three photos of strangers were selected from the participant’s in-group and three from her out-group. All were previous participants from other study communities (including those who participated in pilot interviews) of the same sex as the participant and, when possible, within ten years of her age. AP told the participant the name, group affiliation, and age (an intended distractor) of each candidate recipient. The participant was asked whether she knew any individuals in the photos; if an individual was known, this photo was removed and exchanged for another to insure that the candidate recipient was a stranger. She was then told she had the opportunity to send money to these candidate recipients: she could allocate 21 one *boliviano* coins (\$0.14/1 *boliviano*; total stakes approximately 1/3 of a day’s wage) among these six strangers and herself. Three coins were placed on each of the six photos and three coins were placed in front of the participant (see Fig. 1 for an illustration).

AP informed participants that if they left any coins on a photo, the person in the photo would learn the participant’s name and how

much she sent; any money not on a photo would be kept by the participant. In other words, participants could engage in favoritism towards one or both groups, or towards one or multiple recipients, if they were motivated to do so. This game structure – with an initial equal allocation among all potential recipients, and the option to both give and take coins – creates a unique framing that distinguishes our game from the Dictator Game (e.g., List, 2007) (see Discussion). To avoid the possibility of retribution, recipients did not learn the names of donors who did not allocate any money to them, and donors were informed of this before making allocations. Additionally, to avoid confusion and maintain participants’ trust, donors who kept money for themselves received their payouts at the end of the interview, while recipients were given their payouts, along with the names of the donors and the amounts given, at the end of the field season (mean wait time = 94.7 days, SD = 57.3). Donors who wished to remain anonymous were allowed to do so (34% of the sample); we control for this decision in all analyses, as participants who remained anonymous gave less to in-group members on average than those who shared their name (see Table S8a). For more details on participants who remained anonymous, see Section 2.2.1.

1.2.2. Recipient group characteristics

1.2.2.1. *Access to resources via the out-group.* Before game play, donors were asked about the benefits and costs of being a member of the focal in-group and out-group. Donors interpreted these questions broadly, often describing advantages and disadvantages of group membership, or characteristics of group members. For example, donors frequently mentioned access to market goods and skill at obtaining economic resources as benefits, or lack thereof as costs. Openness to out-group members and willingness to collaborate across groups, or unwillingness to share resources and collaborate, were also often cited. AP coded the first benefit and cost mentioned; the categorizations given by AP and a research assistant blind to the hypotheses exhibited moderate levels of agreement (Cohen’s kappa: 0.75 for benefits and 0.73 for costs (Cohen, 1968); Stuart-Maxwell test: $\chi^2 = 89.8$, $\chi^2 = 69.3$ (Maxwell, 1970)). For the purpose of analysis, we binned benefits by those (1) potentially affecting individuals outside the focal group, (2) affecting individuals who are members of the focal group, (3) related to the perceived good character of group members, and (4) stemming from religious practice. Note that the participant provided responses for both her out-group and in-group; as such, when she reported benefits that affected in-group or out-group individuals (i.e., (1) or (2)), she was among the people affected by benefits for in-group members if she

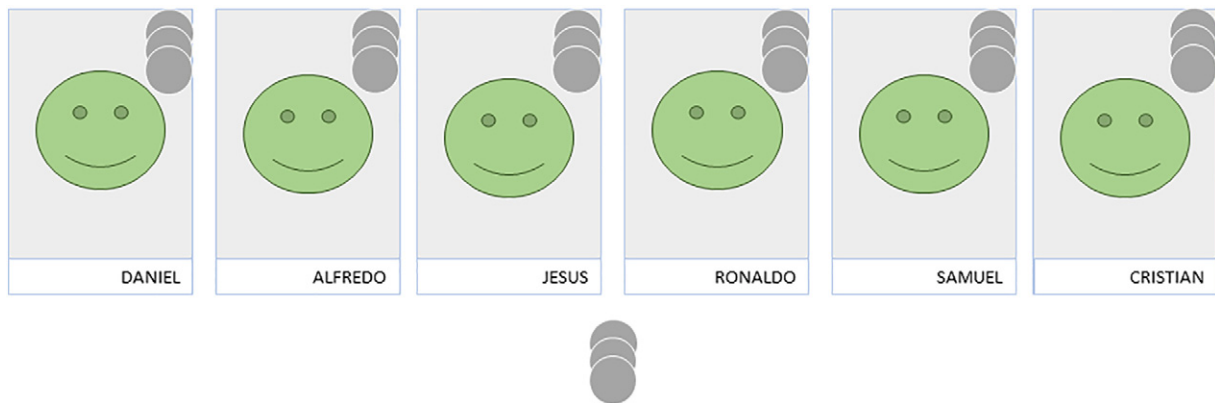


Fig. 1. An example of the non-anonymous giving game. Six photos were arrayed on a table, all past participants in the experiment. The three men on the left were participants who identified with one ethnic group, for example, and the three on the right with another. Participants were told the name, age, and group affiliation of each individual. Stacks of three one *boliviano* coins were placed on each photo and in front of the participant. The participant could move any number of coins between photos, from photos to his own stack, or from his stack to the photos. Participants were informed that any coins left on a photo would be given to that person in the participant’s name (unless the participant wished to remain anonymous) and any coins left in front of the participant would be his.

was discussing an in-group, or among the people affected by benefits for out-group members if she was discussing an out-group. Costs were binned by those (1) potentially affecting individuals outside the focal group, (2) affecting individuals who are members of the focal group, (3) related to the perceived bad character of group members, (4) stemming from religious practice, and (5) related to being the target of discrimination. (See Supplementary Methods 4 for examples of responses given and how questions were coded.)

1.2.2.2. Past exposure. We asked donors to detail all the places they had lived previously, as well as all the cities and towns they had visited for more than a week; the number of places lived and places visited were each counted and used as proxies for exposure to out-groups in general, although neither identifies exposure to particular out-groups (Table S7), nor differentiates between positive and negative past interactions with out-group members (see *Discussion*). TV watching can also be a source of passive exposure to out-group members (e.g., Buchan et al., 2009). Accordingly, we include self-reported number of hours of TV or movies watched per week as a predictor in all models. Because TV watching and number of cities and towns visited had a large range across the three study populations, we z-scored both measures to scale the distribution.

1.2.3. Recipient individual characteristics

After the experimental game was complete, AP asked each donor her perceptions of the six candidate recipients. Though they provide insight into decision-making, these self-reports have limitations. Reports were made post-allocation and thus may be prone to self-presentation bias. Further, when making judgments about photos, participants may attend to certain features of the individual photographed more than others (e.g., physical formidability, trustworthiness (Oosterhof & Todorov, 2008), and attractiveness (Sutherland et al. 2013)). Regardless of the specific perceptions that inform it, affect towards the candidate recipients likely is associated with decision-making (Arora, Peterson, Krantz, Hardisty, & Reddy, 2012), including the allocations analyzed here. See further discussion of self-reported perceptions in the *Discussion*.

1.2.3.1. Resource access. Donors indicated whether they thought each candidate recipient had “a lot of money, some money, a little money, or no money.” “Money” and “a lot of money” were binned together, as few recipients were described as having “a lot”.

1.2.3.2. Cooperative intent. Donors indicated whether each candidate recipient was a “good person” (which connotes kindness and openness to others in Bolivian Spanish), “a little good,” or a “bad person;” whether the donor could trust the candidate recipient (“yes,” “a little,” or “no”); and whether the donor would want to be friends with the candidate recipient (“yes” or “no”). Each of these responses proxies qualities that could increase partner value, such as generosity and trustworthiness (Cottrell, Neuberg, & Li, 2007).

As described above, donors rated candidate recipients after making allocation decisions, which may introduce self-presentation bias. To address this limitation, we re-coded being a “good person” as an ordinal variable (i.e., 0, 1, 2) and calculated an average perceived goodness score for each recipient based on ratings of that recipient by participants other than the donor herself. We then used these “leave one out” consensus measures to predict a donor's own allocations. To avoid possible effects of in-group bias on ratings, ratings of recipients are averaged only over raters for whom the recipient was not a member of their in-group. The same procedure was used to calculate consensus scores for the wealth, willingness to trust, and interest in friendship responses. These measures are employed in a robustness check reported in Table S6; because of collinearity between the goodness and willingness to trust consensus measures, we report model fits with each of these variables separately.

1.2.4. Additional variables

Additional factors may modulate valuation for out-group members, including donor's existing resources and resource access, existing social network (Pisor & Gurven, 2016), and personality (Ashton & Lee, 2007; Nettle, 2006); as these variables are not of direct relevance to the present hypotheses, we include them only in robustness checks (see Tables S4 and S5). Because age distributions were not identical for each group sampled, the age difference between recipient and donor was not always within 10 years (mean age difference = -1.64 , SD = 10.72). That said, age difference and age were unsurprisingly negatively correlated ($r = -0.66$). As such, we control for age difference and age separately, in Tables S5a and b respectively. For detailed descriptions of these additional variables, see Supplementary Methods 5.

1.3. Statistical methods

Which group and individual characteristics affected out-group partner choice? Are these characteristics different from those affecting in-group partner choice? To answer these questions, we use a multinomial modeling approach to consider the donor's decision for each candidate recipient. Recipients are grouped by whether they were a member of the donor's in-group or out-group. Amounts allocated to members of intermediate groups are included in the model to ensure accurate estimation of the probability of giving; however, because it is unclear how these groups are cognized, we do not discuss these estimates here.

We used the Stan program to fit mixed-effect multinomial models with softmax link functions via Markov Chain Monte Carlo (MCMC) estimation (Carpenter et al., 2017). Here, multinomial models are used to estimate the effects of predictors on allocation decisions for both in-group and out-group recipients simultaneously, such that the relationships between each predictor and amount given can vary for the in-group and the out-group. Multinomial models treat the in-group and out-group outcomes as non-independent: for example, if a donor allocates more money to an in-group target, less money is then available for the three out-group targets and the other two in-group targets. The softmax link function scales estimates for each candidate recipient relative to the five others such that they sum to 1, ensuring model identifiability. Random intercepts were estimated for each recipient, as recipients may have had unmeasured characteristics that both affected the amount they received and the amount other recipients received when they appeared alongside a given recipient. We used an MCMC approach because it provides more flexibility to model both multinomial outcomes and random effects than do maximum likelihood approaches.

Results are reported as the relative risk of giving another 1 *boliviano* coin to a candidate recipient (i.e., the exponential of the mean of the posterior distribution), relative to the amount kept for the self (the intercept), with 95% credible intervals. All Markov chains show evidence of good mixing (Rhat ≤ 1.03), have sufficient effective sample sizes (i.e., number of uncorrelated samples from the posterior), and pass posterior predictive checks. (See Supplementary Methods 3 for more details on these methods and Fig. S2 for examples of the posterior predictive checks conducted.)

Because of experimenter error, data were missing at random for donors' perceptions of recipient “goodness,” wealth, and trustworthiness, as well as for donors' perceptions of the benefits and costs of group membership (5% missing for goodness, 6% for wealth, 3% for trustworthiness, 33% for benefits, 35% for costs). As Stan cannot impute categorical variables without use of indicator variables, we imputed these missing values using predictive mean matching (mice; Little, 1988; Van Buuren & Groothuis-Oudshoorn, 2011), generating 100 imputed data sets in the R statistical program (R Core Team, 2017). We ran our models on each of these 100 imputed data sets; reported statistics were calculated on the mixed posterior distributions from these 100 iterations (Zhou & Reiter, 2010). Additionally, one participant had missing data for where he had lived and visited, two continuous variables. These values were imputed as part of the modeling process in Stan.

2. Results

Donors could have selfishly kept all the money for themselves with no repercussions; instead, they gave away an average of B15.55 of the B21 total stakes (74%) to strangers (i.e., 15 *bolivianos* and 55 cents of 21 *bolivianos*). The average out-group and in-group recipient received B2.27 (SD = 1.90) and B2.96 (SD = 2.64) respectively, a statistically significant difference ($t = -4.82$, $df = 936.49$, $p < 0.001$).

2.1. Choosing among out-group and among in-group strangers

Twenty-eight of the 158 (18%) donors presented with out-group members in the experiment did not allocate any money to these recipients. Tsimane' donors were especially unlikely to allocate money to out-group recipients (19 (32%) of 59 Tsimane' donors; Fig. 2). Across all three study populations, fifty donors, or 32% of the 158 presented with out-group members, gave positive, equal amounts to the three out-group members; 31 of these 50 donors (20% of those presented with out-group members) left each out-group recipient with the original allocation of 3 *bolivianos* per person (and 19 of these 31 also left 3 *bolivianos* for each in-group recipient and kept 3 for themselves).

2.1.1. (P1) Individual characteristics and partner choice

2.1.1.1. (P1.1) Do donors give more to those perceived to have more resource holdings? Perceived wealth has a different effect on in-group versus out-group giving. Relative to in-group strangers perceived to have no wealth, donors gave less to in-group strangers who they perceived to be wealthy or moderately wealthy (Fig. 3a; Table 1). Donors were 17% and 25% less likely to give another *boliviano* to an in-group recipient they perceived to be moderately wealthy or wealthy, respectively, relative to an in-group recipient they thought had no money (Tables S4 and S5 adjust for additional covariates; descriptive statistics for all covariates in these models in Tables S1a, b, c, d). On the other hand, out-group strangers perceived to be moderately wealthy were 43% more likely to receive another *boliviano* relative to out-group strangers perceived to have no wealth.

Because donors' perceptions of recipients were elicited after allocations were made, as a check on possible self-reporting bias we used a given recipient's ratings from non-in-group members to predict each donor's allocation to that recipient. The consensus rating of recipient wealth by other donors positively predicted how much a focal donor allocated to the recipient, especially for in-group members (Table S6); this is in contrast to the effect of the donor's own perceptions of wealth

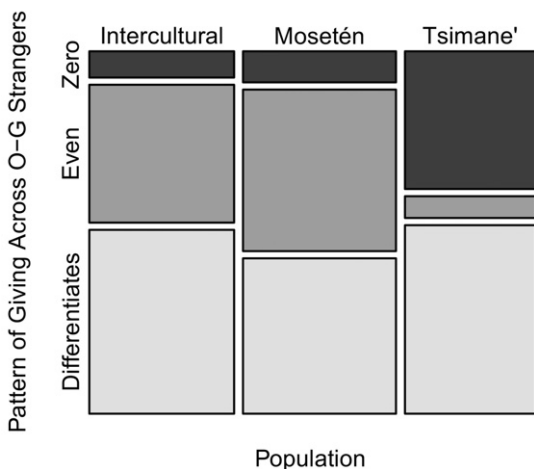


Fig. 2. The proportion of each population that allocated zero bolivianos to all out-group candidate recipients, the same amount to all ("even"), or different amounts to all ("differentiates"; vertical bar width), and the representation of that population in the sample (horizontal bar width).

for in-group candidate recipients, which negatively predicted giving. Further, the relationship between a donor's rating of a recipient's wealth and the consensus rating of that recipient's wealth is low (adjusted $R^2 = 0.04$), suggesting that either (a) donors are detecting different recipient qualities than are their peers, especially for in-group recipients, or (b) donors are exhibiting self-presentation bias, preferentially giving to in-group recipients and attributing this giving to a lack of wealth.

2.1.1.2. (P1.2) Do donors give more to recipients perceived to be cooperative? Relative to recipients perceived to be "bad people," donors were 31% and 52% more likely to give another *boliviano* to in-group recipients who they perceived to be "a little good" and "good people," respectively (Fig. 3b). Giving to out-group recipients followed the same pattern, with recipients perceived to be "good people" receiving the most, followed by those perceived to be "a little good," both relative to "bad people." However, the magnitude of the preference for "good people" as social partners was most pronounced among the Tsimane' (for population-by-population model fits and descriptive statistics by population, see Tables S10 and S11).

Giving to an out-group stranger was insensitive to the donor's perception of that recipient's trustworthiness (Fig. 3c); however, this was not the case for in-group giving. In-group strangers were 27% more likely to receive another *boliviano* if they were perceived as trustworthy by the donor. The effects of goodness and trustworthiness are specific to the donor's own perceptions: consensus ratings of the recipient's goodness and trustworthiness do not predict the amount a given donor allocated to that recipient (Table S6). Thus, unlike perceived wealth, there is less evidence for systematic bias in donors' self-reports of recipients' goodness and trustworthiness. Interest in friendship did not impact out-group or in-group giving.

2.1.2. (P2) Group characteristics and partner choice

2.1.2.1. (P2.1) Do donors give more to recipients from groups perceived to have more resource access? Independently of perceived individual-level qualities of the recipient, we predicted that if donors associated resource access with the recipient's group, they would also allocate more to the recipient. Contrary to predictions, relative to out-groups seen as generating no benefits, a donor was 23% less likely to allocate money to recipients from an out-group she perceived as having benefits that could extend to other groups (Fig. 3d). However, this effect is not robust to the inclusion of other variables in the model (Tables S4 and S5), and its effect in the model reported in Table 1 appears to be a joint consequence of the way we coded the data (see Supplementary Materials 4a) and the nature of the responses of Mosestén participants and, most especially, Tsimane' participants, for whom the perception of between-group benefits reduced the risk of giving another *boliviano* to out-group recipients by 60% (Table S11). When asked about the benefits of membership in a given group, Tsimane' participants' modal response was to say that the group benefitted from access to market resources, irrespective of whether the group was an in-group or an out-group (Table S2). Furthermore, Tsimane' participants named market resources as a benefit more frequently than did the Mosestén and Interculturales. It is possible that market resources were more salient for the Tsimane', relative to the Mosestén and Interculturales, and had an out-sized effect on their out-group giving. This is consistent with our ethnographic impression of the Tsimane', who often view themselves as the "have-nots" relative to other groups; however, the Tsimane' identified candidate out-group recipients as "wealthy" at lower rates than the Mosestén or Interculturales, complicating that explanation.

2.1.3. (P3) Donor characteristics and partner choice

2.1.3.1. (P3.1) Do donors with higher levels of exposure to out-group members give more to out-group members? Donors who had lived in more locations gave more to out-group recipients, as well as to in-group

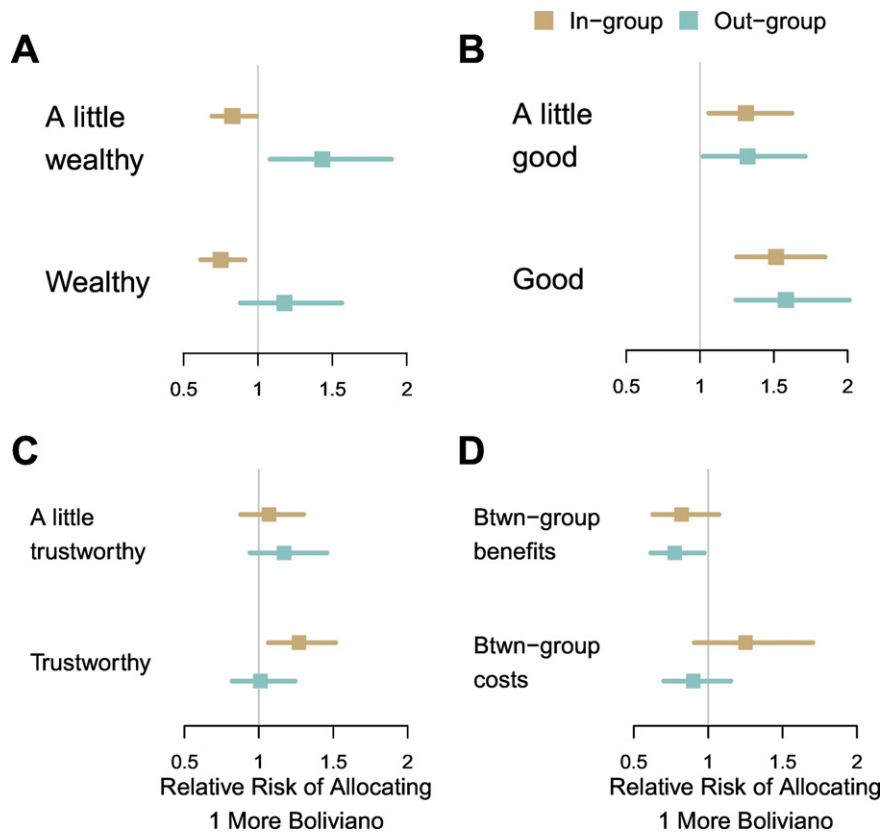


Fig. 3. The relative risk of a donor allocating one more *boliviano* to a candidate recipient by whether she perceives the recipient to be (a) moderately wealthy or wealthy (compared to not wealthy), (b) a moderately “good person” or a “good person” (compared to a “bad person”), and (c) moderately trustworthy or trustworthy (compared to untrustworthy). (d) depicts a donor’s risk of giving another *boliviano* to a candidate recipient by whether the donor perceives the recipient’s group as generating between-group benefits or between-group costs (relative to groups she perceives to generate no between-group benefits or costs). Anonymous donors are primarily responsible for the effect of wealth on out-group giving, goodness on in-group giving, and between-group benefits on out-group giving (Table S9). Non-anonymous donors are primarily responsible for the effect of moderate goodness on in-group giving and trustworthiness on in-group giving.

Table 1

The posterior means (reported as relative risk) and 95% credible intervals for the model including only minimal controls. The first column provides the transformed relative risk (i.e. the risk of giving one *boliviano* more). The relative risk due to a given predictor appears in bold when its credible interval does not include 1.

Prediction	Variable	In-group			Out-group		
		Mean	Credible int. 5%	Credible int. 95%	Mean	Credible int. 5%	Credible int. 95%
P1.1	Intercept	0.14	0.09	0.23	0.09	0.06	0.15
	A little wealthy	0.83	0.69	0.99	1.43	1.08	1.90
	Wealthy	0.75	0.61	0.91	1.18	0.88	1.56
P1.2	A little good	1.31	1.06	1.62	1.32	1.02	1.71
	Good	1.52	1.25	1.85	1.58	1.24	2.01
	A little trustworthy	1.07	0.88	1.30	1.17	0.94	1.46
P2.1	Trustworthy	1.27	1.06	1.52	1.01	0.82	1.24
	Want as friend	1.09	0.96	1.23	1.12	0.97	1.31
	Benefits: Btwn-group	0.82	0.63	1.07	0.77	0.61	0.97
	Benefits: Within-group	1.25	0.91	1.70	0.90	0.70	1.15
	Benefits: Character	1.02	0.73	1.43	0.99	0.67	1.45
	Benefits: Religious	1.09	0.80	1.48	0.98	0.73	1.32
	Costs: Btwn-group	1.10	0.89	1.38	1.16	0.93	1.46
	Costs: Within-group	0.82	0.64	1.04	1.21	0.92	1.61
	Costs: Character	1.14	0.91	1.44	1.15	0.85	1.56
	Costs: Religious	0.87	0.62	1.20	1.05	0.78	1.40
	Costs: Discrimination	0.95	0.66	1.36	0.81	0.46	1.41
P3.1	Places lived	1.15	1.09	1.21	1.20	1.14	1.27
	Places visited (z-score)	0.86	0.79	0.94	0.90	0.82	0.99
	Hours of media (z-score)	1.31	1.19	1.44	1.30	1.17	1.43
Controls	Non-anonymous giving	1.62	1.38	1.90	1.59	1.33	1.90
	Group type: Ethnic	1.17	0.97	1.41	1.19	0.97	1.47
	Donor pop.: Intercultural	1.53	1.24	1.90	1.49	1.21	1.85
	Donor pop.: Tsimane'	1.01	0.77	1.32	0.65	0.49	0.88

Standard deviation for random effects by recipient posterior mean = 0.24. Posterior means for survey version not reported.

recipients, relative to those who had lived in fewer locations (Fig. 4): those who had lived in five locations (third quartile) were 45% more likely to give another *boliviano* to an out-group recipient relative to those who had lived in two (first quartile). The effect of prior locations lived on out-group giving was independent of controls, including Extraversion (Table S5), which may otherwise increase ranging behavior and interest in new social relationships (Nettle, 2006). However, for a subset of participants for whom these data were available, number of prior locations lived was not associated with knowing more members of the focal out-group (Table S7); number of places lived may instead be a proxy for general exposure to strangers. On the other hand, participants who had visited, but not lived in, more places gave less to both in-group and out-group members, while those who reported watching more TV and movies in the past week gave more money to both in-group and out-group members (Fig. 4). As was true for prior location lived, prior locations visited was not associated with the number of individuals known from the focal out-group (Table S7). The media exposure effect and the effect of places lived and visited on in-group giving are independent of the material wealth of the donor's household (Table S5), as well as whether their household owns a TV or a car (Table S3), although the effect of places visited on out-group giving does not hold in either of these models.

2.2. Exploratory analyses

2.2.1. Choosing anonymity

As aforementioned, we allowed participants to play anonymously if they chose; 34% of the sample elected to do so, not sharing their name with recipients. These individuals were 62% and 59% less likely to give an in-group or an out-group recipient (respectively) an additional *boliviano* compared to those who agreed to reveal their names (Table 1). However, of the 20% of donor-recipient interactions in

which a donor allocated 0 *bolivianos* to a given recipient, donors chose to be anonymous in only 42% of these interactions: non-anonymous donors were actually more likely to give 0 *bolivianos* than anonymous donors ($\chi^2 = 5.15$, $df = 1$, $p < 0.05$).

Descriptive statistics for participants who did vs. did not share their name appear in Table S8, and a model with separate terms estimated for those who did vs. did not share their names appears in Table S9. Small sample sizes lead to large credible intervals for a number of levels of the perceived benefits and costs of group membership (Table S8b), so we urge caution in interpreting the following findings: the direction of effects for the individual-level variables in the model (i.e., those associated with P1) suggest that there are two “sub-populations” of donors. Non-anonymous donors penalized candidate recipients perceived as wealthy, while anonymous donors did the opposite. Non-anonymous donors rewarded trustworthy in-group members, while anonymous donors rewarded good in-group members. Non-anonymous donors gave more if they had visited more places and less if they had lived more places and watched more TV and movies, while anonymous donors did the opposite. Furthermore, no single population - the Tsimane', Mosestén, or Interculturales - was more likely to remain anonymous than the others (Tables S10b, d, f), suggesting these two sub-populations do not map onto these larger populations. Effects that are primarily due to the allocations of non-anonymous donors, and those primarily due to the allocations of anonymous donors, are flagged in Figs. 3 and 4.

3. Discussion

With their heavy reliance on cooperative resource acquisition and the ever-present possibility that defection can undermine resource access, humans demonstrate selectivity when choosing cooperative partners. While much research has implicitly investigated the factors affecting partner choice within groups (i.e., ethnic groups, religious groups, or other groups with recognized boundaries), little is known about partner choice with respect to strangers who are members of out-groups. This limitation exists despite evidence that intergroup connections can provide non-local resource access and buffer shortfalls that impact areas larger than the local community. We predicted that both perceived characteristics of individuals, including traits related to cooperative intent and resource access, and of groups, including the out-group's resource access, would affect partner choice among out-group members. Per our previous work, we also suggested that greater exposure to out-group individuals would increase interest in forming relationships with out-group, but not necessarily in-group, strangers.

Among three populations of Bolivian horticulturalists playing a non-anonymous game, we found that donors from the two more market-integrated populations (the Mosestén and Interculturales) were more likely to allocate money to out-group strangers than those from the less market-integrated population (the Tsimane'; Fig. 2). The effects of individual-level traits on a donor's giving differed for out-group vs in-group recipients. Donors avoided giving to in-group strangers they perceived to be wealthy, but gave more to them if they were perceived to be more trustworthy. In contrast, neither high perceived wealth nor trustworthiness was associated with giving to out-group strangers: instead, out-group members perceived to have moderate levels of wealth were preferentially allocated money. However, regardless of a recipient's group membership, donors gave more to recipients they judged to be “good people.”

Our finding that qualities related to resource access and cooperative intent are associated with larger allocations is consistent with past research on partner choice among in-group members. In in-groups, a candidate partner's perceived productivity (Eisenbruch, Grillot, Maestriperieri, & James, 2016), generosity (Barclay & Willer, 2007; Eisenbruch et al., 2016; Tooby & Cosmides, 1996), and trustworthiness (Cottrell et al., 2007) predict an actor's generosity towards that candidate partner in first interactions. While the preference to allocate to out-group members with only moderate amounts of wealth was not

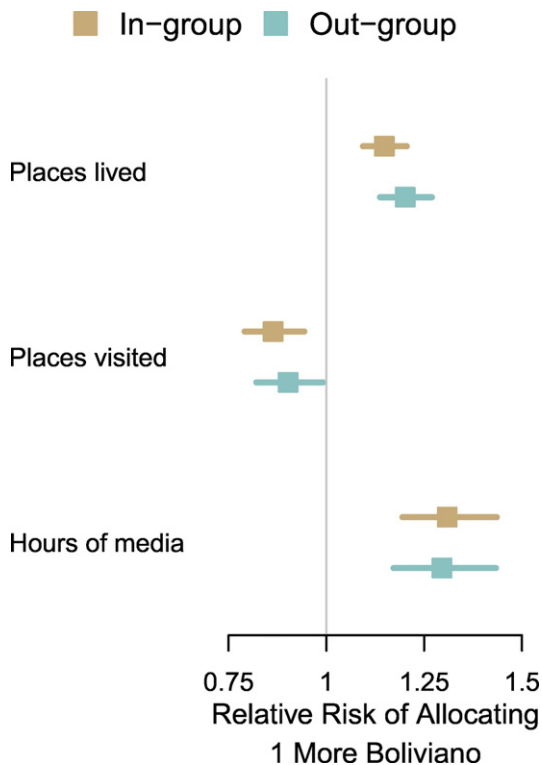


Fig. 4. The relative risk of a donor allocating one more *boliviano* to a candidate recipient by whether she has lived in one additional location, is one standard deviation higher on the number of places she has visited, and is one standard deviation higher on the number of hours of TV and movies she has watched in the past week. Anonymous donors are primarily responsible for the effect of places lived, places visited, and media exposure on giving (Table S9).

anticipated, it may be that donors selectively target individuals who have some money, but not “a lot,” as those with some money may have more to gain from an additional relationship than a wealthy person.

Donors' prior experience with out-groups and perceptions of group-level characteristics had noteworthy effects on allocation. Participants allocated more money to out-group *and* in-group strangers when they themselves had lived in more locations, an effect independent of car ownership (Table S3), household wealth, and extraversion (Table S5). In contrast, participants who had visited more places gave less to out-group *and* in-group members, although this effect was only robust across model specifications for in-group recipients (Tables S3–S5). While having lived in and visited more places may increase exposure to out-groups in general, these variables were not related to knowing more individuals from the focal out-group (Table S7), making the pathway through which mobility translates into interest in strangers less clear. Finally, participants who had higher levels of exposure to TV and movies gave more to both out-group *and* in-group recipients; the effect of media exposure was independent of a donor's own wealth (Table S5) and whether she owned a TV (Table S3).

The impact of a donor's past exposures on interest in out-group and in-group strangers may be due to the tenor of these experiences, not just the presence or absence of exposure in general, or due to unmeasured qualities of the donor herself. A large body of social psychological research suggests that positive intergroup interactions, rather than neutral or negative, lay the groundwork for connections between groups (Brewer, 1996; Gaertner & Dovidio, 2001). While we did not specifically collect data on whether past interactions with strangers had positive or negative outcomes, it may be that the choice to share one's name or remain anonymous reflects this third variable. This could explain why the effects of migration and travel were inverted for these two sub-populations: participants who shared their names gave less if they had lived in more locations but gave more if they have traveled to more places, while those who chose to remain anonymous exhibited the reverse pattern. Alternatively, it is also possible that there is something characteristic of individuals prone to migrate (e.g., Jokela, Elovainio, Kivimäki, & Keltikangas-Järvinen, 2008) or who seek exposure to the media (e.g., Kraaykamp & van Eijck, 2005) that we did not measure. Perhaps individuals who frequently migrate have fewer local kin relationships on which to draw and instead invest in potential partnerships with both in-group and out-group strangers (e.g., Southall, 1973).

Contrary to predictions about group-level traits, participant perceptions of group qualities only affected allocation decisions among Tsimane' and Mosestén participants, with especially pronounced effects for the Tsimane'. Tsimane' donors withheld money from out-group recipients when they perceived the recipient's group as having market resource access. This effect appears to be specific to the perception that a group has market resource access, rather than the perception that a recipient from that group is wealthy. This is consistent with our existing understanding about the high salience of market access to the Tsimane' (R. A. Godoy et al., 2004; Gurven et al., 2015; Pisor & Gurven, 2016; von Rueden, Gurven, & Kaplan, 2008). Combined with the discrimination they face from other Bolivians, the salience of their lack of market access may affect Tsimane' individuals' perceptions of themselves as “have-nots” relative to other Bolivian groups, lowering their interest in members of these groups as social partners, or at minimum lowering their interest in allocating resources to these individuals (e.g., Aktipis, Cronk, & de Aguiar, 2011; Gurven et al., 2000; Jaeggi & Gurven, 2013; Kaplan & Gurven, 2005; Winterhalder, 1996).

While the Tsimane' suffer more discrimination than the Mosestén or Interculturales, the Tsimane' also are the most ethnically homogenous and have the least current exposure to out-group members (for ethno-historical details, cf. Godoy, 2015), whereas out-group interaction is more common among the Mosestén and Interculturales. Despite sharing a language, cultural practices, and a long history of intermarriage with the Tsimane', the Mosestén frequently do business, and often marry exogamously, with individuals who are of similar ethnic backgrounds

as the residents of Intercultural. With four churches and an even larger number of ethnic groups in their community, Interculturales have the highest frequency of contact with out-group members. Indeed, relative to the Tsimane', ethnic group identities are less salient to the Mosestén and Interculturales. As such, the group-level characteristics examined here may provide a better window into changes in out-group perceptions *and* general interest in out-group relationships as a function of frequent out-group exposure, rather than solely into the dynamics of partner choice among individual out-group strangers.

3.1. Study limitations

We note several limitations of the present study. The first concerns the design of the game. While we wished to capture participants' willingness to subtract benefits from one individual or group in order to augment another, experimental games that enable symmetrical giving and taking may lower overall propensity to give (List, 2007). Our results may thus be conservative with respect to allocations to out-group members because, if money was taken from any photo, it was more likely to be taken from out-group than from in-group members. Further, by beginning the game with an allocation of three coins per photo, it is possible that we biased donors' behavior towards “fair” allocations. However, motivations for fairness do not appear to play a large role in game decisions in the present context. Only 12% of participants presented with in-group and out-group candidate recipients did not alter the initial allocation of 3 *bolivianos* per person. Even if we restrict ourselves to in-group recipients, the recipients most likely to receive allocations, only 21.5% of donors allocated positive, equal amounts to all in-group members, whether 3 *bolivianos* or otherwise. To avoid the possibility for retribution outside the experimental context, recipients did not learn if a donor allocated them zero *bolivianos*. Despite this, just 20% of all recipients, in-group or out-group, were given 0 *bolivianos* by a donor. Even the option to remain anonymous did not raise the level of zero giving above that seen among non-anonymous players. These low levels of zero giving may be due to our use of photos in the game, which can augment propensity to give money in general (Burnham, 2003).

Second, participants may have biased their reported perceptions of the candidate recipients post hoc in relation to their allocation decision, as descriptions of the recipients were given after allocation decisions were made. We adopted a consensus approach to test this potential limitation, predicting a donor's allocation to a recipient using the recipient's average ratings from non-in-group members. For perceived recipient goodness and trustworthiness, consensus measures did not predict a donor's giving. However, in the case of in-group recipients, recipients rated as wealthy by consensus were predicted to receive more from a given donor, while the donor's own ratings of the recipient's wealth predicted less giving; this suggests that donors may have been justifying in-group-biased giving post hoc by citing a lack of recipient wealth. Alternatively, it is also possible that unmeasured characteristics of the photos, such as facial attractiveness, affected giving, and that consensus measures of wealth, goodness, and trustworthiness do not capture the effects of attractiveness. This is a possibility we cannot address here.

Third, the researcher conducting the interviews (AP) was herself an out-group member, which could have impacted participant responses: some participants may have been more likely to bias their self-representations than others (Hoffman, McCabe, Shachat, & Smith, 1994). However, the researcher was present in all experiments and was thus a constant source of noise.

Additionally, opposite-sex mating partners are also resources that may be non-locally available, and interest in mating opportunities may augment interest in out-group relationships. For example, ranging behavior by unmarried men often covers large distances (Miner, Gurven, Kaplan, & Gaulin, 2014; Vashro & Cashdan, 2015). However, to limit the dimensions along which partner choice could vary in this relatively small study, we limited recipients to same-sex individuals to focus on same-sex partner choice. Further, while marital status was

not included in the present models due to issues with collinearity, it had no effect on average out-group giving in this same sample in previous analyses (Pisor & Gurven, 2016).

Finally, we note that the present data are cross-sectional and cannot address how changing levels of resource availability or out-group exposure affect out-group partner choice.

4. Conclusion

The ethnographic and archaeological records underscore the importance of out-group relationships to humans. However, little is known about how actors choose out-group cooperative partners. We predicted that actors' perceptions of both the individual characteristics and group characteristics of prospective partners should affect out-group partner choice, especially when these characteristics are associated with benefits for the actor. Among three populations of Bolivian horticulturalists, we find that some qualities of prospective partners affect both in-group and out-group partner preference in an experimental game (e.g., perceived friendliness and openness), while others affect only in-group preference (e.g., trustworthiness). Furthermore, while group characteristics can affect partner preferences, this appears to be a product of the tenor of past interactions with strangers. We suspect that the positive or negative valence of past interactions with strangers is an unmeasured variable that may explain (1) why levels of migration and visitation have opposite effects on giving for participants who remain anonymous vs. share their names with recipients, and (2) why Tsimane' donors who perceive an out-group as having market access gave less to recipients from that out-group. Taken together, these findings shed light on some potential predictors of partner choice among out-group members, an as-yet understudied aspect of human sociality, and suggest that further studies unpacking the relative roles of individual- and group-level characteristics in partner choice are warranted.

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Appendix A. Supplementary data

Supplementary materials, code, and data to this article can be found online at <https://doi.org/10.1016/j.evolhumbehav.2017.09.003> and <http://github.com/annethro/Partner-choice>.

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