**Supplementary materials:**

**Parochial altruism in humans is universally possible but not universally present**

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Data, metadata, and code are available at www.github.com/annethro/parochialism

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**2. BOLIVIAN DATA**

Choice task design, all data preparation, and all analyses were implemented in R version 4.0.2 (R Core Team, 2020).

**2.1 Choice task**

**2.1.1 Data collection**

Participants (n=120; 40% female) were interviewed by ACP and two research assistants in April-June 2017. Participants received monetary compensation for their time. Study protocol were approved by the communities and the Mosetén tribal organization. Given mixed literacy but familiarity with signing forms, participants were read a consent form and provided their written consent via signature. All field protocols were approved by the Max Planck Institute for Evolutionary Anthropology Department of Human Behavior, Ecology, and Culture, and declared exempt from additional IRB oversight.

ACP presented participants with pairs of cards representing hypothetical individuals – each described by six categories of characteristics (Figure Sx) – and asked which of the two cards they would prefer as a new same-sex friend. In addition to the location of the candidate friend, their pueblo indígena, and their religious affiliation, three other categories of characteristics were included that had proven relevant to partner choice in 2014-15: trustworthiness, being a “good person” (*buena gente*), and wealth (Pisor & Gurven, 2018). The levels for these six categories were as follows (translated from Spanish):

* Location: this community, the other side of the river valley, La Paz
* Pueblo indígena: Mosetén, Tsimane’, Aymara, Quechua, Trinitario
* Religious affiliation: Catholic, Evangelical
* Trustworthiness: not trustworthy, trustworthy, very trustworthy
* Good person: not a good person, good person, very good person
* Wealth: does not have money, has money, has lots of money

ACP generated the complete orthogonal array of cards for these six categories and their levels using a Latin square design such that each card in the array differed by at least one level on one of the six categories. ACP randomly sampled 180 cards from this array and randomly sorted them into 90 pairs (without replacement; cf. (Rao, 2014)) using the mix-and-match method in R package support.CEs (version 0.4.1; (Aizaki, 2012). These pairs were then randomly assigned to five blocks; within each block, the pair was randomly assigned an order (1-18) and one card was randomly assigned to appear on the left. To control for any effects of the order of presentation of the six categories, the order of the six categories was randomized into two versions of each block, creating 10 total versions of the task (e.g., Version 1, from the top of the card to the bottom: religious affiliation, trustworthiness, pueblo indígena, location, good person, and wealth (Figure Sx); Version 2: trustworthiness, wealth, religious affiliation, good person, location, pueblo indígena). Each participant was presented with one of 10 versions of the choice task and made 18 sequential decisions between pairs of cards.

**2.1.2 Statistical model**

**2.1.2.1 Data preparation**

To reduce participant identifiability, we binned participant ages into 5-year bins (e.g., an age of 36 was rounded to 40; an age of 21 was rounded to 20). To aid in model estimation, we normalized net household income – that is, the participant’s household’s estimated income over the last month, minus their estimated expenditures – years of schooling, and age such that a value of 0 represents the sample mean and a value of 1 represents one standard deviation above the mean. We also normalized the average amount given to out-group candidate recipients in the 2014-15 economic game for the models described in 2.1.2.3.

Of the 120 total participants, 13 reported having no religious affiliation and one was not asked about their years of schooling. Given our interest in whether participants are choosing candidate friends based on religious affiliation and our inclusion of years of schooling as a control, we imputed these data using predictive mean matching, implemented with the mice package (version 3.10.0; (Van Buuren & Groothuis-Oudshoorn, 2011).

**2.1.2.2 The effects of card characteristics on card choice**

We used a Bernoulli mixed-effect model with logistic link to investigate which card characteristics predicted a participant’s choice of the right-hand card. (Since the choice between two cards in a pair was binary, our decision to model participants’ decisions using the right-hand card was arbitrary; we could just as easily have picked the left.) We parameterized models such that estimates reflect contrasts to lower levels – that is, “in-groups” (i.e., same community, same pueblo indígena, same religious affiliation) and the absence of a quality (i.e., a bad person, someone who is not wealthy, someone who is not trustworthy) – and can be compared to no difference between cards. For example, consider each of the following combinations for Location: Same Valley and Location: City:

\begin{tabular}{l c r}

Row & Loc.SameValley\_Diff & Loc.City\_Diff \\

A & -1 & 1 \\

B & 1 & 0 \\

C & 0 & 0

\end{tabular}

In Row A, the indices indicate that the candidate friend on the left-hand side was from the same river valley, as -1 indicates the presence of the level on the left; the candidate friend on the right-hand side was from the city, as indicated by the 1. By extrapolation, then, neither candidate friend was from the same community. In Row B, the candidate friend on the right-hand side was from the same valley. Because the value for Location: City is 0 – indicating that either both candidate friends are from the city, or neither is – but we know that the right-hand candidate friend is from the same valley, that means that neither is from the city and therefore the left-hand candidate friend is from the same community. In Row C, the coding scheme does not reveal where the candidate friends are from, but rather that there is no difference between the two: they both are in the same location, regardless of which location that is. This coding scheme means that parameter estimates for Location tell us whether (1) a participant is more likely to pick the right-hand candidate if they live further away than the candidate on the left-hand side, and (2) whether there’s something specific about living in the same valley or living in the same city that participants use to make their decision. An alternative coding scheme that tells us just (1), not (2), is described and implemented in our code for comparison (available at www.github.com/annethro/parochialism).

Data are coded such that pueblo indígena and religious affiliation are specific to the participant, based on how they self-identified in census data. For example, imagine a participant who self-identified as Evangelical and Quechua. If she is shown the two cards in Figure Sx, this is coded as 1 for pueblo indígena – her own pueblo indígena appears on the left, whereas a different pueblo indígena appears on the right – and coded as 0 for religious affiliation – the same religious affiliation appears on both cards.

Models were implemented with the brms package (Bürkner, 2017) which passes Bayesian models to Stan (Stan Development Team, 2020). We used weakly informative priors. For fixed effects, given parameters in logistic models are on a scale of 0-1 before they pass through the link function, we used a normal prior with a mean of 0 and standard deviation of 1. For random effects, given the traceplots of initial model runs, we used an exponential distribution with a rate parameter of 1 to make exploration of the parameter space more efficient. For a discussion of the choice of priors, see (McElreath, 2020).

We fit models both with controls and without. We anticipated that participant age, sex, years of schooling, and household net income over the previous month might affect preferences for a candidate friend who lived at a distance, was part of a different pueblo indígena, or was of a different religious affiliation. For example, because mobility is higher among males than females and, thanks to access to roads, has been higher for a larger proportion of younger individuals’ adult lives, sex and age affect exposure to individuals at a distance or from other pueblo indígenas and could impact preferences accordingly (Pisor & Jones, n.d.). Because the outcome of our models was choosing the right-hand card, treating controls as additive did not make sense: this would control for preferences for choosing right, not preferences for choosing someone who lived at a distance, for example. Instead, fit a separate model including each control, interacting the control with the predictors of interest: candidate friend location, pueblo indígena, and religious affiliation. As the inclusion of each control did not qualitatively alter the results of the model fit with no controls, we report the model without controls in the main text.

**2.1.2.3 The effects of economic game play in 2014-2015 on card choice**

We analyzed whether average giving to candidate recipients from a different pueblo indígena in 2014-15 was associated with preferring candidate friends from a different pueblo indígena in 2017; we did the same for candidate recipients and friends with a different religious affiliation. We also explored whether out-group giving, regardless of whether the out-group was religious or a pueblo indígena, predicted preferring candidate friends living at a distance.

A subset of 80 participants (50% female) completed both the choice task and the 2014-15 economic game; the latter is described in (Pisor & Gurven, 2016, 2018). Participants completed a sorting task in which they identified which pueblos indígenas and religious affiliations they identified with the most (1) and the least (5). From this, we classified a participant’s in-groups as those in the first or second positions, out-groups as those in the fourth and fifth positions, and “intermediate” groups as those in the third position. Of the 80 participants who completed both the choice task and the game, 63 identified out-groups and were thus presented with candidate recipients who were identified as part of a religious or pueblo indígena out-group. Because the other 17 did not identify out-groups, they were either presented with one in-group and one intermediate group or two in-groups; given our interest in out-group giving, we excluded them from analysis accordingly.

To check for a relationship between how a participant played in the economic game and their choices in the choice task, we interacted the average amount they gave to out-group members in the economic game with (1) their choice of someone from a different pueblo indígena or religion and (2) their choice of someone from a different location on the choice task. We implemented this as follows:

1. We interacted the pueblo indígena of candidate friends from the choice task with (1) whether the participant was told the pueblo indígena or religion of candidate recipients in the 2014-15 economic game and (2) the amount the participant gave to each out-group member on average – a three-way interaction. We did the same for the religion of candidate friends from the choice task.
2. We interacted the location of candidate friends from the choice task with the amount the participant gave to each out-group member on average – a two-way interaction.

Models were fit both with and without controls. As before, we fit a separate model with each control included, interacting controls with the predictors of interest, described in A and B immediately above, to create four-way and three-way interactions. We fit one model with each of the controls described in 2.1.2.2. We also included three additional controls. The first was planned: whether the participant chose to give money anonymously in the 2014-15 economic games. (Some participants strongly wished to do so, so ACP allowed them this option; see (Pisor & Gurven, 2016, 2018) for details.) The second and third were included as exploratory analyses. Household net income over the previous month was entirely uncorrelated (r = -0.01) between 2014-15 and 2017. This may be because ACP conducted the interviews in spring and summer in 2014-15 and in fall in 2017, and cash crop incomes vary substantially by season; however, it may also reflect changes in household circumstances in the intervening two years that could affect preferences. Accordingly, we explored the effects of controlling for (1) household net income in 2014-15 and (2) the difference in household income between 2017 and 2014-15 on model estimates.

Model specification was otherwise identical to that described above (in Section 2.1.2.2). Using predictive mean matching, as described in Section 2.1.2.2, we imputed data for three people without a religious affiliation and one person missing data on their schooling. As the inclusion of each control did not qualitatively alter the results of the model with no controls, we report the model without controls in the main text.

**2.1.3 Results**

Models with and without controls returned qualitatively similar results; we thus report models including controls here.

**2.1.3.1 The effects of card characteristics on card choice**

The posterior means and 90% credible intervals for the predictors of interest are reported in Figure x in the main text. Participants preferred candidate friends who were not from La Paz, the capital city of Bolivia; we can infer this because when the candidate friend on the right-hand side was from La Paz but the candidate friend on the left-hand side was not, participants were less likely to pick the right-hand card. They also preferred candidate friends not from the same river valley – at least when a candidate friend from the same river valley appeared on the right. Taken together, we can infer that they preferred same-community candidate friends over friends from elsewhere. Likewise, participants preferred candidate friends from their own pueblo indígena and their own religious affiliation over those from other pueblos indígenas and other religious affiliations. Note that these latter effects are more pronounced than the effect of location, as participants consistently avoided candidate friends from other pueblos indígenas or other religious affiliations regardless of whether they appeared on the left or right.

Consistent with preferences elicited in the 2014-15 economic game, participants strongly preferred candidate friends who were “good people” or “very good people” – this was the largest effect observed (Pisor & Gurven, 2018). Participants also preferred participants who were “trustworthy” or “very trustworthy,” although like that of location, this effect depended on whether trustworthy candidate friend appeared on the left or right. Participants avoided picking candidate friends described as having “a lot of money.”

Older participants were more likely to prefer a candidate friend of the same religious affiliation when they appeared on the left and participants with higher net incomes were more likely to prefer someone not from the same river valley when they appeared on the left. Other controls did not predict choice of candidate friend.

**2.1.3.2 The effects of economic game play in 2014-2015 on card choice**

The posterior means and 90% credible intervals for the predictors of interest are reported in Figure Sx. The average amount given by a participant to candidate out-group recipients in the 2014-15 economic game was not related to whether participants chose cards in 2017 based on their out-group membership – regardless of whether the candidate friends on the cards or the candidate recipients in the game were from a different pueblo indígena or had a different religious affiliation. Likewise, the average amount given by a participant to candidate out-group recipients in 2014-15 was not related to whether they chose cards in 2017 based on their location.

With respect to the effects of card characteristics reported in 2.1.3.1, the 90% credible interval included an OR of 1 (that is, the magnitude of effect was reduced such that we cannot rule out no effect) for a candidate friend living in La Paz, if on the right-hand side; from a different pueblo indígena, if on the left-hand side; and having a lot of money, if on the left-hand side. Note that the different in qualitative magnitude of the estimates between the model including card characteristics (Section 2.1.3.1) and the model including both card characteristics and economic game play (this section) is unsurprising given the sample size also differs (n=120 in Section 2.1.3.1, n=63 in this section).

Keeping in mind this difference in sample size, the inclusion of controls reduced the magnitude of the following effects of card characteristics:

* Age -- preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; very trustworthy if on the left; and not “very wealthy” if on the right
* Sex -- preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; and not “very wealthy” if on the right
* Years of schooling -- preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; from the same pueblo indígena when on the right; and not “very wealthy” if on the right
* Net income over the last month in 2017 – preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; from the same pueblo indígena when on the right; and not “very wealthy” if on the right
* Net income over the last month in 2014-15 – preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; and not “very wealthy” if on the right
* Difference in net income between 2017 and 2014-15 -- preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; from the same pueblo indígena when on the right; and not “very wealthy” if on the right
* Non-anonymous game play – preferring candidate friends: not from the same valley on the right and not from La Paz if on the left; from the same pueblo indígena when on the left or the right; and not “very wealthy” if on the right

The four-way interactions between controls and the predictors of interest (described in A and B in section 2.1.2.3) are complicated to interpret, so we refrain from doing so here and refer interested readers to the model code (available at www.github.com/annethro/parochialism).

**2.2 Deriving the predictions for Figure X**

To estimate the predicted relationship between the monetary value of market items owned and average amount given to each candidate out-group recipient, we used the predictors featured in Pisor & Gurven (2016) with two modifications. First, we updated the three model specifications---one for each population---to a left-censored normal, implemented in brms with weakly informative priors. This distribution is more appropriate for modeling the nonnegative data from the Bolivia economic game (Greene 2003, Min & Agresti 2002)---especially as participants might have given negative amounts if they could (e.g., Gervais 2017, List 2007). Second, we removed predictors that (1) did not predict variation in the outcome in Pisor & Gurven (2016), either in the full model (Table S3) or in the population-specific models (Table S4), as the full model generated large credible intervals. (Note that this change in credible intervals vs. those of Pisor and Gurven (2016) is not very surprising given the change in modeling technique.) Predictors included in the models are the normalized value of market items owned, the log of a participant’s subjective socioeconomic status relative to others in their community, whether the participant had been ill during the last 30 days, the number of places they had lived, whether they had a cooperative labor partner, the normalized value of hours per week watching TV or movies, the number of times per week they go to church, and whether they played the game anonymously or non-anonymously. The code is available on the GitHub repository.

**Figure Sx.** An example of one of the 18 sequential decisions made by each participant in the paired comparison choice task. The codes at the bottom right indicate that this pair was the fourth presented to participants who completed the first version of the task; the card marked “L” always appeared on the left and “R” always on the right.

[Insert “Card task figure.png”]

**Figure Sx**. Posterior means and 90% credible intervals for the predictors of interest from the model interacting card choice with economic game play (Section 2.1.3.2).

[Insert “Bolivia\_Card Choice and Game Play\_Non-Standardized.pdf”]

**References [Cody: see below for Bibtex entries]**

Aizaki, H. (2012). Basic functions for supporting an implementation of choice experiments in R. *Journal Of Statistical Software*, *50*(2), 1–24. http://www.jstatsoft.org/v50/c02/

Bürkner, P. C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software*, *80*(1). https://doi.org/10.18637/jss.v080.i01

McElreath, R. (2020). *Statistical Rethinking: A Bayesian Course with Examples in R and STAN*. Chapman and Hall/CRC.

Pisor, A. C., & Gurven, M. (2016). Risk buffering and resource access shape valuation of out-group strangers. *Scientific Reports*, *6*, 30435. https://doi.org/10.1038/srep30435

Pisor, A. C., & Gurven, M. (2018). When to diversify, and with whom? Choosing partners among out-group strangers in lowland Bolivia. *Evolution and Human Behavior*, *39*(1), 30–39. https://doi.org/10.1016/j.evolhumbehav.2017.09.003

Pisor, A. C., & Jones, J. H. (n.d.). *Do people manage climate risk through long-distance relationships?*

R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. http://www.r-project.org/

Rao, V. R. (2014). *Applied Conjoint Analysis*. Springer.

Stan Development Team. (2020). *RStan: the R interface to Stan. R package version 2.19.3*. http://mc-stan.org/

Van Buuren, S., & Groothuis-Oudshoorn, K. (2011). Multivariate Imputation by Chained Equations. *Journal Of Statistical Software*, *45*(3), 1–67. https://doi.org/10.1177/0962280206074463

@article{aizaki2012,

author = {Aizaki, Hideo},

journal = {Journal of Statistical Software},

number = {2},

pages = {1--24},

title = {{Basic functions for supporting an implementation of choice experiments in R}},

url = {http://www.jstatsoft.org/v50/c02/},

volume = {50},

year = {2012}

}

@article{burkner2017,

author = {B{\"{u}}rkner, Paul Christian},

doi = {10.18637/jss.v080.i01},

journal = {Journal of Statistical Software},

number = {1},

title = {{brms: An R package for Bayesian multilevel models using Stan}},

volume = {80},

year = {2017}

}

@book{mcelreath2020,

address = {Boca Raton, FL},

author = {McElreath, Richard},

pages = {594},

publisher = {Chapman and Hall/CRC},

title = {{Statistical Rethinking: A Bayesian Course with Examples in R and STAN}},

year = {2020}

}

@article{pisorgurven2016,

author = {Pisor, Anne C. and Gurven, Michael},

doi = {10.1038/srep30435},

journal = {Scientific Reports},

pages = {30435},

title = {{Risk buffering and resource access shape valuation of out-group strangers}},

volume = {6},

year = {2016}

}

@article{pisorgurven2018,

author = {Pisor, Anne C. and Gurven, Michael},

doi = {10.1016/j.evolhumbehav.2017.09.003},

journal = {Evolution and Human Behavior},

number = {1},

pages = {30--39},

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

volume = {39},

year = {2018}

}

@misc{rcore2020,

address = {Vienna, Austria},

author = {{R Core Team}},

publisher = {R Foundation for Statistical Computing},

title = {{R: A language and environment for statistical computing}},

url = {http://www.r-project.org/},

year = {2020}

}

@book{rao2014,

address = {Heidelberg},

author = {Rao, Vithala R.},

pages = {389},

publisher = {Springer},

title = {{Applied Conjoint Analysis}},

year = {2014}

}

@misc{stan2020,

author = {{Stan Development Team}},

title = {{RStan: the R interface to Stan. R package version 2.19.3}},

url = {http://mc-stan.org/},

year = {2020}

}

@article{vanbuurenetal2011,

author = {{Van Buuren}, Stef and Groothuis-Oudshoorn, Karin},

doi = {10.1177/0962280206074463},

journal = {Journal of Statistical Software},

number = {3},

pages = {1--67},

pmid = {22289957},

title = {{Multivariate Imputation by Chained Equations}},

url = {http://igitur-archive.library.uu.nl/fss/2010-0608-200146/UUindex.html},

volume = {45},

year = {2011}

}

@article{min2002modeling,

author = {Min, Yongyi and Agresti, Alan},

publisher = {Journal of the Iranian Statistical Society (JIRSS)},

title = {{Modeling nonnegative data with clumping at zero: A survey}},

year = {2002}

}

@article{Gervais2017,

author = {Gervais, Matthew M},

doi = {10.1177/1525822X16643709},

journal = {Field Methods},

number = {2},

pages = {113--129},

title = {{RICH economic games for networked relationships and communities: Development and preliminary validation in Yasawa, Fiji}},

volume = {29},

year = {2017}

}

@article{List2007,

author = {List, John A},

journal = {Journal of Political Economy},

mendeley-groups = {Econ Game},

number = {3},

pages = {482--493},

title = {{On the Interpretation of Giving in Dictator Games}},

volume = {115},

year = {2007}

}

@book{Greene2003Econometric,

author = {Greene, William H},

edition = {Fifth},

isbn = {0-13-066189-9},

publisher = {Pearson Education},

title = {{Econometric Analysis}},

year = {2003}

}