The Amplifying Role of Need in Giving Decisions

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Abstract

Hamilton's rule predicts that altruism should depend on costs incurred and benefits provided, but these depend on the relative needs of the donor and recipient. Rewriting Hamilton's rule to account for relative need suggests an amplifying effect of need on relatedness, but not necessarily other relationship qualities. In a reanalysis of three studies of social discounting and a new replication, we find that relative need amplifies the effects of relatedness on giving in two samples of U.S. adults recruited online, but not U.S. undergraduates or Indian adults recruited online. Among U.S. online participants, the effect of genetic kinship was greater when the partner was perceived to be in higher need than when in lower need. In the other samples, relatedness was associated with greater giving and greater need, but the effect of relatedness was not significantly amplified by need. Need never amplified the effect of social closeness on giving, although it did diminish the effect of closeness in U.S. undergraduates, likely reflecting a ceiling effect. These results confirm predictions from a modification of Hamilton's rule in a sample of U.S. adults, but raise important questions about why they hold in some samples but not others. They also illustrate the importance of understanding how contextual factors, such as relative need, can moderate the importance of common variables used in evolutionary cost-benefit analyses.

Keywords: Giving, Social Discounting, Need-Based Giving, Kin selection

Evolutionary theories of individual sacrifice often predict that decisions should be sensitive to the ratio of fitness gains to costs. As an example, Hamilton's theory of inclusive fitness predicts that individuals should sacrifice for a genetically related partner as long as the fitness cost of sacrificing (c_d) relative to the partner's benefit (b_p) is less than the donor's genetic relatedness to the partner (r) (Hamilton, 1964). Similarly, theories of reciprocal altruism predict that an individual should sacrifice for a partner as long as the partner's benefit b_p discounted by the probability that the partner returns the benefit is greater than the cost, c_d (Trivers, 1971).

Complicating these simple calculations is the fact that observable costs and benefits are usually only proximate currencies (e.g. food, money) that may have different fitness consequences for the donor and recipient at any one point in time. For example, the fitness benefit of a blood meal for a starving vampire bat is much greater than the fitness cost incurred by a well-fed partner giving up that same blood meal (Wilkinson, 1984; 1988). For this reason, we should expect individuals to be attuned not only to proximate benefits and costs of a decision (i.e. the amount of food or money), but also to the relative fitness gains from the same quantity of a currency for the donor and recipient.

One way that humans conceive of these relative gains is in terms of a recipient's need and how it compares to the donor's need (Aktipis, Cronk, & de Aguiar, 2011; Gurven, 2004; Hruschka, 2010). Experimental studies have shown that a range of proxies for a partner's need at varying times scales (e.g. being sick, being poor, a recent loss) increase both self-reported likelihood of helping the partner (Burnstein, Crandall, & Kitayama, 1994; Hackman, Danvers, & Hruschka, 2015; Korchmaros & Kenny, 2006) and transfers of actual money (Howe, Murphy, Gerkey, & West, 2016). Moreover, observational studies of Tsimane forager-horticulturists in Bolivia show that families with objectively greater need—measured as daily consumption relative to production of calories over a year—are more likely to receive food from other households and are less likely to share food outside the household (Hooper, Gurven, Winking, & Kaplan, 2015).

While most studies have examined main effects of need, formal evolutionary models of individual sacrifice suggest that relative need should also modify the effect of other factors, such as relatedness, probability of a return, and the ratio of proximate benefits to costs. Here, we define need in terms of the fitness change from a unit change in a proximate currency (e.g. food, money). For example, suppose we decompose the cost incurred by a donor as $c_d = cf_d$ where c is the proximate cost of sacrifice and f_d is the donor's fitness loss for a loss of one unit of the relevant currency. Similarly, the benefit to recipients can be rewritten $b_p = bf_p$ where b is the proximate benefit and f_p is the fitness gain for the receipt of one unit of the relevant currency. With these substitutions, Hamilton's rule becomes the following:

$$\frac{b}{c}\frac{f_p}{f_d}r > 1$$

Thus, the decision to sacrifice should depend on the product of three quantities: the ratio of benefits to costs in a proximate currency (e.g. food, money) ($\frac{b}{c}$), the need of the partner relative to one's own need ($\frac{f_p}{f_d}$), and one's relatedness to the partner (r). Notably, when a partner is in greater relative need, the same increase in r should lead to a larger increase in the amount one is willing to sacrifice (c) to give the same proximal benefit (b) for a partner. In short, a partner's greater relative need should amplify the effect of genetic relatedness on willingness to give. In this generalized form, b and c can represent different types or amounts of resources, but in specific cases such as the direct transfer of resources (e.g. a donation of money from one person to another), *b* and *c* could also be equivalent. In those cases, what may matter most is the relative need of each partner.

Models of repeated beneficial interactions among unrelated individuals provide different predictions about the moderating effect of need. In this case, genetic relatedness in the equation, *r*, is replaced with the probability of the partner returning the benefit in the future, *p*. The value *p* depends on a number of factors, including the expected duration of the relationship, the degree of discounting of the future benefit, and one's trust that the partner will return the benefit in the future when needed (Fehr & Fischbacher, 2003). The current fitness gains to the partner (f_p) are replaced with the expected future fitness gains for the donor ($f_{d'}$) from a one unit change in the currency.

$$\frac{b}{c}\frac{f_{d'}}{f_d}p > 1$$

In this case, as one's future need relative to one's present need increases ($\frac{f_{d'}}{f_d}$), one should be willing to sacrifice more (c) all else being equal. Crucially, in this case, there should be no amplifying effect of the current need of the recipient relative to that of the donor.

The decomposition of costs and benefits illustrates how assessments of relative need should play a role in decisions to help others, and how relevant indicators of need (e.g., self vs. partner's need, self's present vs. future need) matter differently depending on key qualities of the relationship (e.g., genetic relatedness, probability of a future return). Although numerous studies have examined the additive effects of relatedness, need, and proxies for mutually beneficial reciprocal relationships (Delton & Robertson, 2016; Hackman et al., 2015; Howe et al., 2016; Jones & Rachlin, 2006; Korchmaros & Kenny, 2006; Lieberman & Lobel, 2012), far fewer have examined how relative need might amplify the effect of genetic relatedness on generosity. One recent observational study suggests that need—operationalized in terms of a household's caloric consumption minus production—amplifies the effect of genetic relatedness on food sharing in a small-scale society (Hooper et al., 2015). In that paper, the researchers used objective proxies of need, measured in caloric surpluses or deficits. However, perceptions of important social categories such as genetic relatedness or need can influence behavior even when they do not objectively track features of the world. For example, perceived kinship can influence altruism and sexual attraction even when individuals are not genetically related (Lieberman & Lobel, 2012; Lieberman, Tooby, & Cosmides, 2007). It is still unclear how *perceptions* of a recipient's versus one's own need also amplify the effect of genetic relatedness on giving.

The Current Study

In this study, we assess whether perceptions of relative need amplify the effects of genetic relatedness and a proxy for expectations of future return (e.g. social closeness to a partner) according to the expectations described above. Specifically, a donor's need relative to the recipient's should amplify the effects of genetic relatedness. However, relative need should not amplify the effects of social closeness, as reciprocal giving involves a trade-off between the donor's current and expected future need, not the recipient's need. To assess these expectations, we re-analyzed three existing data sets from three distinct samples (U.S. undergraduates, U.S. MTurk users, and Indian MTurk users) using multi-level modeling with interactions among the key variables. We also collected and analyzed new data for a direct replication of the study in a U.S. Mturk sample.

Methods

Participants. Participants were drawn from three prior published studies and one direct replication: one conducted on U.S. undergraduate students, two conducted online recruiting individuals from Amazon's Mechanical Turk (Mturk) in the U.S., and another conducted through Mturk in India (Hackman et al., 2015). The Mturk workers were paid $0.50 for a 15-minute survey.

Data points for specific partners were excluded (a) if the participant did not answer one of the questions used to calculate the dependent variable for that partner, (b) if a partner was listed as two different kinds of genetic kin, (c) if a romantic partner was also listed as genetic kin, and (d) if there were multiple crossover points among the social discounting questions. We also excluded participants if there were less than four alters left for a given participant after all the exclusions. The proportion of each sample eliminated at each exclusion step is given in the supplemental materials (Table S1). Much of the prior literature has analyzed only the data of participants who had a single, consistent crossover point in the choice to forego money for a partner. Since we are building on existing findings in the published literature, we present analyses only with alters with a single consistent crossover point in this manuscript. However, recently researchers have proposed that inconsistent crossover points can be an indicator not just of inattention to the task but of a different way of parsing and responding to the questions (Hruschka et al. in press, Tiokhin, Hackman, & Hruschka, preprint). We therefore present the same analyses including participants who had multiple crossover points in the Supplementary Materials. Including alters with multiple crossovers yields the same qualitative results.

After exclusions, there were 224 participants and 1,524 alters in the Mturk U.S. Study 1 sample; 198 participants and 1,246 alters in the Mturk U.S. Study 2 sample; 68 participants and 438 alters in the Mturk India sample; 42 participants and 312 alters in the undergraduate in person sample; and 62 participants and 412 alters in the undergraduate online sample. The average age of the final Mturk U.S. Study 1 sample was 35.8 years; 57.8% were female and 42.2% were male. Average age in the Mturk U.S. Study 2 sample was 36.2 years; 49.0% were female and 51% were male. Average age in the Mturk India sample was 31.4 years; 30.2% were female and 69.8% were male. Average age in the U.S. undergraduate in person sample was 21.6 years; 67.8% were female and 32.2% were male. Average age in the U.S. undergraduate online sample was 22.6 years; 72.6% were female and 27.4% were male. As in previous research, results for both U.S. undergraduate samples were qualitatively similar, and so these samples were combined during analysis.

<Insert Table 1 Here>

Procedures. Participants were asked to nominate a series of others (alters) based on their closeness rank—for example, the person the participant is closest to, 2nd closest to, etc. In all surveys administered online, the closeness ranks for alters were 1, 2, 5, 10, 20, 50, and 100. Individuals in the in-person interviews reported on the first 50 alters to whom they felt closest. For each alter, participants answered questions about their relationship and completed a social discounting paradigm. In the social discounting paradigm, based on Jones and Rachlin (2006), participants decide among a series of hypothetical tradeoffs between money for the self or for the alter.

Measures.

Measure of Relative Need. For each alter, after completing the social discounting task participants were asked if they agree or disagree to a single item question: “this person needs the money more than me” on a 7-point Likert scale. Higher scores indicate greater perceived need of the alter.

Relatedness and Relationship Type. Participants selected their relationship to each alter from a list. Categories included a variety of kin and non-kin relationships. Biological relatedness was coded according to the coefficient of relatedness for the category chosen. For example, a parent, child, or full sibling was coded 0.5. A dummy code was also created to indicate if the alter was an individual’s mate, which included a spouse, partner, boyfriend, or girlfriend.

Measure of Closeness. The alter’s ranked social distance (1, 2, 5, 10, 20, 50, 100) was used as a proxy for expectation of a future return of benefits from the partner. The functional form of the relationship between social distance and giving is non-linear. To approximate this relationship, we log transformed rank. To ensure that increasing values indicated increasing closeness, we used the additive inverse in analyses.

Reported Giving. The dependent variable was the outcome of the social discounting task. In this task, participants were asked if they would give up some dollar amount for the alter they nominated to receive $75. The amounts they were asked to give up started at $85 and decreased in increments of $10 until it reached $5. There was also an option of giving up $0. The point at which an individual first shifted from choosing the option that favored themselves to the option favoring the alter is the indifference point, and represents the value the participant places on that alter. This was taken as an index of their level of hypothetical giving to an alter.

Analysis. We estimated linear models with known predictors from previous research, including perceived social closeness to the alter, the perceived financial need of the alter, the genetic relatedness of the alter, and whether the alter was a participant's romantic partner (Hackman, Danvers, & Hruschka, 2015). We included whether an alter was an individual's romantic partner because it was a significant independent predictor of giving, above and beyond closeness, relatedness, and need in earlier work (Hackman, Danvers, & Hruschka, 2015). We also present in supplemental materials the results of models without romantic partner. To disentangle the influence of predictors at level 1 (the alters) and level 2 (the participants providing ratings), we included the average relatedness and the average level of need of alters nominated by each participant. Including these effects is a standard technique in multi-level modeling to isolate the level at which predictors are influencing outcomes (Snijders & Bosker, 1999). In this context, these predictors adjust for differences between participants in the number of family members listed as alters and the average need of all alters listed. Our hypotheses involved interactions at level 1, so these level-2 variables are statistical adjustments to improve the estimates of the terms of interest.

Our key hypotheses concern interactions, but we present both linear models without any interaction terms and then include models testing for the presence of interactions. We first estimated a model with all samples included and dummy codes used to test for differences between samples. However, after seeing several significant differences in effects across the samples, we decided to estimate and present separate models for each sample.

To assess whether need amplifies the effect of genetic relatedness and social closeness on giving, we included interaction terms for need by genetic relatedness and need by social closeness. All predictor variables involved in interactions were grand mean centered in their respective samples before the model was estimated. Our theoretical predictions were derived from including need in formal models of giving (described in Introduction). We assess the statistical significance of these theoretically motivated interactions at an alpha = 0.05 level, and keep them in the model regardless of their significance.

It is also important to assess if assumptions about the homogeneity of effects of key variables (e.g., need x relatedness) hold as other variables change (e.g., closeness). To assess whether the interaction of kinship and need is constant across varying levels of closeness, we started with a model with a three-way interaction between relatedness, need, and closeness, as well as all two-way interactions between these three variables. If terms used to assess assumptions about the homogeneity of effects—relatedness x need x closeness and relatedness x closeness—were not significant, we removed them from the model to avoid adding excess interactions. However, to ensure that terms are kept if there is any possibility that the assumption of homogeneity was violated, we used a liberal test to keep them in the model (alpha = 0.10).

Results

As in prior research, all key predictors were statistically significant in a model without interactions. These results are presented in Table 2.

<Insert Table 2 Here>

The final retained models including interactions are presented in Table 3. The observed and modeled associations are displayed in Figure 1.

<Insert Table 3 Here>

Does Need Amplify the Effect of Relatedness? Results indicate that there are significant interactions between relatedness and need in both U.S. online Mturk samples (Study 1: $b = 5.34$, $t\,(1401.2) = 3.43$, $p = .001$; Study 2: $b = 3.93$, $t\,(1042.5) = 2.63$, $p = .009$). Notably, in U.S. Mturk sample 1, the interaction of relatedness and need is attenuated with increasing values of closeness ($b = -2.15$, $t\,(1404.4) = -2.24$, $p = .025$). This is a consistent with a ceiling effect whereby high giving at high levels of closeness leaves little room for increases in the effect of relatedness. While need amplified the effect of relatedness in both U.S. online Mturk samples, it did not significantly moderate the effect of relatedness among U.S. undergraduates ($b = 0.84$, $t\,(655.4) = 0.42$, $p = .673$) or among Mturk users in India ($b = -1.27$, $t\,(386.1) = -0.47$, $p = .642$).

Does Need Amplify the Effect of Closeness? There was no evidence that need amplified the effect of closeness. In all the Mturk studies, this interaction was non-significant (Mturk U.S.

Study 1: $b = 0.05$, $t(1368.2) = 0.31$, $p = .757$; Mturk U.S. Study 2: $b = 0.22$, $t(1023.9) = 0.96$, $p = .336$; Mturk India: $b = -0.50$, $t(386.9) = -1.58$, $p = .114$). In the U.S. undergraduate sample, there was a significant interaction between need and closeness ($b = -1.44$, $t(646.8) = -4.70$, $p < .001$). However, in this case, need dampened rather than amplified the effect of closeness.

<Insert Figure 1 Here>

Tests of Homogeneity of Effects. In addition to the significant 3-way interaction in U.S. Mturk Sample 1, there was also an unexpected significant interaction between closeness and relatedness in U.S. Mturk Sample 2 ($b = 7.01$, $t(1014.5) = 2.27$, $p = .023$). This cannot be explained as a ceiling effect because closeness appears to amplify the effect of relatedness in this case.

Discussion

Modifications of Hamilton's inequality predict that relative need should amplify the effect of relatedness on giving. We found evidence supporting this prediction in two samples of U.S. Mturkers, a finding that is consistent with results from field-based studies among Tsimane horticulturalists (e.g. Hooper et al., 2015). However, need did not amplify the effect of relatedness in two other samples—U.S. undergraduates or Indian Mturkers. These results indicate that need does not only have a main effect on generosity, but can also change the way that other factors, such as genetic relatedness, are considered when determining how much to give to another person. However, these findings also raise important questions about why the predicted effects observed in the U.S. Mturk samples are not found among U.S. undergraduates or Indian Mturkers.

A similar modifications of Hamilton's inequality predicts that relative need would not amplify the effect of closeness on giving. This prediction held across all four samples. Indeed, the only significant interaction between need and closeness involved need *dampening*, rather than amplifying, the effect of closeness. This dampening is consistent with a ceiling effect whereby high levels of giving to needy partners leaves little room for closeness to have an effect on giving.

These results raise important questions about what affects the generalizability of findings across these samples. One possibility is methodological. For all samples, giving toward needy others was close the maximum amount when an alter was high in need, closeness, and relatedness, leaving less room for expression of amplifying effects. The potential for a ceiling effect can be seen in Figure 1A, which plots the raw data. In the left panel displaying giving to close others, the amount given to individuals is close to the maximum ($90) even for individuals low in need. The limited range of dollar values used in this sample might therefore have masked amplifying effects of need on relatedness among Indian Mturkers and U.S. undergraduates, who were more generous overall.

Another possibility has to do with different response styles. Specifically, participants recruited online from the U.S. tended to conform most closely to our predictions from formal models. These participants also tended to follow "consistent" responses styles by having no more than one crossover point in a series of social discounting decisions (Hruschka et al., in press; Tiokhin, Hackman, & Hruschka, preprint). By contrast, participants from other samples, most notably the Indian Mturk sample, showed higher levels of "inconsistent" responding. We show in the supplemental materials that respondents who respond with more than one crossover point ("inconsistent responses") usually show expected associations of giving with need and relatedness. However, this may also indicate a fundamental difference in how respondents react to the task that deserves further exploration and may account for differences in results.

This research operationalized need by asking participants a single question about how much the alter needed the money relative to the participant. Some theoretical approaches emphasize differences among temporary, acute need—as in the result of an environmental shock—and chronic need (e.g. Aktipis, Cronk, & Aguilar, 2011). In this literature need-based transfers would be expected under conditions of temporary, acute need, but not necessarily chronic need. However, research also shows that relatively chronic differences in need play an important role in people's willingness to share with and help others (Hooper, Gurven, Winking, & Kaplan, 2015; Hackman, Danvers, Hruschka, 2015). To assess the potential importance of acute vs. chronic need, future research should consider varying the temporal scale of financial need among alters: temporary financial shocks (like an unexpected medical expense) or a chronic financial deprivations (like underemployment).

Several studies have found evidence that specific factors—such as closeness, need, and relatedness—influence giving, but understanding the deeper algorithmic structure of giving decisions requires examining how these factors are combined in to make decisions. Formal models of giving, like Hamilton's rule, suggest that need should moderate the effects of other recipient characteristics in decision-making. If giving is governed by an interactive, and not additive, algorithm, then examining a single factor in isolation may give a misleading impression of its importance in decision-making.

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Table 1: Descriptive Statistics and Correlations of Key Variables by Sample

A: Mturk U.S. Study 1

Variable	*M*	*SD*	1	2	3
1. Giving	40.32	29.85			
2. Need	3.35	1.93	.43** [.39, .47]		
3. Relatedness	0.12	0.20	.39** [.35, .43]	.11** [.06, .16]	
4. Closeness	-2.30	1.55	.57** [.53, .60]	.16** [.11, .21]	.43** [.39, .47]

B: Mturk U.S. Study 2

Variable	*M*	*SD*	1	2	3
1. Giving	41.26	30.97			
2. Need	3.60	1.91	.43** [.38, .47]		
3. Relatedness	0.10	0.19	.34** [.29, .39]	.16** [.10, .21]	
4. Closeness	-2.17	1.54	.47** [.42, .51]	.11** [.05, .16]	.41** [.36, .45]

C: Mturk India Sample

Variable	*M*	*SD*	1	2	3
1. Giving	43.08	28.59			
2. Need	4.31	1.92	.38** [.29, .46]		
3. Relatedness	0.09	0.18	.35** [.27, .43]	.14** [.05, .23]	

4. Closeness	-2.31	1.57	.55** [.48, .61]	.30** [.22, .39]	.38** [.29, .45]

D: Undergraduate Sample

Variable	*M*	*SD*	1	2	3
1. Giving	51.58	28.70			
2. Need	3.57	1.90	.44** [.38, .50]		
3. Relatedness	0.13	0.20	.33** [.27, .40]	.11** [.03, .18]	
4. Closeness	-2.27	1.45	.54** [.49, .59]	.23** [.16, .30]	.55** [.49, .60]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. Correlations do not account for nesting within participants. * indicates $p < .05$. ** indicates $p < .01$.

Table 2: Regression Model with Main Effects Only

	U.S. Online 1			U.S. Online 2			India Online			Undergrad		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
Intercept	34.23	27.23 – 41.24	**<0.001**	27.92	19.44 – 36.40	**<0.001**	63.84	46.18 – 81.50	**<0.001**	51.77	39.82 – 63.72	**<0.001**
Need	4.73	4.18 – 5.28	**<0.001**	4.51	3.82 – 5.19	**<0.001**	5.06	3.96 – 6.17	**<0.001**	4.88	4.04 – 5.71	**<0.001**
Close	7.33	6.62 – 8.05	**<0.001**	7.97	7.07 – 8.87	**<0.001**	6.44	5.23 – 7.65	**<0.001**	7.47	6.20 – 8.74	**<0.001**
Related	29.43	23.87 – 34.98	**<0.001**	20.20	13.24 – 27.15	**<0.001**	32.45	21.14 – 43.76	**<0.001**	16.78	8.03 – 25.54	**<0.001**
Random Effects												
σ^2	256.99			297.56			277/85			292.13		
τ_{00}	211.12			279.42			213.88			199.78		
ICC	0.45			0.48			0.43			0.41		
Obs.	1511			1156			428			718		
Marg. R^2 / Cond. R^2	0.471 / 0.710			0.407 / 0.694			0.402 / 0.662			0.401 / 0.644		

Note: Model statistically controls for mean need and relatedness scores for each participant, so that the regression coefficients reported here can be interpreted as the within-subjects effects. Whether an alter was also a romantic partner was also included as a covariate. Coefficients and significance tests for these covariates are not reported for clarity. “Obs.” signifies observations. “Marg.” signifies marginal. “Cond.” signifies conditional.

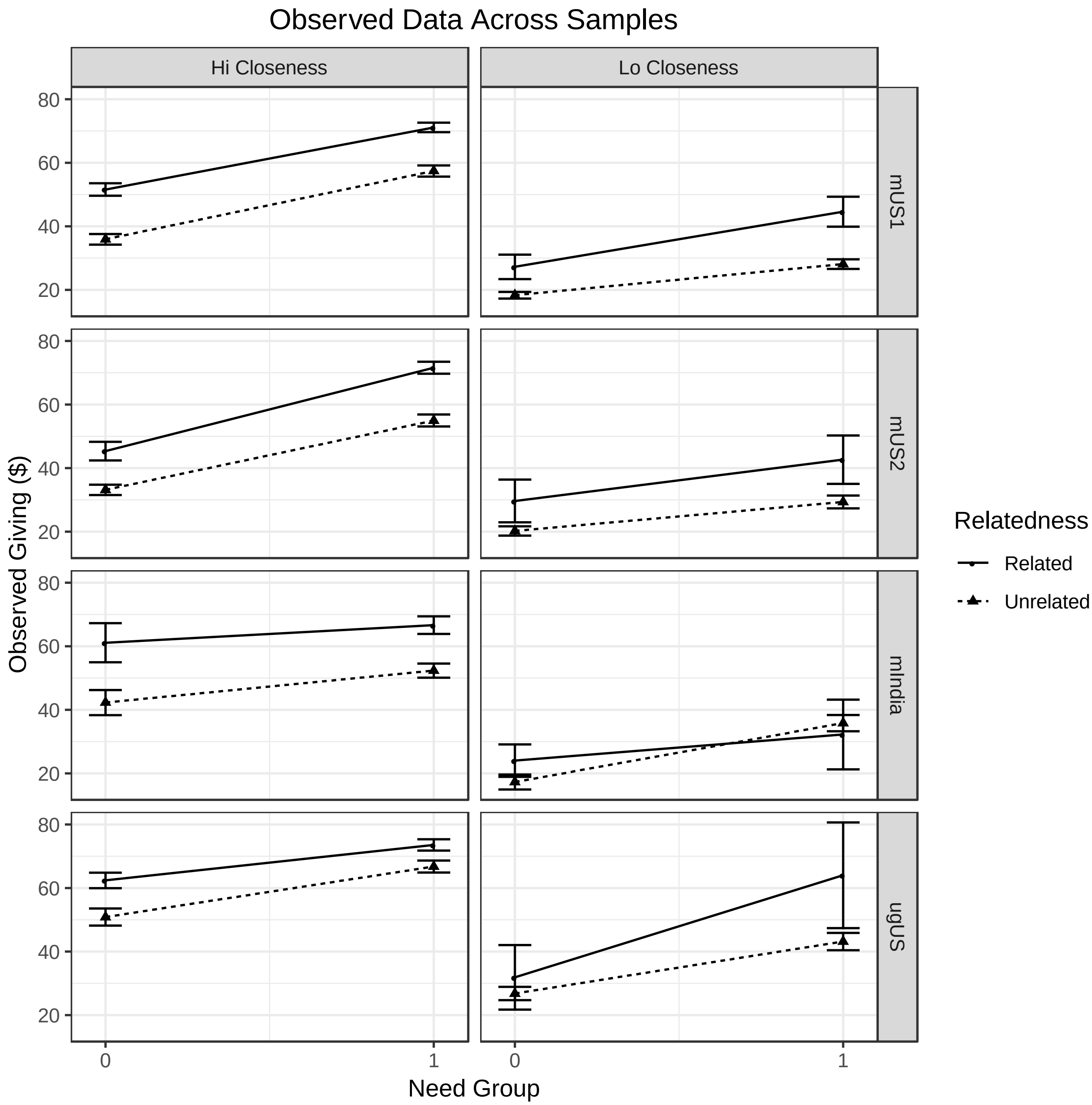
Table 3: Final Results of Exploratory Full Factorial Interaction Modeling

	U.S. Online 1			U.S. Online 2			India Online			Undergrad		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
Intercept	34.31	27.24 – 41.39	**<0.001**	26.08	17.52 – 34.64	**<0.001**	64.83	47.23 – 82.44	**<0.001**	52.56	40.80 – 64.32	**<0.001**
Need	4.82	4.21 – 5.43	**<0.001**	4.10	3.38 – 4.81	**<0.001**	5.08	3.97 – 6.18	**<0.001**	5.25	4.42 – 6.09	**<0.001**
Close	7.44	6.72 – 8.16	**<0.001**	8.31	7.36 – 9.25	**<0.001**	6.37	5.16 – 7.58	**<0.001**	7.41	6.16 – 8.65	**<0.001**
Related	28.84	23.31 – 34.37	**<0.001**	10.37	0.50 – 20.24	**0.040**	32.95	21.30 – 44.60	**<0.001**	17.16	8.46 – 25.86	**<0.001**
Need x Close	0.05	-0.28 – 0.38	0.757	0.22	-0.22 – 0.66	0.335	-0.50	-1.12 – 0.12	0.113	-1.44	-2.04 – -0.84	**<0.001**
Need x Related	5.34	2.29 – 8.39	**0.001**	3.93	1.00 – 6.85	**0.009**	-1.27	-6.64 – 4.09	0.642	0.85	-3.09 – 4.78	0.550
Close x Related		-		7.01	0.96 – 13.06	**0.023**		-			-	
Need x Close x Related	-2.15	-4.04 – -0.27	**0.025**		-			-			-	
Random Effects												
σ^2	253.20			291.33			275.14			280.41		
τ_{00}	215.55			282.83			211.77			193.72		
ICC	0.46			0.49			0.43			0.41		
Obs.	1511			1156			428			718		
Marg. R^2 / Cond. R^2	0.473 / 0.715			0.411 / 0.701			0.407 / 0.665			0.419 / 0.656		

Note: Model statistically controls for mean need and relatedness scores for each participant, so that the regression coefficients reported here can be interpreted as the within-subjects effects. Coefficients and significance tests for these covariates are not reported for clarity. “Obs.” signifies observations. “Marg.” signifies marginal. “Cond.” signifies conditional.

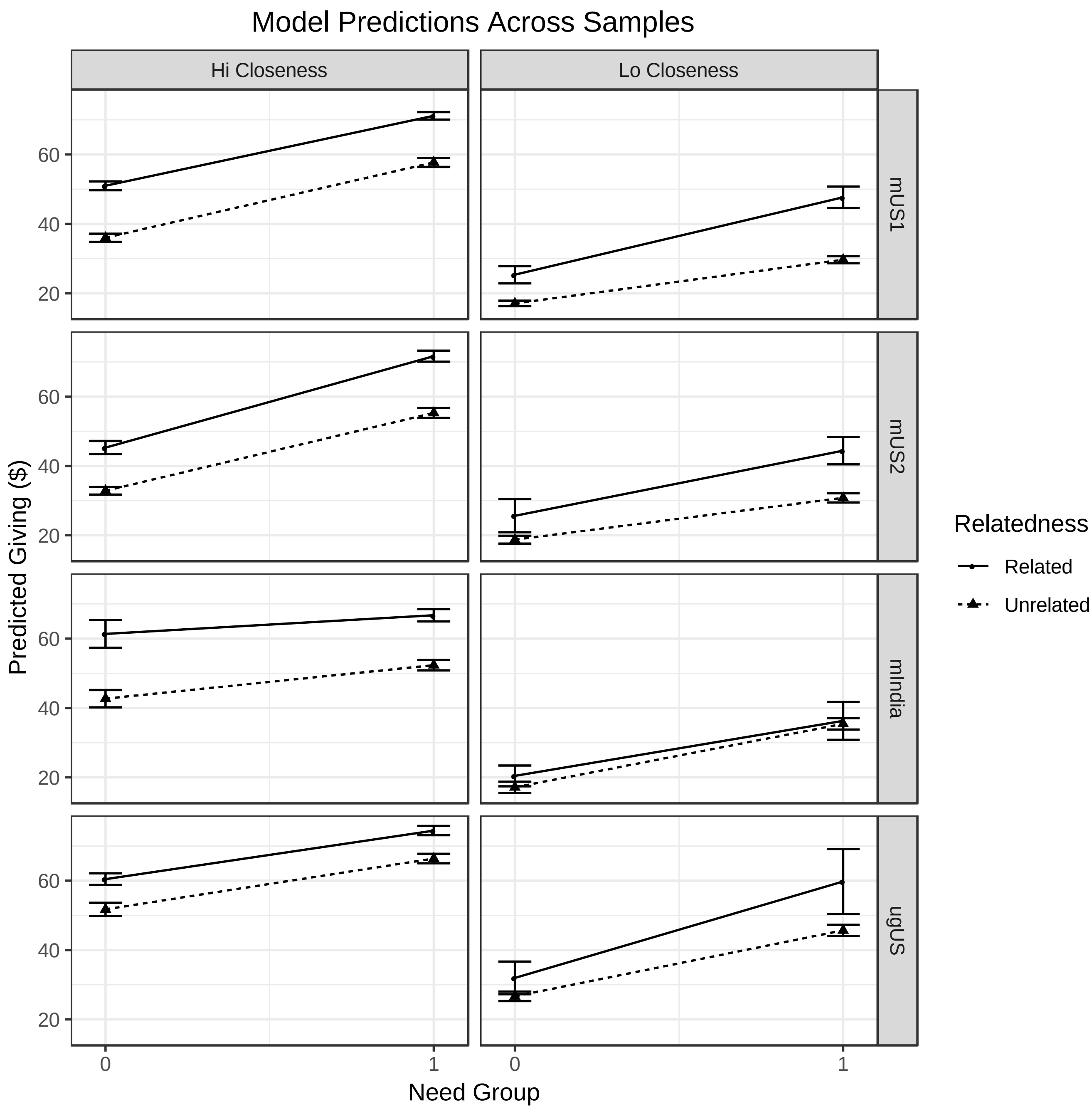
Figure 1: Interaction of Need with Relatedness in Predicting Giving

A: Observed Three Way Relationships by Sample



Note: Need scores were recoded as 0 if they were below 4 on the original Likert scale, and recoded as 1 if they were at or above 4. Closeness was recoded as high if the alter was ranked as among the top 10 for a participant, and as low if the alter way below this. All values were analyzed as continuous variables, but are presented as dichotomous to more clearly visualize trend. Error bars represent the standard error of the mean. Sample labels are as follows: mUS1: Mturk US Study 1. mUS2: Mturk US Study 2. mIndia: Mturk India. ugUS: Undergraduate US.

B: Model Estimated Three Way Relationships by Sample



Note: The same divisions were used as in 1A. Plotted data is of model predictions, averaging across covariates (e.g., mean relatedness of alters, mean need of alters, romantic partner).