

Fitness interdependence as indexed by shared fate: Factor structure and validity of a new  
measure

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## Abstract

Assessing interdependence between self and specific others has a rich history in psychological science. Here, we report a novel scale to measure Shared Fate. Studies 1 and 2 ( $N_1 = 198$ ,  $N_2 = 216$ ) show that the Shared Fate scale has two factors assessing perceived shared fate and emotional shared fate with a target, has good reliability (Cronbach's alpha = 0.81 to 0.91; McDonald's omega = 0.89 to 0.96), and predicts participants' willingness to help interdependent others. Studies 3 and 4 ( $N_3 = 695$ ,  $N_4 = 629$ ) indicate that the Shared Fate scale has good discriminant, convergent, concurrent, and predictive validity as well as test-retest reliability across a 14-day period. Taken together, our results suggest that Shared Fate scale is a useful instrument for work on cooperation, interdependence, and social behavior. However, there are still many open questions about the cognitive architecture underlying perceptions of shared fate and how shared fate interacts with genetic relatedness and other sources of fitness interdependence.

*Keywords:* perceived interdependence, closeness, willingness to help, interdependence

**Public significance:** While interdependence has a long and rich history in social psychology, evolutionary psychologists have recent begun to incorporate this concept into their work by assessing how *fitness* interdependence influences social relationships. Here, we created and assessed a novel scale that shows how one's perceptions of shared fate impacts willingness to help others. With the help of a scale that allows for the measurement of Shared Fate, future work can investigate the causes of fitness interdependence and its consequences for human relationships and human societies.

## Fitness interdependence as indexed by shared fate: Factor structure and validity of a new measure

The concept of interdependence has a long, rich history in psychology (Thibaut & Kelley, 1959). It has been incorporated into an evolutionary framework via the concept of *fitness* interdependence (Brown, 1999; Burtsev, 2003; Durham, 1976; Hoekstra et al., 1991; Petersen et al., 2010; Roberts & Sherratt, 2007; Schlosser & Wagner, 2008; Tooby & Cosmides, 2010), or “the degree to which two or more organisms influence each other’s success in replicating their genes” (Aktipis et al., 2018). Fitness interdependence can be negative -- when organisms compete for the same finite resources -- or positive -- when organisms mutually depend on each other for survival and reproduction. Positive fitness interdependence captures entwined fitness interests that arise from shared needs, goals, or fates (Brown, 1999) at the dyadic (Rusbult, 1983; Thibaut & Kelley, 1959) or group level (Bloch, 2013; Rabbie, 1991; Rabbie & Horwitz, 1988).

Fitness interdependence underlies many ultimate evolutionary explanations for behaviors that benefit others but cost the actor (Aktipis et al., 2018), including inclusive fitness (Hamilton, 1964), reciprocity (Axelrod & Hamilton, 1981; Trivers, 1971), stakeholder theory (Roberts, 2005), and the cultivation and maintenance of enduring bonds (Brown, 1999; Brown & Brown, 2006; Hruschka, 2010; Tooby & Cosmides, 1996). Theoretical models suggest that interdependence-based altruism towards non-kin evolved because individuals had repeated interactions (Barclay, 2020) or shared resources in challenging environments (Aktipis et al., 2011, 2016; Cashdan, 1985; Hao et al., 2015; Kaplan et al., 1985). Further, interdependence from activities such as food sharing and cooperative hunting has been proposed as an important contributor to the evolution of human cooperation (Tomasello et al., 2012).

Although interdependence is an important force for aligning interests between individuals, it is not possible for an individual in a given social situation to definitively know the objective extent to which they are interdependent with others in that situation. However, psychological

variables such as “closeness,” “oneness,” and other proximal indicators of aligned interests (Balliet et al., 2017; Columbus et al., 2020; Gerpott et al., 2018) may approximately capture the extent to which a dyad or group is interdependent. Because these proximal variables are believed to be associated with long-term fitness outcomes, fitness interdependence can be indirectly assessed with measures of these variables. As an example, research on incest avoidance has shown that cues such as early life co-residence contribute to perceptions of genetic relatedness (Lieberman et al., 2007; Sznycer et al., 2016) and, ultimately, to perceptions of interdependence. Similarly, the use of kin terms increases perceptions of interdependence (Cronk et al., 2019).

Previous research has shown that interdependence is proximately perceived in several other ways beyond those mentioned here (e.g., Campbell, 1965; Deutsch, 2015; Rabbie et al., 1989; Rabbie & Horwitz, 1988; Tajfel & Turner, 1979; Tomasello et al., 2012). However, in this paper we focus on an aspect of perceived interdependence that has received far less empirical attention – shared fate with a specific other (e.g., Brown, 1999; Wilson & Sober, 1994). Shared fate has a powerful influence on shaping cooperative interactions -- when the fates of two or more individuals are yoked together, they are more likely to behave prosocially (Campbell, 1965; Foster, 1965; Olson, 1965) and to enhance the others' welfare even at a personal cost (Aktipis et al., 2011, 2018; Delton, 2010; Delton & Robertson, 2016; Tooby & Cosmides, 1996). Despite the power that shared fate has in shaping cooperative relationships, individual-level perceptions of shared fate have remained largely unstudied. To address this gap in the literature, we created a new scale that assesses perceived shared fate as a proximate measure of fitness interdependence.

***Previous research on shared fate.*** There is a rich body of work in psychology assessing proximate motivations and behaviors underlying interdependence (Aron et al., 1991; Batson, 2011; Chopik et al., 2017). In social psychology, outcome interdependence assesses structural and abstract properties that characterize interactions between people (Kelley &

Thibaut, 1978; Thibaut & Kelley, 1959; Van Lange & Vuolevi, 2010). This tradition focuses on situational approaches to interdependence, examining how the outcomes of social situations foster relationships with different levels of interdependence between partners (Balliet et al., 2017; Galovan et al., 2017; Johnson, 2003; Thibaut & Kelley, 1959). From this perspective, two individuals, if they have shared fates, could be considered to be in a relationship of mutual dependence and common interests. However, because this approach focuses on situational variation in interdependence, it leaves certain questions unresolved. For instance, it is unclear if variation in perceived shared fate is stable across different dyads in the same situation. Furthermore, beyond situational variation, it is likely that perceived shared fate can also be attributed to differences in relationships (e.g., kin versus friends versus enemies).

Research on the importance of interdependence in close relationships begins to highlight why situational accounts may be incomplete, as both mates and close friends provide emotional and material support to each other (Aron et al., 1991; Rusbult, 1983), yet the extent to which interdependence manifests in these relationships is not the same. Psychologists have focused on measuring subjective interdependence in these relationships using concepts such as mutual dependence, irreplaceability, and closeness (Bell et al., 1995; Brown, 1999; Gerpott et al., 2018). Other methods that assess common interests and shared fate use spatial and physical metaphors such as proximity and physical merging (Aron et al., 1991; Cialdini et al., 1997; Hackman et al., 2015, 2017; Jones & Rachlin, 2006; Korchmaros & Kenny, 2001; Vezzali et al., 2016). However, these relational approaches to interdependence have not yet developed a general and direct measure of perceived shared fate that can be utilized across different relational and social targets (e.g., partners, kin, friends, enemies, groups). This is because relational approaches either sample shared fate exclusively at the dyadic-relational level, or (in the metaphor-based approaches) focus on perceptions of closeness rather than shared fate *per se*.

***The present research.*** Shared fate has been assumed to be essential to interdependence in previous investigations, but extant measures are not well-equipped to assess how perceived shared fate changes across relational targets and beyond situational variations. We therefore aimed to design a scale that would directly assess perceived shared fate as a stable (i.e., cross-situational) indicator of the self's relationship to varying social targets (e.g., partners, kin, friends, enemies). Previous research suggests that perceived shared fate may manifest in certain emotions and perceptions such as mutuality, closeness, perspective-taking, oneness, shared agency, and partner-specific empathy (Aron et al., 1992; Brown 1999; Chang et al., 2010; Davis, 1980; Fischer et al., 2012; Korchmaros & Kenny, 2001). We therefore created the Shared Fate scale to focus on how individuals perceive their outcomes and emotions to be entwined with those of another. We were specifically interested in developing a brief measure with high face validity so one could easily measure the extent to which people perceive that they have shared fate with a given other individual *X in general—that is, irrespective of the various possible situations or contexts in which the self and X may find themselves in.*

In addition, we aimed to measure a related aspect of shared fate: the emotional reactions that one has to the outcomes of interdependent others (Gervais & Fessler, 2017; Sznycer & Lukaszewski, 2019). The inclusion of emotional shared fate in our scale distinguishes our scale from others because it allows us to assess how one's emotional responses to *changes* in a target's welfare affect interdependence as opposed to focusing on how the value placed on the target's welfare shapes overall affect towards a target (as in welfare trade-off ratios and emotions associated with helping in the absence of reciprocity; Brown, 1999; Delton & Robertson, 2016; Sznycer et al., 2019; Tooby et al., 2008). A measure assessing these emotional changes is useful for a number of reasons, including being able to predict how variation in shared fate with different targets will relate to different behaviors toward those



targets (e.g., in crisis situations) and relates to other objective indicators of fitness interdependence (e.g., genetic relatedness).

However, because no such measure yet exists in the literature, our primary aim was to design a scale to measure perceptions of shared fate. In establishing this scale, we conducted four studies to assess its factor structure; its predictive, concurrent, discriminant, and convergent validity; and its test-retest reliability. Due to the exploratory nature of the studies, we did not preregister these analyses. We conducted an exploratory factor analysis in study 1 and a confirmatory factor analysis in study 2 to assess factor structure. Studies 3 and 4 assess the validity and reliability of the scale. We report all manipulations, measures, and exclusions in these studies.

## Pilot study

### Item generation

Item generation focused on creating basic verbal indicators of how people view their welfare as associated with the welfare of others (see Table 1 for all items that were considered for this scale). All authors were affiliated with the [Human Generosity Project](#) (Aktipis et al., 2011, 2016; Cronk & Aktipis, 2018; Cronk et al., 2019; Hao et al., 2015), and were involved in item creation or provided feedback about the appropriateness of these items in Western and non-Western societies as is best practice in scale development (DeVellis, 2016; Fowler, 1995; Morgado et al., 2017). As stated previously, we emphasized the face validity of these items so they could be used in a variety of cross-cultural settings.

Table 1.  
All possible items generated before item selection and reduction.

Item	Response scale
When something good happens to [target], that is...	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>
When something bad happens to [target], that is... (RC)	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>

When something good happens to me, that is...	-3 <i>Very bad for X</i> , 0 <i>neither good nor bad for X</i> , +3 <i>Very good for X</i>
When something bad happens to me, that is... (RC)	-3 <i>Very bad for X</i> , 0 <i>Neither good nor bad for X</i> , +3 <i>Very good for X</i>
When something happens that increases [target]'s material wealth, that is...	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>
When something happens that decreases [target]'s material wealth, that is... (RC)	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>
When something happens that makes [target] feel good, that is...	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>
When something happens that makes [target] feel bad, that is... (RC)	-3 <i>Very bad for me</i> , 0 <i>Neither good nor bad for me</i> , +3 <i>Very good for me</i>
When something good happens to [target], that is...	1 <i>Neither good nor bad for me</i> , 4 <i>Very good for me</i>
When something good happens to [target], that is...	1 <i>Neither good nor bad for me</i> , 4 <i>Very bad for me</i>
When something bad happens to [target], that is... (RC)	1 <i>Neither good nor bad for me</i> , 4 <i>Very good for me</i>
When something bad happens to [target], that is... (RC)	1 <i>Neither good nor bad for me</i> , 4 <i>Very bad for me</i>
[target] and I rise and fall together.	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
I feel that [target]'s gain is my gain, and [target]'s loss is my loss.	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
I feel that [target]'s gain is my loss, and [target]'s loss is my gain. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
Honestly, I don't really care whether [target] thrives or not. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
What is good for [target] is good for me.	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
What is good for [target] is bad for me. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
When [target] fails, I feel bad.	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
When [target] fails, I feel good. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
When [target] succeeds, I feel bad. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
When [target] succeeds, I feel good.	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>
Life without [target] would be better for me. (RC)	1 <i>Do not agree at all</i> , 7 <i>Strongly agree</i>

Life without [target] would be impossible for me. 1 *Do not agree at all*, 7 *Strongly agree*

[target] and I share a common fate. 1 *Do not agree at all*, 7 *Strongly agree*

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*\*Note.* [target] represents the target. In the pilot survey, participants reported the names of multiple targets. When participants were presented with questions about specific targets, the name of that target was propagated into the questions.

## Participants

99 United States participants (39 female) with 97% positive ratings were recruited via Mturk and paid \$5 for their participation. Two participants were removed from the analyses because of inattention, leaving a final sample of 97 participants (39 females,  $M_{age} = 34.00$ ,  $SD_{age} = 12.00$ ). Participants completed the potential items towards five target individuals: a sibling, a friend, an acquaintance, a stranger, and an enemy.

## Item selection

All participants responded to all items listed in Table 1 for each target. These items were generated based on the recommendations of team members who collect data at non-Western field sites to ensure that the items were easily interpretable and understandable across a wide variety of societies. After the participants completed all measures, we computed correlations between items, reliability and dimensionality indices, and principal component extractions. The items were highly correlated ( $r$ 's > 0.50) across all target categories, so we were not able to exclude potential items from the scale for being unrelated to perceived interdependence. As such, we focused our item selection criteria on how the items clustered together in terms of reliability, dimensionality, and the principal component extractions. This strategy resulted in two potential versions of the Shared Fate scale based on the item clustering. One scale assessed global attitudes and emotions about shared fate with the target (Shared Fate scale; Table 2) and the other scale assessed participants' perceptions of yoked outcomes between themselves and the target (Correlational Shared Fate scale; supplementary material Table S5). However, when considering the mean item correlations across targets, it was clear that the Shared Fate scale's

items were more closely correlated ( $r$ 's = 0.45 – 0.61) and therefore would be most appropriate for psychometric analysis<sup>1</sup>.

Table 2.

Items retained for the Shared Fate scale.

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When X succeeds, I feel good.

When X fails, I feel bad.

I feel that X's gain is my gain.

What is good for X is good for me.

Honestly, I don't care whether X thrives or not. (RC)

X and I rise and fall together.

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## Study 1 and Study 2 Method

### Participants

Based on power analyses with  $\alpha$  of .05, 80% power, and an effect size estimate of  $f^2 = 0.06$ , we determined that we needed a sample size of at least 200 participants for Study 1 and Study 2. We chose  $f^2 = 0.06$  to ensure we were sufficiently powered to detect effects with these new items. A sample size of 200 is also reasonable for the exploratory and confirmatory factor analyses models that we planned to run (Wolf et al., 2013).

For study 1, we recruited 200 participants in August 2016, offering a \$5 payment for participation. Two participants were removed from the analyses because of inattention, leaving a final sample of 198 (93 females;  $M_{age} = 34.00$ ,  $SD_{age} = 10.00$  years).

For study 2, we recruited 223 participants in March 2017 ( $M_{age} = 34.00$ ,  $SD_{age} = 9.00$ ; 121 females), offering a \$5 payment for participation. All participants passed a comprehension check question embedded in the survey.

### Materials and Procedures

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<sup>1</sup> For completeness, we also present the psychometric analysis of Correlational Shared Fate in the supplementary materials.

In both studies, participants completed our measure of Shared Fate as well as other measures of interdependence and willingness to help several targets, including family members and non-relatives. We included multiple measures of interdependence from the literature to assess 1) if our measure predicts willingness to help others in the same way as these measures and 2) to see how our measure compared to others when we used statistical approaches that controlled for the variance associated with each measure. Participants provided the first name of each target at the beginning of the study, and those names were automatically inserted into the questionnaire. Participants answered all questions for one target before moving on to the next. Targets, measures within targets, and items within measures were randomized. All questions and wordings are presented in the supplemental materials.

In study 1, targets included a friend, sibling, stranger, acquaintance, and enemy. In study 2, targets included a friend, sibling, acquaintance, cousin, aunt/uncle, and niece/nephew. There were many missing responses for nieces/nephews (26%), so we ran analyses both with and without this category of relationships. The exclusion of this category did not affect the results, so we present the analyses with nieces/ nephews included.

*Shared Fate scale.* This scale consists of items assessing global attitudes and emotions about shared fate with the target (e.g., When [target] succeeds, I feel good).

*Fitness Interdependence – Mutualism (Brown, 1999).* This scale consists of three items that measure the degree of mutual interdependence for fitness-related outcomes (e.g., I feel like I need [target] as much as they need me). Importantly, while this measure has more conceptual overlap with our Shared Fate scale than any extant measure, it does not specifically index perceptions of yoked material outcomes, instead being a more abstract measure of mutual dependence.

*Inclusion of the Other in the Self Scale (IOS; Aron et al., 1992).* This scale – which represents the metaphorical approach to assessing interdependence in psychology – consists

of overlapping circles and participants select the set of circles that best represents their relationship with the target (Figure 1).

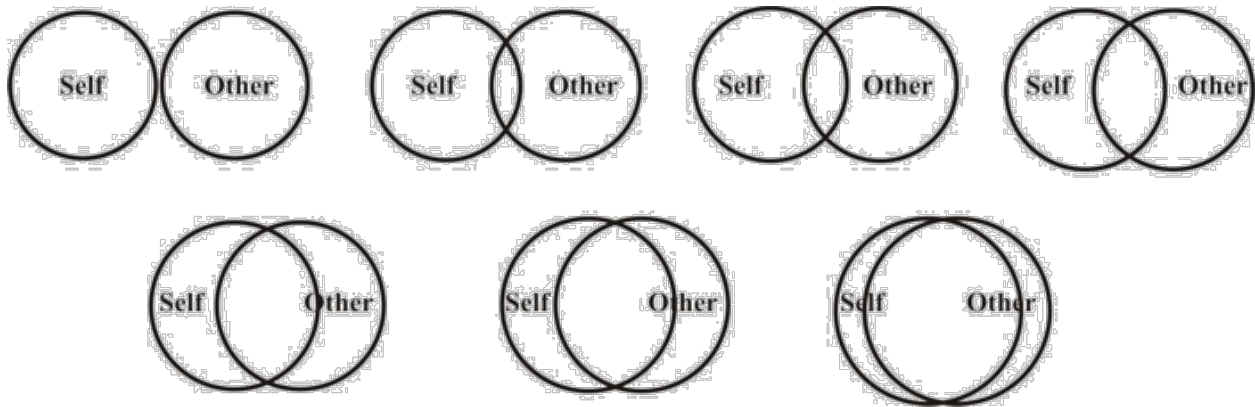


Figure 1. The IOS (Aron et al., 1992) was included in this study to determine whether Shared Fate predicted variation in willingness to help above and beyond the IOS.

*Closeness* (Korchmaros & Kenny, 2001). As a second metaphorical indicator of interdependence, this question asks, “How close do you feel toward [target]?” on a scale from 1 “not at all close” to 7 “extremely close”. This question was asked only in Study 2.

*Genetic relatedness.* As a more objective indicator of interdependence, participants were asked (a) if their sibling was a full, half, step-, or adopted sibling, (b) if their uncle/aunt was a parent’s sibling or a parent’s sibling’s spouse, and (c) if their nephew/niece was a sibling’s offspring or a spouse’s sibling’s offspring. We then assigned genetic relatedness between the participant and each target (see supplemental materials for assigned relatedness).

We included multiple outcome measures in this study in order to assess the discriminant and predictive validity of our scale compared to existing scales in the literature. Because previous literature has documented the relationships between existing measures of interdependence and willingness to help others (Aron et al., 1992; Brown, 1999; Delton & Robertson, 2016; Sznycer et al., 2019; Tooby et al., 2008), we included multiple measures of willingness to help others as outcome measures in order to assess differences in the operationalization of willingness to help others that can be attributed our Shared Fate measure.

*Willingness to help in times of need.* This scale includes seven questions about situations where there is an opportunity to help a target in need of help (e.g., How willing would you be to help [target] move boxes to their new apartment?). This scale does not specify that repayment is required nor assess how much of one's own welfare is sacrificed to help another. We included this scale as an outcome measure to help indicate discriminant and predictive validity for our Shared Fate scale. Cronbach's  $\alpha$ 's across the questions ranged from 0.83 to 0.88. Because we created this scale, we assessed the dimensionality of our willingness to help scale using the Kaiser criterion of eigenvalues (Kaiser, 1958), scree plots (Cattell & Vogelman, 1977), and parallel analysis (O'Connor, 2000). The results of these analyses suggest that a one-factor solution should provide the best fit. We, therefore, created a composite score for the items.

*Help in the absence of reciprocity (Brown, 1999).* As an additional outcome measure, this scale includes nine questions presented in Brown (1999) but removed before the final stage of analyses. We selected this scale, as opposed to Brown's other investment scales, because we believe it closely represents a person's willingness to help another in the absence of social bonds (e.g., I would help [target], even if [target] could never return the help). We created a composite score for this variable as discussed in Brown (1999). This scale was also included in order to show that our Shared Fate scale has discriminant and predictive validity.

*Welfare Tradeoff Ratio (WTR).* Our final outcome measure was a hypothetical money-allocation task that presents a set of ten decisions per target (Delton & Robertson, 2016; Sznycer et al., 2019; Tooby et al., 2008). We included this measure as an outcome because WTR is used to show how much of one's own welfare an individual is willing to sacrifice in order to help another -- or, in other words, the conditions under which participants will forgo personal benefits to help another. In each set, participants choose between one of two options (see Table S1 for all allocation options): an amount of money for themselves with no money for the target (the *Self* option), or an amount of money for the target with no money for themselves (the *Other*

option; Jones & Rachlin, 2006). This task estimates the largest amount of money the participant would forego in order to benefit another. We operationalized participants' Welfare Tradeoff Ratios (WTR) as the mean of (i) the highest cost/benefit ratio where the participant chooses for the *Other*, and (ii) the lowest cost/benefit ratio where the participant chooses for the *Self*. 84-90% of the decision sets were completed in a consistent manner (i.e., with either 0 or 1 shifts between *Other* and *Self* choices). Again, this measure was included in order to show that our Shared Fate measure had discriminant and predictive validity.

## **Analyses**

### **Exploratory and Confirmatory Factor Analyses**

We assessed the underlying factor structure of the Shared Fate scale by performing exploratory factor analyses in R (R Core Team, 2013) using the psych package (Revelle, 2016) and confirmatory factor analyses in R using the lavaan package (Rosseel, 2012). Code and data for the analyses is available at [https://osf.io/xp65s/?view\\_only=f2100322c5064f0b8095337f6f259981](https://osf.io/xp65s/?view_only=f2100322c5064f0b8095337f6f259981).

### **Correlation with extant interdependence measures**

In Studies 1 and 2, we assess the degree to which the new Shared Fate measure correlates with measures related to proximate indicators of fitness interdependence.

### ***Predicting willingness to help***

We used linear mixed models to evaluate whether Shared Fate predicted participants' willingness to help after controlling for other relevant variables in Study 2. We included individual-level random intercepts. The predictor variables were relationship-level variables (*Shared Fate scale*, *Fitness Interdependence – Mutuality*, *IOS*, *Closeness*, and genetic relatedness) and participant-level variables (age and gender). For all models, sex was dummy coded such that males = 1 and females = 0.

## **Study 1 and 2 Results**

### **Reliability and validity of measures**



The Shared Fate scale showed good reliability across all targets (Study 1 Cronbach's  $\alpha = 0.81$  to  $0.91$ , McDonald's  $\omega = 0.89$  to  $0.96$ ; Study 2 Cronbach's  $\alpha = 0.86$  to  $0.91$ , McDonald's  $\omega = 0.92$  to  $0.95$ ). We found that the Shared Fate measure correlated with validated measures of interdependence using different conceptualizations, indicating acceptable concurrent validity (see Table 4). Other interdependence measures (Cronbach's  $\alpha = 0.93$  to  $0.95$ ) and willingness to help measures showed good reliability across targets (Help in the absence of reciprocity Cronbach's  $\alpha = 0.86$  to  $0.92$ ; Help in times of need Cronbach's  $\alpha = 0.82$  to  $0.88$ ).

### **Exploratory Factor Analysis (Study 1)**

To determine the number of factors to extract, we used the Kaiser Criterion (Kaiser, 1958), screeplots (Cattell & Vogelman, 1977), and parallel analysis (O'Connor, 2000). These indices gave slightly different results, suggesting that one to two factors should be extracted for each target. As such, we examined one and two-factor solutions for each target as well as data across targets. While the one-factor solution was interpretable, the fit statistics indicated that the one-factor solution was not a good fit for the data (individual targets,  $\chi^2(9) = 63.48 - 274.60$ , all  $p$ 's  $< 0.001$ , SRMRs =  $0.08 - 0.16$ , TLIs =  $0.41 - 0.83$ , RMSEAs =  $0.17 - 0.38$ ; across targets,  $\chi^2(9) = 984.36$ ,  $p < 0.001$ , SRMR =  $0.08$ , TLI =  $0.74$ , RMSEA =  $0.328$ , 90% CI [ $0.31, 0.37$ ]).

The two-factor solution was interpretable, and fit statistics indicated that the two-factor solution was a good fit for the data (individual targets,  $\chi^2(4) = 2.31 - 7.08$ ,  $p$ 's =  $0.13 - 0.68$ , SRMRs =  $0.01 - 0.02$ , TLIs =  $0.98 - 1.00$ , RMSEAs =  $0.00 - 0.062$ , factors correlated  $0.49 - 0.69$ ; across targets,  $\chi^2(4) = 9.05$ ,  $p = 0.06$ , SRMR =  $0.00$ , TLI =  $0.997$ , RMSEA =  $0.04$ , 90% CI [ $0.00, 0.07$ ]). However, simple structure was not achieved for two of the six targets. These two factors accounted for  $77.38\% - 92.00\%$  of the variance in responses.

We investigated the models where simple structure was not obtained (enemy and acquaintance). For the enemy target, "I feel that X's gain is my gain" cross-loaded. For the acquaintance target, "What is good for X is good for me," cross-loaded. We plotted the loadings

for both targets (Figure S1 shows plots of factor loadings for all targets) to gain a better understanding about the nature of the cross-loadings. We determined that the item “What is good for X is good for me” should be allowed to cross-load as this item loaded similarly on both factors for both targets (see Table 3).

Table 3.

*Factor loadings for the two-factor solution of the Shared Fate scale in study 1 across targets.*

	Emotional Shared Fate (ESF)	Perceived Shared Fate (PSF)
When X succeeds, I feel good	<b>0.93</b>	0.03
When X fails, I feel bad	<b>0.87</b>	0.06
I feel that X’s gain is my gain	0.06	<b>0.90</b>
What is good for X is good for me	<b>0.19</b>	<b>0.74</b>
Honestly, I don’t care whether X thrives or not (RC)	<b>0.88</b>	-0.06
X and I rise and fall together	-0.10	<b>0.98</b>
	SS loading = 2.55 Variance explained = 0.42	SS loading = 2.44 Variance explained = 0.41
Factors correlated $r = 0.78$ .		

\*Note. Bolded loadings indicate which factor the items are most strongly loaded on.

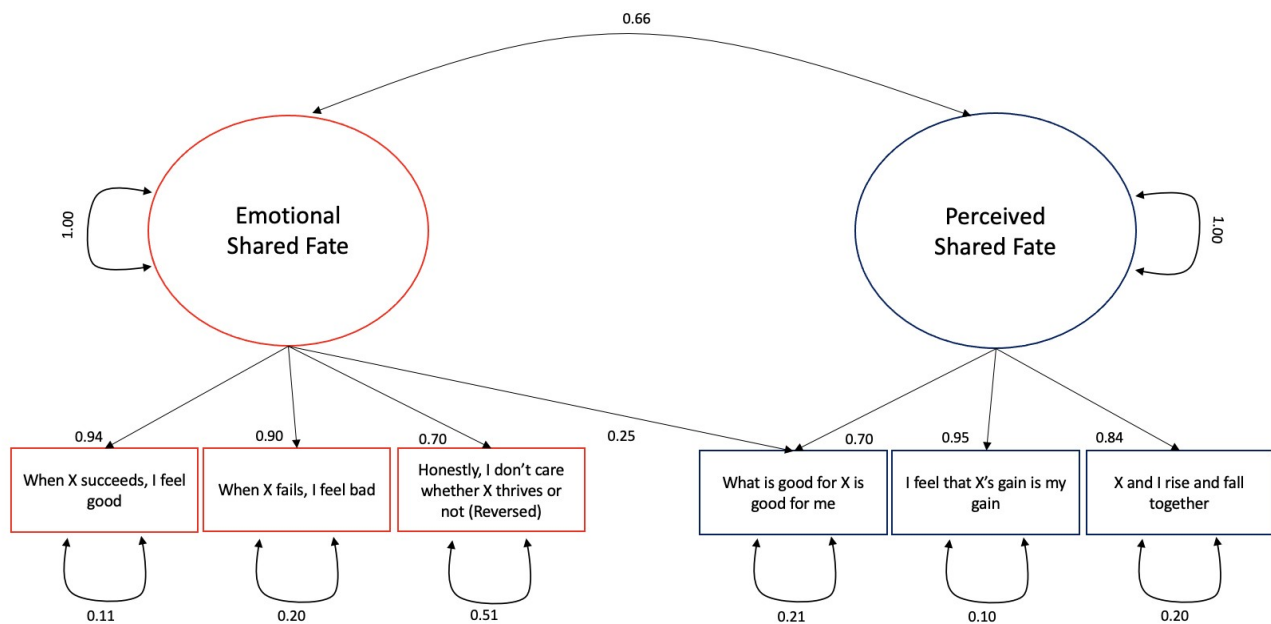
## Confirmatory factor analysis (Study 2)

Next, we performed confirmatory factor analyses on the data collected in Study 2. First, we considered the two-factor solution without cross-loadings. For all models, the two-factor solution without cross-loadings was not a good fit for the data (individual targets,  $X^2(8) = 22.24 - 50.32$ , all  $p$ ’s < 0.004, CFIs = 0.97 - 0.98, TLIs = 0.94 - 0.97, SRMRs = 0.03 - 0.05, RMSEAs = 0.09 - 0.15; across targets,  $X^2(8) = 149.02$ ,  $p < 0.001$ , CFI = 0.98, TLI = 0.96, SRMR = 0.04, RMSEA = 0.11, 90% CI [0.10, 0.13]).

We then considered the two-factor solution with cross-loadings. For all but one model, the two-factor solution with cross-loadings fit the data well (individual targets,  $X^2$ s (7) = 2.85 - 11.94,  $p$ 's = 0.10 - 0.90, CFIs = 0.99 - 1.00, TLIs = 0.97 - 1.00, SRMRs = 0.007 - 0.04, RMSEAs = 0.00 - 0.06; across targets,  $X^2$  (7) = 24.27,  $p$  = 0.001, CFI = 1.00, TLI = 0.99, SRMR = 0.017, RMSEA = 0.042, 90% CI [0.025, 0.061]). The only model where this solution did not achieve traditional fit statistics cutoff values was for the “close friend” target,  $X^2$  (7) = 18.79,  $p$  = 0.009, CFI = 0.99, TLI = 0.97, SRMR = 0.03, RMSEA = 0.083, 90% CI [0.04, 0.13].

Figure 2.

Confirmatory factor structure across targets based on data collected in study 2 shows that there are two factors in the Shared Fate scale, one factor identified by 4 items and the other factor identified by 3 items. Higher factor loadings indicate stronger relationships between the measured and latent variables. Residual variances for each measured variable are presented under the items.



## Assessing measurement invariance

One of our goals was to create a scale that measures feelings and perceptions of Shared Fate across many different types of relationships because this is not yet easily and directly achieved with any extant measures. In order to assess this, we investigated measurement invariance to show that our items have the same meaning across targets and participants (Lee, 2018). We are most concerned with configural invariance, where the pattern of latent constructs is the same across targets (Putnick & Bornstein, 2016). We also looked at metric invariance, where relationships between manifest variables and latent constructs hold across groups (Putnick & Bornstein, 2016). We do not expect to see metric invariance, because we do not think manifest variables in our scale would contribute equally to the latent constructs across different targets.

First, we tested for configural invariance by specifying the same factor structure across different groups. Results from the fit indices were acceptable across groups,  $X^2(42) = 58.84$ ,  $p = 0.04$ , CFI = 1.00, TLI = 0.99, SRMR = 0.02, RMSEA = 0.04, 90% CI [0.007, 0.065]. These results indicate that we have configural invariance, suggesting that participants conceptualized the same two-dimensional structure of perceived interdependence across targets.

Next, we tested for metric invariance by requiring the same factor structure and equal factor loadings across groups. The model fit of the metric model was then compared to the model fit of the configural model to assess metric invariance. The fit for the metric model was acceptable,  $X^2(67) = 118.72$ ,  $p < 0.001$ , CFI = 0.99, TLI = 0.99, SRMR = 0.056, RMSEA = 0.06, 90% CI [0.04, 0.08]. However, we found that there was a significant difference in fit between these models,  $\Delta X^2 = 59.89$ ,  $\Delta df = 25$ ,  $p = 0.001$ ,  $\Delta CFI = 0.006$ ,  $\Delta TLI = 0.005$ ,  $\Delta RMSEA = 0.02$ . Due to the large number of observations in our model, we observed change in CFI between the nested models to assess metric invariance (Cheung & Rensvold, 2002). Change in CFI equal to

or less than 0.01 is considered acceptable for establishing metric invariance. Using the changes in CFI as our guideline, we can see that the practical effect of this decrement in fit is minimal.<sup>2</sup>

### ***Correlation with extant interdependence measures (validity coefficients)***

Using data from Studies 1 and 2, we found that responses to the novel Shared Fate scale were significantly correlated with existing measures using different conceptualizations related to perceived interdependence (Table 4). These results suggest that our Shared Fate scale measures a construct related to previous measures and therefore is a valid measure of a proximate interdependence indicator.

When considering these validity coefficients, the results from Studies 1 and 2 show that our Shared Fate scale is a valid measure of interdependence. Our Shared Fate scale, along with both of its subfactors (PSF and ESF), is highly correlated ( $r$ 's > 0.30) with more traditional measures of interdependence (e.g., mutuality, oneness) and suggest that our measure assesses the same concept as these other scales. However, it is interesting to note that genetic relatedness had a low validity coefficient with both our measures and more traditional measures of interdependence, suggesting that while genetic relatedness is an important source of fitness

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<sup>2</sup> However, we acknowledge that there is no consensus regarding whether nested chi-squared differences or changes in fit statistics is preferable when assessing measurement invariance, we also assessed the modification indices of our metric model to determine if we could improve the fit of the metric model. We acknowledge that using modification indices to add paths that were not specified in the original model and are not theoretically grounded is not good research practice unless these paths are confirmed in a new model (<https://cran.r-project.org/web/packages/OpenMx/OpenMx.pdf>). However, we are presenting these analyses here in order to support our use of the  $\Delta$ CFI statistic and completeness when assessing model fit. We used the standard in the literature of only investigating modification indices that are larger than 10. The modification indices suggested only two relationships in the model met this criteria: adding a new covariance path between "When X fails, I feel bad" and "X and I rise and fall together", and adding a new factor loading between "Honestly, I don't care whether X thrives or not" and the shared fate factor. We first investigated adding the covariance path and the fit for this metric model was good,  $X^2(61) = 101.79$ ,  $p = 0.001$ , CFI = 0.99, TLI = 0.99, SRMR = 0.06, RMSEA = 0.05, 90% CI [0.04, 0.07]. We found that there was a slight decrease in fit between the configural and this metric models,  $\Delta X^2 = 42.952$ ,  $\Delta df = 19$ ,  $p = 0.001$ ,  $\Delta$ CFI = 0.006,  $\Delta$ TLI = 0.004,  $\Delta$ RMSEA = 0.012. We next investigated adding the new factor loading in addition to the covariance path and the fit for this metric model was good,  $X^2(60) = 93.37$ ,  $p = 0.004$ , CFI = 0.99, TLI = 0.99, SRMR = 0.05, RMSEA = 0.05, 90% CI [0.03, 0.07]. We found that there was a slight decrease in fit between the configural model and this metric model,  $\Delta X^2 = 34.53$ ,  $\Delta df = 18$ ,  $p = 0.01$ ,  $\Delta$ CFI = 0.003,  $\Delta$ TLI = 0.002,  $\Delta$ RMSEA = 0.008. While adding the modifications to the model did improve fit, the change in the fit statistics across all three versions of the metric model are minimal. These minimal changes suggest that our assessment of the original metric model acceptably fitting the data was an acceptable interpretation given the change in model fit.

interdependence, genetic relatedness alone may not be sufficient for indexing interdependence within relationships. Additionally, we can see from the validity coefficients that our measure of helping behavior (helping in times of need) assesses the same concept as Brown's (1999) measure of help without reciprocity. Interestingly, our measure of helping in times of need and Brown's helping without reciprocity measure were less strongly correlated with WTR. This may suggest that WTR assesses a slightly different concept that deals more with the valuation of others in interdependent relationships. Taken together, these results provide initial support for the validity of our Shared Fate scale.

Table 4. Correlation table of key predictors and outcomes (Studies 1 and 2)

	Shared Fate - overall	PSF	ESF	Brown's M	IOS	Closeness	Relatedness (r)	WTR	Help in need	Help w/o reciprocity
Shared Fate - overall	--	0.93***	0.94***	0.82***	0.80***	--	0.37***	0.61***	0.84**	0.71***
PSF	0.92***	--	0.74***	0.76***	0.78***	--	0.34***	0.54***	0.74*	0.55***
ESF	0.89***	0.64***	--	0.77***	0.71***	--	0.36***	0.60***	0.83*	0.77***
Brown's M	0.65***	0.60***	0.57***	--	0.78***	--	0.32***	0.56***	0.79*	0.65***
IOS	0.75***	0.72***	0.63***	0.61***	--	--	0.42***	0.56***	0.79*	0.60***
Closeness	0.73***	0.66***	0.67***	0.60***	0.76***	--	--	--	--	--
Relatedness (r)	0.14***	0.14***	0.12***	0.06*	0.18***	0.07*	--	0.31***	0.43*	0.32***
WTR	0.49***	0.43***	0.46***	0.36***	0.50***	0.48***	0.15***	--	0.62*	0.54***
Help in need	0.73***	0.58***	0.75***	0.55***	0.64***	0.70***	0.17***	0.43***	--	0.76***
Help w/o reciprocity	0.62***	0.43***	0.70***	0.46***	0.50***	0.59***	0.14***	0.38***	0.72*	--

\*Note. \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ . Correlations for Study 1 are in the upper triangle. Correlations for Study 2 are in the lower triangle. The item for closeness was only asked in Study 2. PSF = Perceived Shared Fate, ESF = Emotional Shared Fate, Brown's M = Brown's mutualism, IOS = Inclusion of Other in Self, r = genetic relatedness, WTR = welfare tradeoff ratio.

### Shared fate strongly predicts willingness to help

We computed target-specific weighted mean scores for Shared Fate factors based on the target-specific latent scores. Each item's raw score was multiplied by its factor loading to compute weighted scores, and the weighted scores were used to create the composites. This

strategy allows us to account for the influence of the cross-loaded item on both the Perceived Shared Fate and Emotional Shared Fate latent variables. To test the effect of Shared Fate on outcome measures of help, we computed hierarchical mixed-linear models. The Shared Fate scale was designed to assess interdependence towards specific relationship partners. A multi-level regression approach allows us to a) determine how much variance in measures of help is attributable to the between-person level compared to the within-person level, and b) disambiguate within-level effects (i.e., shared fate towards specific targets) from between-level effects (i.e., a person's average shared fate across targets). Whereas between-level effects may index trait-level tendencies to perceive interdependence across relationships, overall quality/interdependence towards one's relationship partners, or something else not measured in the present studies, we should see that assessments of shared fate towards specific relationship partners calibrate the extent to which people are willing to help.

Across models, observations were nested by participant ID, yielding up to five observations per participant for Study 1, and up to six observations per participant for Study 2 (i.e., one observation per relationship target). We applied an unrestricted covariance structure for random effects, allowed within-person residual variances for each relationship target to be uniquely estimated (constraining their correlations), and employed maximum-likelihood for the estimation method. We computed the cluster-means (i.e., a participant's average score across targets) to obtain between-level effects, and the cluster-mean centered scores to obtain the within-level effects for all predictors. We included random effects for perceived and emotional shared fate and other measures of interdependence whenever possible (i.e., when there was significant variation in the slopes and/or the model converged).

In the following analyses, we first include perceived and emotional shared fate as predictors. We then test whether the positive (within-person) effects of perceived and emotional shared fate on measures of help were qualified by relationship type. We treated enemies as the reference group for Study 1 and acquaintances as the reference group in Study 2. Next, we

control for other measures of interdependence to show that the Shared Fate scale predicts measures of help above and beyond existing measures of interdependence. Finally, we found that emotional shared fate showed consistently stronger positive effects on measures of help than perceived shared fate. Considering that these results suggest that emotional shared fate may be the more proximal predictor of help, we tested for indirect effects of perceived shared fate on measures of help as mediated by emotional shared fate. We ran multi-level regressions with the PROC MIXED procedure for SAS V. 9.4 and computed indirect effects using the *Rmediation* program (Tofighi & MacKinnon, 2011). Code for these analyses is available here (LINK).

### ***Willingness to help in the absence of reciprocity (Study 1)***

Relative to an intercepts-only model, including emotional and perceived shared fate improved model fit ( $\Delta\text{-2LL}$ ,  $X^2(9) = 1039.1$ ,  $p < 0.001$ ), explaining 19.51% of the between-person variance and 76.58% of the within-person variance ( $\text{ICC} = 0.06$ ). Emotional shared fate positively predicted willingness to help in the absence of reciprocity at the between- ( $\gamma = 1.07$ ,  $\text{SE} = 0.10$ ,  $\text{CI}_{95\%} [0.87, 1.27]$ ) and within-person levels ( $\gamma = 0.63$ ,  $\text{SE} = 0.04$ ,  $\text{CI}_{95\%} [0.56, 0.71]$ ; Figure S2). Perceived shared fate positively predicted help in the absence of reciprocity at the within-person level ( $\gamma = 0.29$ ,  $\text{SE} = 0.03$ ,  $\text{CI}_{95\%} [0.23, 0.35]$ ), but negatively at the between-person level ( $\gamma = -0.39$ ,  $\text{SE} = 0.07$ ,  $\text{CI}_{95\%} [-0.52, -0.25]$ ).

To test for an indirect effect of perceived shared fate on willingness to help via emotional shared fate (at the within-person level), we regressed perceived shared fate (cluster-mean centered) on emotional shared fate to obtain the *a* path ( $\gamma = 0.59$ ,  $\text{SE} = 0.01$ ,  $\text{CI}_{95\%} [0.57, 0.63]$ ). The *c'* ( $\gamma = 0.29$ ,  $\text{SE} = 0.03$ ) and *b* paths ( $\gamma = 0.63$ ,  $\text{SE} = 0.04$ ) were obtained from the model above. The indirect effect based on these parameters was 0.38 ( $\text{SE} = 0.02$ ,  $\text{CI}_{95\%} [0.33, 0.43]$ ), suggesting that emotional shared fate partially mediates the positive effect of perceived shared fate on willingness to help in the absence of reciprocity.

We also found a main effect of target type ( $F(4, 223) = 5.89$ ,  $p < 0.01$ ), a perceived



shared fate (Level-1)  $\times$  target type interaction ( $F(4, 245) = 215.98, p < 0.001$ ), and an emotional shared fate (Level-1)  $\times$  target type interaction ( $F(4, 345) = 2.65, p = 0.03$ ;  $\Delta$ -2LL,  $X^2(12) = 94.1, p < 0.001$ ; see Table S4). Compared to willingness to help an enemy in the absence of reciprocity ( $\gamma = 2.52, SE = 0.31, CI_{95\%} [1.94, 3.04]$ ), people were more likely to help a friend in the absence of reciprocity ( $\gamma = 0.47, SE = 0.20, CI_{95\%} [0.07, 0.86]$ ). Participants' willingness to help other targets in the absence of reciprocity when controlling for perceived and emotional shared fate was not statistically significantly different than their willingness to help an enemy (Table S2). Whereas perceived shared fate positively predicted help in the absence of reciprocity for an acquaintance ( $\gamma = 0.23, SE = 0.08, CI_{95\%} [0.07, 0.38]$ ), a friend ( $\gamma = 0.20, SE = 0.06, CI_{95\%} [0.08, 0.33]$ ), and a sibling ( $\gamma = 0.18, SE = 0.07, CI_{95\%} [0.03, 0.32]$ ), perceived shared fate negatively predicted willingness to help an enemy in the absence of reciprocity ( $\gamma = -0.26, SE = 0.11, CI_{95\%} [-0.48, -0.03]$ ), and it did not predict willingness to help a stranger ( $\gamma = -0.07, SE = 0.09, CI_{95\%} [-0.26, 0.11]$ ). In contrast, emotional shared fate positively predicted willingness to help in the absence of reciprocity across targets, but with the strongest effect for an enemy ( $\gamma = 1.06, SE = 0.13, CI_{95\%} [0.80, 1.32]$ ), followed by a stranger ( $\gamma = 0.74, SE = 0.10, CI_{95\%} [0.53, 0.94]$ ), a friend ( $\gamma = 0.72, SE = 0.11, CI_{95\%} [0.50, 0.94]$ ), a sibling ( $\gamma = 0.59, SE = 0.11, CI_{95\%} [0.36, 0.82]$ ), and an acquaintance ( $\gamma = 0.56, SE = 0.09, CI_{95\%} [0.37, 0.75]$ ).

When controlling for other measures of interdependence (i.e., IOS and mutualism;  $\Delta$ -2LL,  $X^2(8) = 94.7, p < 0.001$ ), we find that perceived shared fate had a smaller positive effect but remains a statistically significant predictor, while emotional shared fate remains the strongest positive predictor of willingness to help in the absence of reciprocity (Table 5).

**Table 5**

*Mixed-linear model predicting willingness to help in the absence of reciprocity (Study 1)*

Obs. = 1000	$\gamma$	SE	df	$t$	$p$	95% CI	
Intercept	2.35	0.31	190	7.55	<.0001	1.74	2.96

## Level-2

Perceived shared fate	-0.47	0.08	193	-5.92	<.0001	-0.63	-0.32
Emotional shared fate	1.02	0.10	192	9.79	<.0001	0.81	1.22
Inclusion of other in the self	0.02	0.07	190	0.26	0.79	-0.12	0.15
Mutualism	0.18	0.09	185	2.02	0.04	0.00	0.35

## Level-1

Perceived shared fate	0.09	0.04	162	2.51	0.01	0.02	0.17
Emotional shared fate	0.48	0.04	168	12.20	<.0001	0.41	0.56
Inclusion of other in the self	0.10	0.03	167	3.02	0.003	0.03	0.17
Mutualism	0.23	0.04	733	6.40	<.0001	0.16	0.29

*Note.*  $N = 200$ ,  $ICC = 0.06$ ,  $T_{\text{intercept}} = 0.36$  ( $z = 7.68^{***}$ ),  $T_{\text{perceived SF}} = 0.02$  ( $z = 1.15$ ),  $T_{\text{emotional SF}} = 0.04$  ( $z = 1.50$ ),  $T_{\text{IOS}} = 0.04$  ( $z = 2.61^{**}$ ),  $T_{\text{intercept.perceived SF}} = -0.36$  ( $z = -1.32$ ),  $T_{\text{intercept.emotional SF}} = 0.09$  ( $z = 0.40$ ),  $T_{\text{perceived SF.emotional SF}} = 0.64$  ( $z = 0.91$ ),  $T_{\text{intercept.IOS}} = -0.18$  ( $z = -1.17$ ),  $T_{\text{perceived SF.IOS}} = -0.35$  ( $z = -1.11$ ),  $T_{\text{emotional SF.IOS}} = -0.61$  ( $z = -2.40^*$ ).  $\sigma^2_{\text{acquaintance}} = 0.44$  ( $z = 6.93^{***}$ ),  $\sigma^2_{\text{friend}} = 0.23$  ( $z = 4.90^{***}$ ),  $\sigma^2_{\text{sibling}} = 0.51$  ( $z = 7.38^{***}$ ),  $\sigma^2_{\text{stranger}} = 0.45$  ( $z = 6.21^{***}$ ),  $\sigma^2_{\text{enemy}} = 0.66$  ( $z = 6.17^{***}$ ).

## Willingness to help in the absence of reciprocity (Study 2)

Relative to an intercepts-only model, including emotional and perceived shared fate improved model fit ( $\Delta\text{-2LL}$ ,  $X^2(9) = 1050.4$ ,  $p < 0.001$ ), explaining 49.28% of the between-person variance and 59.75% of the within-person variance ( $ICC = 0.33$ ). Emotional shared fate positively predicted willingness to help in the absence of reciprocity at the between- ( $\gamma = 0.88$ ,  $SE = 0.05$ ,  $CI_{95\%} [0.78, 0.99]$ ) and within-person levels ( $\gamma = 0.59$ ,  $SE = 0.03$ ,  $CI_{95\%} [0.52, 0.66]$ ; Figure S2). Perceived shared fate positively predicted help at the within-person level ( $\gamma = 0.16$ ,  $SE = 0.02$ ,  $CI_{95\%} [0.12, 0.21]$ ), but negatively at the between-person level ( $\gamma = -0.21$ ,  $SE = 0.04$ ,  $CI_{95\%} [-0.29, -0.13]$ ). Based on these parameters ( $c' = 0.16$ ,  $SE = 0.02$ ;  $b = 0.59$ ,  $SE = 0.03$ ) and the within-level effect of perceived shared fate on emotional shared fate ( $a = 0.45$ ,  $SE = 0.02$ ,

CI<sub>95%</sub> [0.41, 0.49]), the indirect effect of perceived shared fate on willingness to help in the absence of reciprocity via emotional shared fate was 0.26 (SE = 0.02, CI<sub>95%</sub> [0.22, 0.30]).

When testing for differences across relationships ( $\Delta$ -2LL,  $X^2(15) = 93.7$ ,  $p < 0.001$ ), we found a main effect of target ( $F(5, 325) = 15.36$ ,  $p < 0.001$ ), such that, compared to an acquaintance ( $\gamma = 2.49$ , SE = 0.17, CI<sub>95%</sub> [2.15, 2.82]), participants were more willing to help a sibling ( $\gamma = 0.16$ , SE = 0.08, CI<sub>95%</sub> [0.007, 0.32]), a niece/nephew ( $\gamma = 0.40$ , SE = 0.08, CI<sub>95%</sub> [0.25, 0.55]), and a friend ( $\gamma = 0.44$ , SE = 0.08, CI<sub>95%</sub> [0.28, 0.60]), but not a cousin ( $\gamma = 0.08$ , SE = 0.08, CI<sub>95%</sub> [-0.08, 0.24]) or an aunt/uncle ( $\gamma = 0.03$ , SE = 0.08, CI<sub>95%</sub> [-0.13, 0.19]). However, unlike Study 1, we did not find a perceived shared fate  $\times$  target type interaction ( $F(5, 430) = 1.18$ ,  $p = 0.32$ ) or an emotional shared fate  $\times$  target type interaction ( $F(5, 439) = 0.94$ ,  $p = 0.45$ ).

When we controlled for other measures of interdependence ( $\Delta$ -2LL,  $X^2(8) = 136$ ,  $p < 0.001$ ), we found that perceived shared fate (at Level-1) no longer predicted willingness to help in the absence of reciprocity, but emotional shared fate (at Level-1) remained the strongest positive predictor (Table 6).

**Table 6**

*Mixed-linear model predicting willingness to help in the absence of reciprocity (Study 2)*

Obs. = 1375	$\gamma$	SE	df	$t$	$p$	95% CI	
Intercept	2.36	0.19	242	12.45	<.0001	1.98	2.73
<i>Level-2</i>							
Perceived shared fate	-0.26	0.04	225	-5.74	<.0001	-0.35	-0.17
Emotional shared fate	0.74	0.06	229	11.59	<.0001	0.62	0.87

Relatedness	1.38	0.83	223	1.66	0.10	-0.26	3.02
Closeness	0.19	0.05	222	3.98	<.0001	0.10	0.28
Inclusion of other in the self	-0.05	0.04	221	-1.17	0.24	-0.13	0.03
Mutualism	0.01	0.03	193	0.27	0.78	-0.05	0.07
<i>Level-1</i>							
Perceived shared fate	0.01	0.03	219	0.37	0.71	-0.04	0.06
Emotional shared fate	0.48	0.04	272	12.73	<.0001	0.41	0.56
Relatedness	-0.21	0.10	488	-2.11	0.04	-0.41	-0.01
Closeness	0.09	0.02	1028	5.16	<.0001	0.06	0.13
Inclusion of other in the self	0.12	0.02	977	5.18	<.0001	0.07	0.16
Mutualism	0.003	0.02	983	0.22	0.83	-0.03	0.03

*Note.*  $N = 246$ ,  $ICC = 0.33$ ,  $T_{intercept} = 0.22$  ( $z = 8.71^{***}$ ),  $T_{perceived\ SF} = 0.02$  ( $z = 2.09^*$ ),  $T_{emotional\ SF} = 0.07$  ( $z = 3.29^{**}$ ),  $T_{intercept.perceived\ SF} = -0.90$  ( $z = -4.56^{***}$ ),  $T_{intercept.emotional\ SF} = 0.20$  ( $z = 1.28$ ),  $T_{perceived\ SF.emotional\ SF} = -0.30$  ( $z = -1.34$ ).  $\sigma^2_{acquaintance} = 0.55$  ( $z = 8.71^{***}$ ),  $\sigma^2_{cousin} = 0.34$  ( $z = 8.13^{***}$ ),  $\sigma^2_{friend} = 0.24$  ( $z = 7.84^{***}$ ),  $\sigma^2_{niece/nephew} = 0.35$  ( $z = 7.44^{***}$ ),  $\sigma^2_{sibling} = 0.22$  ( $z = 7.46^{***}$ ),  $\sigma^2_{aunt/uncle} = 0.30$  ( $z = 7.67^{***}$ ).

### **Welfare tradeoff ratio (Study 1)**

Compared to an intercepts-only model, including emotional and perceived shared fate improved model fit ( $\Delta-2LL$ ,  $X^2(6) = 550.7$ ,  $p < 0.001$ ), explaining 20.54% of the between-person variance and 57% of the within-person variance ( $ICC = 0.11$ ). Both factors positively predicted welfare tradeoff ratio at the between-person level (emotional shared fate  $\gamma = 0.09$ ,  $SE = 0.03$ ,  $CI_{95\%} [0.02, 0.16]$ ; perceived shared fate  $\gamma = 0.05$ ,  $SE = 0.02$ ,  $CI_{95\%} [0.005, 0.09]$ ), and within-person level (emotional shared fate  $\gamma = 0.13$ ,  $SE = 0.01$ ,  $CI_{95\%} [0.10, 0.15]$ ; perceived shared fate  $\gamma = 0.08$ ,  $SE = 0.01$ ,  $CI_{95\%} [0.06, 0.10]$ ; Figure S3). Taking the parameters from the model above ( $c' = 0.08$ ,  $SE = 0.01$ ;  $b = 0.13$ ,  $SE = 0.01$ ) and the within-level effect of perceived shared fate

on emotional shared fate ( $a = 0.59$ ,  $SE = 0.01$ ,  $CI_{95\%} [0.57, 0.63]$ ), the indirect effect of perceived shared fate on welfare tradeoff ratio via emotional shared fate was 0.08 ( $SE = 0.01$ ,  $CI_{95\%} [0.06, 0.09]$ ).

When testing for differences across relationships ( $\Delta-2LL$ ,  $X^2(12) = 80.6$ ,  $p < 0.001$ ), we found a main effect of target ( $F(4, 273) = 8.34$ ,  $p < 0.001$ ), such that compared to an enemy ( $\gamma = -0.27$ ,  $SE = 0.10$ ,  $CI_{95\%} [-0.47, -0.07]$ ), participants reported higher welfare tradeoff ratios for a friend ( $\gamma = 0.31$ ,  $SE = 0.08$ ,  $CI_{95\%} [0.15, 0.46]$ ) and a sibling ( $\gamma = 0.18$ ,  $SE = 0.07$ ,  $CI_{95\%} [0.03, 0.33]$ ), but not for a stranger ( $\gamma = 0.04$ ,  $SE = 0.07$ ,  $CI_{95\%} [-0.11, 0.18]$ ) or an acquaintance ( $\gamma = 0.11$ ,  $SE = 0.07$ ,  $CI_{95\%} [-0.02, 0.24]$ ). We did not find a perceived shared fate ( $F(4, 409) = 1.79$ ,  $p = 0.13$ ) or an emotional shared fate  $\times$  target type interaction ( $F(4, 351) = 1.01$ ,  $p = 0.40$ ).

After controlling for other measures of interdependence ( $\Delta-2LL$ ,  $X^2(4) = 49.1$ ,  $p < 0.001$ ), we found that perceived shared fate had a smaller positive effect on welfare tradeoff ratio (Level-1), but emotional shared fate remained the strongest positive predictor (Table 7).

**Table 7**

*Mixed-linear model predicting welfare tradeoff ratio (Study 1)*

Obs. = 1000	$\gamma$	SE	df	$t$	$p$	95% CI	
Intercept	-0.17	0.10	189	-1.60	0.11	-0.37	0.04
<i>Level-2</i>							
Perceived shared fate	0.05	0.03	192	1.68	0.09	-0.01	0.10

Emotional shared fate	0.09	0.03	193	2.45	0.02	0.02	0.15
Inclusion of other in the self	-0.01	0.02	197	-0.32	0.75	-0.05	0.04
Mutualism	0.03	0.03	189	0.90	0.37	-0.03	0.09
<i>Level-1</i>							
Perceived shared fate	0.02	0.01	623	2.01	0.04	0.00	0.05
Emotional shared fate	0.09	0.01	469	5.78	<.0001	0.06	0.11
Inclusion of other in the self	0.04	0.01	713	4.24	<.0001	0.02	0.06
Mutualism	0.05	0.01	733	3.69	0.00	0.02	0.07

*Note.*  $N = 200$ ,  $ICC = 0.11$ ,  $T_{intercept} = 0.04$  ( $z = 7.26^{***}$ ),  $T_{emotional\ SF} = 0.01$  ( $z = 4.2^{***}$ ),  $T_{intercept.emotional\ SF} = 0.79$  ( $z = 7.11^{***}$ ).  $\sigma^2_{acquaintance} = 0.03$  ( $z = 6.3^{***}$ ),  $\sigma^2_{enemy} = 0.11$  ( $z = 8.24^{***}$ ),  $\sigma^2_{friend} = 0.08$  ( $z = 8.16^{***}$ ),  $\sigma^2_{stranger} = 0.08$  ( $z = 8.43^{***}$ ),  $\sigma^2_{sibling} = 0.06$  ( $z = 6.69^{***}$ ).

### ***Welfare tradeoff ratio (Study 2)***

Including emotional and perceived shared fate improved model fit ( $\Delta-2LL$ ,  $X^2(9) = 500$ ,  $p < 0.001$ ) relative to an intercepts-only model, accounting for 11.42% of the between-person variance and 38.48% of the within-person variance ( $ICC = 0.42$ ). Both factors positively predicted welfare tradeoff ratio at the between-person level (emotional shared fate  $\gamma = 0.10$ ,  $SE = 0.03$ ,  $CI_{95\%} [0.04, 0.16]$ ; perceived shared fate  $\gamma = 0.07$ ,  $SE = 0.02$ ,  $CI_{95\%} [0.02, 0.11]$ ), and within-person level (emotional shared fate  $\gamma = 0.11$ ,  $SE = 0.01$ ,  $CI_{95\%} [0.09, 0.14]$ ; perceived shared fate  $\gamma = 0.08$ ,  $SE = 0.01$ ,  $CI_{95\%} [0.06, 0.10]$ ; Figure S3). Taking the parameters from the model above ( $c' = 0.08$ ,  $SE = 0.01$ ;  $b = 0.11$ ,  $SE = 0.01$ ) and the within-level effect of perceived shared fate on emotional shared fate ( $a = 0.45$ ,  $SE = 0.02$ ), the indirect effect of perceived shared fate on welfare tradeoff ratio via emotional shared fate was 0.05 ( $SE = 0.005$ ,  $CI_{95\%} [0.04, 0.06]$ ).

As in Study 1, we found differences in welfare tradeoff ratio ( $\Delta-2LL$ ,  $X^2(12) = 80.6$ ,  $p < 0.001$ ) by target type ( $F(5, 291) = 14.42$ ,  $p < 0.001$ ), but no interaction with perceived shared

fate ( $F(5, 383) = 0.69, p = 0.63$ ) or emotional shared fate ( $F(5, 392) = 0.73, p = 0.60$ ). Compared to an acquaintance ( $\gamma = -0.15, SE = 0.08, CI_{95\%} [-0.32, 0.01]$ ), participants reported higher welfare tradeoff ratios for a cousin ( $\gamma = 0.06, SE = 0.02, CI_{95\%} [0.01, 0.11]$ ), a friend ( $\gamma = 0.11, SE = 0.03, CI_{95\%} [0.05, 0.17]$ ), a niece/nephew ( $\gamma = 0.27, SE = 0.03, CI_{95\%} [0.20, 0.33]$ ), and a sibling ( $\gamma = 0.10, SE = 0.03, CI_{95\%} [0.05, 0.16]$ ), but not for an aunt/uncle ( $\gamma = 0.03, SE = 0.03, CI_{95\%} [-0.02, 0.09]$ ).

When controlling for other measures of interdependence, perceived shared fate no longer predicted welfare tradeoff ratio, but emotional shared fate (Level-1) was the second strongest positive predictor following relatedness (Table 8).

**Table 8**

*Mixed-linear model predicting welfare tradeoff ratio (Study 2)*

Obs. = 1375	$\gamma$	SE	df	$t$	$p$	95% CI	
Intercept	-0.12	0.10	249	-1.19	0.24	-0.33	0.08
<i>Level-2</i>							

Perceived shared fate	0.02	0.02	228	0.94	0.35	-0.03	0.07
Emotional shared fate	0.05	0.04	235	1.50	0.13	-0.02	0.12
Relatedness	-0.39	0.46	236	-0.86	0.39	-1.30	0.51
Closeness	0.01	0.03	229	0.54	0.59	-0.04	0.07
Inclusion of other in the self	0.07	0.02	229	3.06	0.002	0.02	0.11
Mutualism	0.02	0.02	215	1.14	0.25	-0.01	0.06
<i>Level-1</i>							
Perceived shared fate	0.02	0.01	125	1.66	0.10	-0.004	0.05
Emotional shared fate	0.06	0.01	182	4.43	<.0001	0.03	0.09
Relatedness	0.13	0.04	360	3.03	0.002	0.04	0.21
Closeness	0.03	0.01	258	3.92	<0.001	0.02	0.05
Inclusion of other in the self	0.05	0.01	229	4.11	<.0001	0.03	0.07
Mutualism	-0.01	0.01	903	-1.21	0.22	-0.02	0.00

*Note.*  $N = 246$ ,  $ICC = 0.42$ ,  $T_{intercept} = 0.08$  ( $z = 9.97^{***}$ ),  $T_{closeness} = 0.002$  ( $z = 3.07^*$ ),  $\tau_{IOS} = 0.01$  ( $z = 3.58^{***}$ ),  $T_{perceived\ SF} = 0.01$  ( $z = 3.01^{**}$ ),  $T_{emotional\ SF} = 0.004$  ( $z = 1.27$ ),  $T_{intercept.closeness} = 0.40$  ( $z = 2.50^*$ ),  $T_{intercept.IOS} = -0.002$  ( $z = -0.02$ ),  $T_{closeness.IOS} = -0.72$  ( $z = -4.65$ ),  $T_{intercept.perceived\ SF} = -0.15$  ( $z = -1.24$ ),  $T_{closeness.perceived\ SF} = -0.02$  ( $z = -0.07$ ),  $\tau_{IOS.perceived\ SF} = -0.41$  ( $z = -2.41^*$ ),  $T_{intercept.emotional\ SF} = 0.52$  ( $z = 2.12^*$ ),  $T_{closeness.emotional\ SF} = 0.56$  ( $z = 1.05$ ),  $\tau_{IOS.emotional\ SF} = -0.22$  ( $z = -0.59$ ),  $T_{perceived\ SF.emotional\ SF} = -0.39$  ( $z = -1.33$ ).  $\sigma^2_{acquaintance} = 0.03$  ( $z = 6.02^{***}$ ),  $\sigma^2_{cousin} = 0.02$  ( $z = 5.88^{***}$ ),  $\sigma^2_{friend} = 0.05$  ( $z = 6.96^{***}$ ),  $\sigma^2_{niece/nephew} = 0.16$  ( $z = 8.45^{***}$ ),  $\sigma^2_{sibling} = 0.04$  ( $z = 5.81^{***}$ ),  $\sigma^2_{aunt/uncle} = 0.07$  ( $z = 8.20^{***}$ ).

### ***Willingness to help in times of need (Study 1)***

We were unable to run mixed-linear models for this measure of help due to the random intercept variance being highly correlated with the within-person residual variance (yielding a singular covariance matrix in a baseline/intercepts model). As an alternative, we ran fixed-



effects regressions. This type of analysis allows us to test for within-level effects by controlling for all of the variance that may be attributable to the between-person level (i.e., by including participant ID as a categorical predictor of willingness to help). After controlling for participant ID (which accounted for 10% of the between-person variance), perceived ( $b = 0.46$ ,  $SE = 0.03$ ,  $CI_{95\%} [0.40, 0.52]$ ) and emotional shared fate ( $b = 0.86$ ,  $SE = 0.03$ ,  $CI_{95\%} [0.79, 0.93]$ ; Figure S4) positively predicted willingness to help in times of need, accounting for 75% of the within-person variance ( $F(201, 798) = 22.03$ ,  $p < 0.001$ ,  $R^2 = 0.85$ ). Based on the parameters shown above ( $c' = 0.46$ ,  $SE = 0.03$ ;  $b = 0.86$ ,  $SE = 0.03$ ), and on the effect of perceived shared fate on emotional shared fate ( $a = 0.66$ ,  $SE = 0.02$ ,  $CI_{95\%} [0.63, 0.70]$ ), the indirect effect of perceived shared fate on willingness to help in times of need via emotional shared fate was 0.57 ( $SE = 0.02$ ,  $CI_{95\%} [0.52, 0.62]$ ).

We tested for differences by relationship target ( $\Delta R^2 = 0.04$ ), and found a main effect of target ( $F(4, 786) = 15.12$ ,  $p < 0.001$ ), and a target  $\times$  emotional shared fate interaction ( $F(4, 786) = 3.69$ ,  $p = 0.005$ ), but not a target  $\times$  perceived shared fate interaction ( $F(4, 786) = 1.65$ ,  $p = 0.16$ ). Compared to an enemy ( $b = 0.91$ ,  $SE = 0.33$ ,  $CI_{95\%} [0.27, 1.56]$ ), participants were more willing to help an acquaintance ( $b = 1.03$ ,  $SE = 0.20$ ,  $CI_{95\%} [0.63, 1.44]$ ), a friend ( $b = 2.05$ ,  $SE = 0.37$ ,  $CI_{95\%} [1.32, 2.79]$ ), a sibling ( $b = 2.31$ ,  $SE = 0.38$ ,  $CI_{95\%} [1.56, 3.06]$ ), and a stranger ( $b = 1.26$ ,  $SE = 0.34$ ,  $CI_{95\%} [0.59, 1.92]$ ). Although participants were the least willing to help an enemy, the positive effect of emotional shared fate on willingness to help in times of need was strongest for an enemy ( $b = 0.95$ ,  $SE = 0.08$ ,  $CI_{95\%} [0.80, 1.11]$ ), followed by a sibling ( $b = 0.69$ ,  $SE = 0.07$ ,  $CI_{95\%} [0.54, 0.84]$ ), an acquaintance ( $b = 0.64$ ,  $SE = 0.06$ ,  $CI_{95\%} [0.52, 0.76]$ ), a friend ( $b = 0.57$ ,  $SE = 0.11$ ,  $CI_{95\%} [0.36, 0.79]$ ), and a stranger ( $b = 0.51$ ,  $SE = 0.06$ ,  $CI_{95\%} [0.40, 0.63]$ ).

When we controlled for other measures of interdependence ( $\Delta R^2 = 0.03$ ), we found a smaller positive effect of perceived shared fate, but emotional shared fate remains the strongest predictor of willingness to help in times of need (Table 9).

## Table 9

*Fixed-effects regression model predicting willingness to help in times of need (Study 1)*

	<i>b</i>	SE	<i>t</i>	<i>p</i>	95% CI	
Perceived shared fate	0.13	0.03	3.90	0.001	0.06	0.20
Emotional shared fate	0.62	0.03	17.17	<.0001	0.55	0.69
Inclusion of other in the self	0.29	0.03	10.87	<.0001	0.24	0.35
Mutualism	0.21	0.03	6.42	<.0001	0.14	0.27

*Note.*  $F(203, 796) = 29.66$ ,  $p < 0.001$ ,  $R^2 = 0.88$ . For brevity, we do not show the intercept (equivalent to a single participants' willingness to help), or the person-specific deviations from the intercept for all participants.

***Willingness to help in times of need (Study 2)***

Relative to an intercepts-only model, including perceived and emotional shared fate improved model fit ( $\Delta\text{-2LL}$ ,  $X^2(9) = 1289.1$ ,  $p < 0.001$ ), accounting for 45.66% of the between-person variance and 67.66% of the within-person variance ( $\text{ICC} = 0.26$ ). Emotional shared fate positively predicted willingness to help in times of need at the between- ( $\gamma = 0.81$ ,  $\text{SE} = 0.06$ ,  $\text{CI}_{95\%} [0.69, 0.93]$ ), and within-person level ( $\gamma = 0.70$ ,  $\text{SE} = 0.04$ ,  $\text{CI}_{95\%} [0.63, 0.78]$ ; Figure S4). Perceived shared positively predicted willingness to help at the within- ( $\gamma = 0.25$ ,  $\text{SE} = 0.02$ ,  $\text{CI}_{95\%} [0.20, 0.30]$ ), but not the between-person level ( $\gamma = -0.02$ ,  $\text{SE} = 0.04$ ,  $\text{CI}_{95\%} [-0.11, 0.06]$ ). Based on the parameters from the model above ( $c' = 0.25$ ,  $\text{SE} = 0.02$ ;  $b = 0.70$ ,  $\text{SE} = 0.04$ ) and the within-person level effect of perceived shared fate on emotional shared fate ( $a = 0.45$ ,  $\text{SE} = 0.02$ ), the indirect effect of perceived shared fate on willingness to help in times of need through emotional shared fate was 0.31 ( $\text{SE} = 0.02$ ,  $\text{CI}_{95\%} [0.27, 0.36]$ ).

When testing for differences by relationship target ( $\Delta\text{-2LL}$ ,  $X^2(15) = 191.5$ ,  $p < 0.001$ ), we found a main effect of target ( $F(5, 315) = 29.27$ ,  $p < 0.001$ ), but no interaction between target type and perceived shared fate ( $F(5, 358) = 1.95$ ,  $p = 0.08$ ) or target type and emotional shared

fate ( $F(5, 454) = 1.39, p = 0.22$ ). Compared to an acquaintance ( $\gamma = 2.0, SE = 0.18, CI_{95\%} [1.64, 2.36]$ ), participants were more willing to help a cousin ( $\gamma = 0.17, SE = 0.09, CI_{95\%} [0.004, 0.35]$ ), a friend ( $\gamma = 0.77, SE = 0.09, CI_{95\%} [0.60, 0.95]$ ), a niece/nephew ( $\gamma = 0.51, SE = 0.08, CI_{95\%} [0.34, 0.68]$ ), and a sibling ( $\gamma = 0.38, SE = 0.09, CI_{95\%} [0.21, 0.55]$ ), but not an aunt/uncle ( $\gamma = 0.13, SE = 0.08, CI_{95\%} [-0.04, 0.30]$ ).

After controlling for other measures of interdependence ( $\Delta-2LL, X^2(12) = 308.4, p < 0.001$ ), perceived shared fate was no longer a statistically significant predictor of willingness to help in times of need (Level-1), but emotional shared fate remained the strongest positive predictor (Table 10).

**Table 10**

*Mixed-linear model predicting welfare tradeoff ratio (Study 2)*

Obs. = 1375	$\gamma$	SE	df	$t$	$p$	95% CI	
Intercept	2.04	0.21	235	9.85	<.0001	1.63	2.45
<i>Level-2</i>							

Perceived shared fate	-0.11	0.05	214	-2.18	0.03	-0.20	-0.01
Emotional shared fate	0.57	0.07	227	8.15	<.0001	0.44	0.71
Relatedness	2.00	0.91	218	2.20	0.03	0.21	3.79
Closeness	0.22	0.05	215	4.28	<.0001	0.12	0.33
Inclusion of other in the self	0.03	0.04	224	0.56	0.58	-0.06	0.11
Mutualism	0.01	0.04	216	0.33	0.74	-0.06	0.08
<i>Level-1</i>							
Perceived shared fate	0.04	0.03	82	1.53	0.13	-0.01	0.09
Emotional shared fate	0.49	0.04	255	13.12	<.0001	0.42	0.57
Relatedness	-0.13	0.10	479	-1.27	0.21	-0.34	0.07
Closeness	0.17	0.02	896	9.57	<.0001	0.13	0.20
Inclusion of other in the self	0.15	0.02	290	5.89	<.0001	0.10	0.20
Mutualism	0.01	0.01	891	0.59	0.56	-0.02	0.04

*Note.*  $N = 246$ ,  $ICC = 0.26$ ,  $T_{intercept} = 0.28$  ( $z = 9.04^{***}$ ),  $T_{perceived\ SF} = 0.01$  ( $z = 0.73$ ),  $T_{emotional\ SF} = 0.06$  ( $z = 2.68^{**}$ ),  $T_{IOS} = 0.02$  ( $z = 2.63^{**}$ ),  $T_{intercept.perceived\ SF} = -0.24$  ( $z = -0.65$ ),  $T_{intercept.emotional\ SF} = -0.18$  ( $z = -1.05$ ),  $T_{perceived\ SF.emotional\ SF} = 0.49$  ( $z = 0.65$ ),  $T_{intercept.IOS} = -0.43$  ( $z = -3.08^{**}$ ),  $T_{IOS.perceived\ SF} = 0.14$  ( $z = 0.22$ ),  $T_{IOS.emotional\ SF} = -0.24$  ( $z = -0.88$ ).  $\sigma^2_{acquaintance} = 0.69$  ( $z = 8.47^{***}$ ),  $\sigma^2_{cousin} = 0.24$  ( $z = 7.08^{***}$ ),  $\sigma^2_{friend} = 0.18$  ( $z = 5.9^{***}$ ),  $\sigma^2_{niece/nephew} = 0.26$  ( $z = 6.75^{***}$ ),  $\sigma^2_{sibling} = 0.25$  ( $z = 7.3^{***}$ ),  $\sigma^2_{aunt/uncle} = 0.29$  ( $z = 7.58^{***}$ ).

### Study 3 Method

In Study 3 we assessed validity by evaluating the scale's discriminant, concurrent, and convergent validity.

#### Participants

Participants were recruited from Prolific.co ( $N = 695$ ,  $M_{age} = 29.00$  years,  $SD_{age} = 10.00$  years, 52.60% male) in July 2020 and compensated with \$1.75 for their time. All participants successfully passed our attention checks.

### **Materials and procedures**

Acquaintances were the only targets in this study because our scale has configural invariance across targets and Shared Fate with acquaintances was approximately normally distributed. Given the strong correlation between perceived and emotional subscales ( $r = .64$ ), we compute both zero-order and partial Pearson correlations (see Table 8). Wording for all items is presented in the supplemental materials.

#### *Discriminant validity*

To assess discriminant validity, we included two empathy measures that should not be related to Shared Fate perceptions – Interpersonal Reactivity Index (IRI) Perspective Taking (e.g., I sometimes find it difficult to see things from the "other guy's" point of view; Davis, 1980) and Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001). The IRI captures the disposition to empathize and spontaneously take on another's perspective or point of view. The RMET assesses the ability to infer the emotional and cognitive states of others from only their eyes. Each image is accompanied by four descriptor words of which only one is correct (Figure 3). Correct responses are summed to reflect 'mentalizing' ability.



Figure 3. Sample item from the Reading the Mind in the Eyes Test. The mental state depicted in this figure is “preoccupied.”

### *Concurrent Validity*

To assess concurrent validity, we included two measures assessing Perceived Shared Fate and Emotional Shared Fate – Perceived Shared and Non-Shared Agency Scale - Collaboration (e.g., My acquaintance and I tend to negotiate when we disagree; Chang et al., 2010) and Partner Empathy (e.g., I share my acquaintance’s empathy; Fischer et al., 2012). We modified the collaboration scale to measure the pursuit of joint goals between the participant and an acquaintance. The partner empathy scale captures the extent to which dyads share similar emotions.

### *Convergent Validity*

To assess convergent validity, we created vignettes to assess Perceived Shared Fate and Emotional Shared Fate with a target who was experiencing positive or negative life events. These vignettes were created to test if our scale captures Shared Fate using a different method. In the first vignette, participants read that their acquaintance had received an important job promotion. In the second vignette, participants read that their acquaintance had lost their

parents in a car accident. Participants then answered questions measuring Shared Fate perceptions and emotions. See supplemental materials for vignettes and item wording.

### *Predictive Validity*

To assess the predictive behavioral validity of our scale, we included a modified Dictator Game where participants could give an acquaintance lottery tickets to use in a raffle for \$5.00 USD. Participants indicated how many lottery tickets they would allocate to an acquaintance on a slider bar ranging from 0-100. Minimal deception was used and no information about acquaintances beyond initials was collected. After the study, two participants were randomly selected to receive a \$5.00 USD<sup>3</sup> bonus payment regardless of allocation decisions.

## **Study 3 Results**

### *Discriminant Validity*

We assessed discriminant validity using participants' tendencies to engage in perspective-taking (IRI perspective-taking subscale) and their ability to infer emotional and cognitive states of others (RMET). Zero-order Pearson correlations show that the RMET was not correlated with Emotional Shared Fate ( $r = 0.02$ ,  $p = 0.67$ ), and weakly negatively correlated with Perceived Shared Fate ( $r = -0.11$ ,  $p = 0.005$ ). Zero-order Pearson correlations show that the IRI perspective-taking subscale was moderately positively correlated with Emotional Shared Fate ( $r = 0.26$ ,  $p < 0.001$ ) and weakly correlated with Perceived Shared Fate ( $r = 0.12$ ,  $p = 0.003$ ). Together, these results suggest that our measure of Shared Fate shows discriminant validity with measures of perspective-taking and inferring the emotional and cognitive states of others.

Controlling for Perceived Shared Fate, Emotional Shared Fate was weakly positively correlated with the RMET ( $r = 0.14$ ,  $p < 0.001$ ) and moderately with the IRI perspective-taking

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<sup>3</sup> Difference in payment amounts reflect differences in the recruitment platform and differences in the ethical payment standards of these platforms.

subscale ( $r = 0.26, p < 0.001$ ). Controlling for Emotional Shared Fate, Perceived Shared Fate was negatively correlated with the RMET ( $r = -0.17, p < 0.001$ ) and the IRI subscale ( $r = -0.11, p = 0.004$ ). The weak correlations indicate that Emotional Shared Fate shows discriminant validity with other trait measures of empathy in the literature.

### *Concurrent Validity*

We expected Perceived Shared Fate and Emotional Shared Fate to show moderate to strong zero-order correlations with our measures of concurrent validity – shared agency and partner empathy. Zero-order Pearson correlations show that partner empathy was strongly correlated with Emotional Shared Fate ( $r = 0.69, p < 0.001$ ) and Perceived Shared Fate ( $r = 0.65, p < 0.001$ ). Similarly, shared agency was correlated with Emotional Shared Fate ( $r = 0.43, p < 0.001$ ) and Perceived Shared Fate ( $r = 0.39, p < 0.001$ ). Partial Pearson correlations showed that controlling for Perceived Shared Fate led to stronger correlations between partner empathy and Emotional Shared Fate ( $r = 0.43, p < 0.001$ ) than Perceived Shared Fate and partner empathy when controlling for Emotional Shared Fate ( $r = 0.29, p < 0.001$ ). Controlling for Emotional Shared Fate led to stronger correlations between shared agency and Perceived Shared Fate ( $r = 0.23, p < 0.001$ ) than between shared agency and Emotional Shared Fate when controlling for Perceived Shared Fate ( $r = 0.13, p = 0.001$ ). Our results suggest that our measure of Shared Fate has concurrent validity with other measures of interdependence.

### *Convergent Validity*

We expected our measures of convergent validity to show moderate to strong positive zero-order correlations with Perceived Shared Fate and Emotional Shared Fate. Zero-order Pearson correlations showed that positive feelings from an acquaintance's promotion positively correlated with Emotional Shared Fate ( $r = 0.66, p < 0.001$ ) and with Perceived Shared Fate ( $r = .39, p < .001$ ). Increased negative feelings from an acquaintance's loss positively correlated with



Emotional Shared Fate ( $r = 0.46, p < 0.001$ ) and with Perceived Shared Fate ( $r = 0.23, p < 0.001$ ). Thinking that an acquaintance's promotion is a positive influence in one's life is positively correlated with Perceived Shared Fate ( $r = 0.53, p < .001$ ) and Emotional Shared Fate ( $r = 0.40, p < 0.001$ ). Likewise, thinking about how an acquaintance's loss is a negative influence was positively correlated with Perceived Shared Fate ( $r = 0.45, p < 0.001$ ) and Emotional Shared Fate ( $r = 0.44, p < 0.001$ ).

While we expected that both Perceived Shared Fate and Emotional Shared Fate would show moderate to strong positive correlations with our measures of convergent validity, we expected that Perceived Shared Fate would be more strongly correlated with items assessing perceived outcome interdependence (i.e., *"how do you feel this promotion will influence you?"*, and *"how do you feel this loss will influence you?"*) when controlling for Emotional Shared Fate, than Emotional Shared Fate when controlling for Perceived Shared Fate. In contrast, we expected Emotional Shared Fate to be more strongly correlated with items assessing affective reactivity to another's outcomes (i.e., *"how good do you feel about your acquaintance receiving this promotion?"*, and *"how bad do you feel about your acquaintance losing their parents?"*) when controlling for Perceived Shared Fate, than Perceived Shared Fate after controlling for Emotional Shared Fate. Controlling for Perceived Shared Fate, *"how good do you feel about your acquaintance receiving this promotion?"* was more strongly correlated with Emotional Shared Fate ( $r = 0.59, p < 0.001$ ) than with Perceived Shared Fate after controlling for Emotional Shared Fate ( $r = -0.17, p < 0.001$ ). Similarly, controlling for Perceived Shared Fate, *"how bad do you feel about your acquaintance losing their parents?"* was more strongly correlated with Emotional Shared Fate ( $r = 0.44, p < 0.001$ ) than with Perceived Shared Fate after controlling for Emotional Shared Fate ( $r = -0.16, p < 0.001$ ). In contrast, when controlling for Emotional Shared Fate, *"how do you feel this promotion will influence you?"* was more strongly correlated with Perceived Shared Fate ( $r = 0.37, p < 0.001$ ) than Emotional Shared Fate after controlling for Perceived Shared Fate ( $r = 0.04, p = 0.27$ ). Lastly, controlling for

Emotional Shared Fate, “*how do you feel this loss will influence you?*” was correlated with Perceived Shared Fate ( $r = .21, p < .001$ ) at roughly the same level as Emotional Shared Fate when controlling for Perceived Shared Fate ( $r = .18, p < .001$ ). These results demonstrate the convergence across different methods of our measures of Emotional Shared Fate and Perceived Shared Fate.

### *Predictive Validity*

Finally, we assessed predictive behavioral validity using a modified Dictator Game. Zero-order Pearson correlations show that participants who have greater Perceived Shared Fate ( $r = 0.26, p < 0.001$ ) and Emotional Shared Fate ( $r = 0.28, p < 0.001$ ) with an acquaintance allocated more tickets towards that acquaintance. Controlling for the corresponding subscale weakened but did not remove these associations (ESF,  $r = 0.14, p < 0.001$ ; PSF,  $r = 0.09, p = 0.01$ ).

Table 11. Correlations between perceived interdependence and validity measures.

N = 667	PSF	ESF	PSF <sub>p</sub>	ESF <sub>p</sub>	M	SD
Emotional Shared Fate	.723**	-	-	-	4.83	1.24
Perceived Shared Fate	-	-	-	-	3.68	1.56
Reading Minds in the Eyes	-.108**	0.017	-.174**	.138**	7.11	1.86
Perspective Taking	.116**	.263**	-.111**	.261**	3.57	0.63
Partner Empathy	.647**	.693**	.294**	.427**	4.29	1.34
Shared Agency	.428**	.391**	.229**	.131**	2.49	0.59
Job promotion (feel good)	.387**	.659**	-.170**	.594**	5.59	1.48
Job promotion (positive Influence)	.526**	.405**	.368**	0.043	3.49	2.05

Parent's death (feel bad)	.232**	.462**	-.165**	.437**	6.21	1.23
Parent's death (negative influence)	.449**	.440**	.212**	.186**	4.33	1.69
Dictator (tickets given)	.267**	.286**	.091*	.140**	33.39	24.80

*Note.* \*\* =  $p < .01$ , \* =  $p < .05$ . The second and third columns reflect zero-order Pearson correlations, the fourth column reflects partial Pearson correlations for Emotional Shared Fate controlling for Perceived Shared Fate, and the fifth column reflects partial Pearson correlations for Perceived Shared Fate controlling for Emotional Shared Fate.

## Study 4 Method

### Participants

Fourteen days after study 3, the same participants were invited to participate in study 4 ( $N = 629$ ) and were compensated with \$1.25 for their time. Participants were excluded from analyses if indicated that they did not remember their acquaintance from Study 3 or if the initials for their acquaintance in Study 4 did not match the initials provided in Study 3. This resulted in 242 exclusions and a final sample size of 397 ( $M_{age} = 28.40$   $SD_{age} = 9.90$ , 50.8% female).

### Measures and materials

To assess test-retest reliability, we measured Shared Fate at both time points and predicted there would be a strong positive correlation between Shared Fate scores.

### Study 4 results

We conducted paired-samples t-tests and zero-order Pearson correlations between the Shared Fate scores. We observed no mean differences in Emotional Shared Fate with an acquaintance between Study 3 ( $M = 4.79$ ,  $SD = 1.26$ ) and Study 4 ( $M = 4.73$ ,  $SD = 1.21$ ),  $t(395) = -1.71$ ,  $p = .09$   $[-.14, .01]$ , or between Perceived Shared Fate with an acquaintance between Study 3 ( $M = 3.58$ ,  $SD = 1.59$ ) and Study 4 ( $M = 3.61$ ,  $SD = 1.47$ ),  $t(392) = -.795$ ,  $p = .43$   $[-.14, .06]$ . Additionally, there were strong positive correlations between Emotional Shared Fate ( $r(396) = .82$ ,  $p < .001$ ) and Perceived Shared Fate ( $r(393) = .78$ ,  $p < .001$ ). These results

suggest that the Shared Fate scale has good test-retest reliability fourteen days after assessment.

## **Discussion**

This paper presents a novel scale assessing Shared Fate as a proximate indicator of interdependence, focusing on how people perceive their outcomes and anticipated emotions to covary with a partner's material outcomes. As a novel measure of an interdependence indicator, our scale builds upon traditional interdependence theory (Aron et al., 1992; Cialdini et al., 1997; Kelley & Thibaut, 1978) and evolutionarily based interdependence theories (Aktipis et al., 2018; Brown, 1999; Roberts, 2005; Tomasello et al., 2012). However, our scale differs from previous approaches because we measure proximate emotions and perceived outcomes rather than the aspects of the situation, abstract global or metaphorical perceptions, or long-term dyadic relationships (Aron et al., 1992; Bell et al., 1995; Brown, 1999; Cialdini et al., 1997; Hackman et al., 2015; Gerpott et al., 2018; Jones & Rachlin, 2006; Korchmaros & Kenny, 2001; Vezzali et al., 2016). While these measures have greatly contributed to our understanding of interdependence, the new scale adds a new way of measuring the proximate mechanisms that index fitness interdependence. By directly assessing perceived Shared Fate with a target, our scale can be used to address theoretical aims that are not easily addressed by other measures.

For example, the Shared Fate scale allows one to examine the degree to which individuals perceive their outcomes to covary with the outcomes of the target, which scales such as Gerpott et al.'s (2018) are able to do only at the level of the situation. This scale also offers a simple and easily comprehended way of assessing interdependence that lends itself well to translation and use with diverse populations. This is important in the light of calls for research to move away from populations living in large-scale, hierarchical societies (Henrich et al., 2010; Rad et al., 2018). Thus, this scale provides a novel and reliable tool for studying Shared Fate, which has been theoretically specified as a key proximate mechanism through which

interdependence can shape willingness to help. For researchers who wish to adopt this scale in their research, there are two methods for assessing interdependence via this scale.

If the one's interest lies in global perceptions of shared fate (i.e., regardless of whether shared fate is being driven by emotional shared fate or perceived shared fate), then it is appropriate for researchers to make a composite score by averaging participant responses. For researchers who are interested in only emotional or perceived shared fate (i.e., but not both aspects), then it is appropriate to make a composite score by averaging the items for that specific subscale. However, for researchers who are interested in disentangling the relationships between emotional and perceived shared fate in their research (i.e., plan to use the whole scale and both subscales), then it is advisable to use weighted scores, as we have done in our analyses. The reason that this is the preferred strategy is that our Shared Fate scale has one item that cross-loads, and this item does not contribute equally to both subfactors. To create a weighted score, researchers can 1) perform their own confirmatory analyses to determine the factor loadings of these items in their own data and then weight the raw scores by these factors loadings, or 2) use the factor loadings we report in Figure 2 as an approximation of the loadings in their own data. However, it is important that researchers who use the second strategy acknowledge that they have done so in their research, as it is possible that the factor loadings in their own data may be different than the ones we report here depending on participant age, target, or cultural factors.

### **Limitations**

Common method variance is a problem when establishing scale validity because the factor analyses may capture the similarity between items from a common method as opposed to the similarity between the items due to a common latent factor. We addressed this in studies 3 and 4 by asking about Shared Fate in different forms, including how people would feel at the prospect of an acquaintance obtaining an important job promotion and how bad they would feel if an acquaintance lost their parents in a car accident. An additional limitation is that we

prioritized face validity and ease of translation when we were creating the scale. Our emphasis on prioritizing these aspects of the scale may have biased our scale to not include more subtle aspects of Shared Fate perceptions. We realize that the emphasis on face validity may be a weakness of the current scale, but we believe that the current scale serves as a starting point for research and that face validity is important, particularly for facilitating diverse methodological and theoretical aims in future research (e.g., cross-cultural, or multi-level examinations).

An additional limitation that should be addressed in future research deals with the relationships between ESF and PSF. As we documented here, ESF did not fully mediate the effects of PSF so we can infer that PSF is providing information about Shared Fate that cannot be inferred from ESF. But what kind of information is PSF providing? It is possible that PSF indexes more proximate assessments of Shared Fate while ESF indexes more ultimate assessments of Shared Fate, but we cannot assess that possibility with the current data. While this is a limitation of the current study, this conundrum does pose an interesting starting place for future researchers to investigate the nature and origin of Shared Fate in human psychology.

### **Future directions**

What is the nature of the causal relationship between perceived and emotional shared fate? Our analyses indicated that, even when controlling for other measures of interdependence, positive and negative affect in response to a target's outcomes (i.e., emotional shared fate) was the primary predictor across five of the six measures of helping we investigated (behind relatedness for welfare tradeoff ratio in Study 2), while perceptions of Shared Fate only had a weak positive effect (Study 1) or no effect (Study 2) on helping after controlling for other measures of interdependence. Accordingly, we consistently found an indirect effect of perceived shared fate on all measures of help via emotional shared fate, which suggests that perceptions of shared fate may give rise to affect regarding a target's outcomes, in turn proximally guiding helping motivation. However, these results do not allow us to determine the exact nature of the causal pathways between shared fate and willingness to help.

A longitudinal approach, looking at how perceptions and emotions pertaining to Shared Fate develop over time, would allow us to examine which factor predicts the development of the other.

Another important direction for future work is to evaluate whether Shared Fate can be captured by a single item for each subscale. Our scale uses six items to measure Perceived Shared Fate and Emotional Shared Fate, which may be too many items for some field researchers to use. If future research discovered that one item from each factor is sufficient, then researchers working with non-literate or limited-literacy populations would be able to assess Shared Fate using fewer items.

Another area for future research is how Shared Fate maps onto valuation. It may be the case that Emotional Shared Fate closely tracks intrinsic, rather than instrumental, valuation of others. Perceived Shared Fate, in contrast, may be more influenced by instrumental interdependence (e.g., non-repetitive joint actions, coordination), or closely track *de facto* interdependence (e.g., through genetic relatedness or via marriage). The fact that we found that perceived shared fate (at the between-person level) negatively predicted willingness to help in the absence of reciprocity, as well as negatively predicted willingness to help an enemy in the absence of reciprocity, but emotional shared fate positively predicted willingness to help in the absence of reciprocity (and other measures of help) across targets supports the notion that perceived shared fate may be more akin to instrumentality than emotional shared fate. However, this hunch will need to be investigated in future studies.

Another interesting direction involves mapping relationships between actual fitness interdependence and perceptions of interdependence. Future work could assess how sources of objective interdependence (e.g., mutual aid, co-residence, group membership) contribute to perceived interdependence in the form of Perceived and Emotional Shared Fate. Because perceived interdependence presumably takes cues from the environment to construct a 'best guess' at the actual underlying fitness interdependence, it may not always be accurate. For

example, in large-scale postindustrial societies with high mobility and a complex division of labor, individuals may be highly fitness interdependent in reality, but they may not receive cues that they are interdependent (perhaps because market transactions cue interchangeability and replaceability rather than interdependence). In contrast, in smaller-scale societies, interdependence in subsistence activities and risk management may provide consistent cues that lead individuals to perceive themselves as more interdependent with those around them.

Perceptions of fitness interdependence may have important consequences for emotional well-being (Cross et al., 2003; Kershaw et al., 2015; McCormick, 1997). Future work could investigate whether higher scores on the Shared Fate scale correlate with measures of well-being. Because the scale is target-specific, future research could measure perceived interdependence towards multiple others in an individual's network. For instance, one could manipulate Shared Fate towards kin, friends, and one's in-groups to measure how gains (or losses) in Shared Fate alter well-being.

Conceptually, genetic relatedness should be considered a component of fitness interdependence, as two genetically related individuals influence their mutual reproductive success. Future research should help clarify the cognitive architecture underlying perceived interdependence. It may be that many diverse cues get integrated into an internal cognitive summary variable that includes cues like genetic relatedness (Burnstein et al., 1994; Curry et al., 2013; Hackman et al., 2015a; Lieberman et al., 2007; Sznycer et al., 2016), risk pooling (A. Aktipis et al., 2011; Cashdan, 1985; Kaplan et al., 1985), reciprocation (Cosmides & Tooby, 2005; Delton et al., 2011; Hoffman et al., 1998), cooperative relationships (Hruschka, Daniel J., Silk, Joan B., 2015; Hruschka, 2010), the existence of common friends or enemies (Pietraszewski, 2016; Shaw et al., 2017), worldview similarity (Curry & Dunbar, 2013; Pinsof & Haselton, 2016; John Tooby et al., 1996), mutualism (Balliet et al., 2017; Charness & Rabin, 2002; Rusbult, 1983; Thibaut & Kelley, 1959), and shared group membership (Choi & Bowles,



2007). Alternatively, there may be several independent summary variables that influence behavior. In order to distinguish between these possibilities, further research is needed.

### **Concluding remarks**

The Shared Fate scale provides a tool to help study cooperation and helping behavior in many domains. Although we applied this scale only to dyads, the scale can theoretically be used to assess Shared Fate with groups. The structure of the scale allows for many different kinds of targets to be included. Many important human relationships are characterized by high fitness interdependence, from mating relationships, to friendships, to parent-child relationships. Fitness interdependence is also often a characteristic of human groups, from small-scale societies to large nations that have shared fate (e.g., Lin & Jackson, 2019). With the help of a scale that allows for the measurement of Shared Fate, future work can investigate the causes of fitness interdependence and its consequences for human relationships and human societies.

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## Supplementary Information

### Prompts for targets in Studies 1 and 2.

#### Study 1

*Friend:* Think of your closest same-sex friend. Please type the first name of this person.

*Sibling:* Please think of your sibling (including a full sibling, half-sibling, step-sibling, or adopted sibling). If you have more than one sibling, think of the one whose name comes first alphabetically. Please type the first name of this person.

*Acquaintance:* Please think of a same-sex acquaintance who is not a close friend, but is someone you see on a regular basis. Please type the first name of this person.

*Stranger:* Please think of a stranger; a person randomly drawn from the population of American people of your sex and age.

*Enemy:* Please think of someone you do not like and feel is against you, a person you may even feel is an enemy.

#### Study 2

*Friend:* Think of your closest same-sex friend. Please type the first name of this person.

*Sibling:* Please think of your sibling (including a full sibling, half-sibling, step-sibling, or adopted sibling). If you have more than one sibling, think of the one whose name comes first alphabetically. Please type the first name of this person.

*Acquaintance:* Please think of a same-sex acquaintance who is not a close friend, but is someone you see on a regular basis. Please type the first name of this person.

*Cousin:* Please think of your cousin (including a full cousin, half-cousin, step-cousin, or adopted cousin). If you have more than one cousin, think of the one whose name comes first alphabetically. Please type the first name of this person.

*Uncle:* Please think of your uncle or aunt (including a sibling of a parent of yours, or the spouse of a sibling of a parent of yours). If you have more than one uncle or aunt, think of the one whose name comes first alphabetically. Please type the first name of this person.

### **Scales used in Studies 1 – 3.**

#### *Shared Fate items*

1. When [target] succeeds, I feel good.
2. When [target] fails, I feel bad.
3. I feel that [target's] gain is my gain.
4. What is good for [target] is good for me.
5. Honestly, I don't care whether [target] thrives or not. (reverse coded)
6. [Target] and I rise and fall together.

Coded on a scale of 1 "do not agree at all" to 7 "strongly agree".

#### *Correlational Shared Fate items*

1. When something good happens to [X], that is...
2. When something bad happens to [X], that is... (RC)
3. When [X] succeeds, I feel...
4. When [X] fails, I feel... (RC)
5. [X]'s gain is...
6. [X]'s loss is... (RC)

Coded on: -3 "very bad for me / very bad / my loss" to 0 "neither good nor bad for me / neither good nor bad / neither my gain nor my loss" to +3 "very good for me / very good / my gain. RC = reverse coded.

#### *Fitness Interdependence – Mutuality (FI-M; Brown, 1999)*

1. I feel like I need [target] as much as they need me.
2. I need [target] as much as they need me.
3. [target] needs me as much as I need them.

Coded on a scale of 1 (Do not agree at all) to 7 (Strongly agree)

#### *Genetic relatedness coefficients.*

Sibling: 0.5 for full sibling, 0.25 for half sibling, 0 for step- or adopted sibling

Aunt/ Uncle: 0.25 for a parent's sibling, 0 for a parent's sibling's spouse

Cousin: 0.125

We used 0.125 for relatedness to cousins on the assumption that most of the cousins they chose were first cousins. This conceptualization of cousin relatedness has a precedent in the existing literature (see Brown, 1999).

Friend, acquaintance, enemy, and stranger: 0

#### *Willingness to help in times of need*

1. During a winter storm, [target] knocks on your door because their heating is out. How willing would you be to let them sleep in your living room for the night?<sup>1</sup>
2. [target] has no water in their house. How willing would you be to fill their jugs with water from your tap?<sup>2</sup>
3. [target]'s house is being fixed, so it isn't livable. How willing would you be to let them move into your house for a week?<sup>3</sup>
4. How willing would you be to help [target] move boxes to their new apartment?<sup>4</sup>
5. How willing would you be to lend \$100 to [target]?<sup>5</sup>
6. How many favors have you done for [target] in the last two months?<sup>6</sup>

7. If [target] needed a kidney, how willing would you be to donate a kidney to them? <sup>7</sup>

<sup>1,2,3,4,5,7</sup>Coded on: **1** (Not willing at all) ... **7** (Very willing)

<sup>6</sup>Coded on: **1** (none), **2** (1), **3** (2), **4** (3), **5** (4-7), **6** (8-10), **7** (more than 10).

*Help in the absence of reciprocity* (Brown, 1999)

1. I would help [target], even if [target] could never return the help.
2. I would be very angry if I spent a lot of time helping [target] and [target] couldn't find time to help me. (RC)
3. I doubt that I would help [target] unless [target] gave me something in return. (RC)
4. I would help [target] in their time of need, even if [target] could never return the help.
5. I will help [target] only if [target] helps me. (RC)
6. I am only willing to do as much for [target] as [target] is willing to do for me. (RC)
7. I would help [target] as long as [target] was willing to help me in return. (RC)
8. If [target] was in need, I would want to help [target], as long as [target] needed, even at high cost to myself.
9. I would do as much as I could for [target], even if [target] couldn't do as much for me

Coded on a scale from 1 (Do not agree at all) to 7 (Strongly agree). RC = reverse coded.

*Welfare Tradeoff Ratio (Delton & Robertson, 2016; Tooby et al., 2008).*

**Table S1**

*Welfare tradeoff ratio decisions made by participants (amounts in \$)*

<i>Self</i> (Participant)	<i>Other</i> (Target)
-38	84
-20	79
-6	82
6	85
18	81
30	75
46	77
66	83
78	78
91	76

*Note.* Each row indicates one decision. For each decision, the participant has to choose between an amount of money for themselves and an amount of money for the target. Foregoing a positive sum for the self to deliver money to the target indicates a positive welfare tradeoff ratio. Choosing a negative amount for the self indicates a negative (spiteful) welfare tradeoff ratio—it means the participant is willing to pay money to prevent the target from getting money.

*Interpersonal Reactivity Index (IRI)- Perspective taking (Davis, 1980).*

1. I sometimes find it difficult to see things from the "other guy's" point of view.
2. I try to look at everybody's side of a disagreement before I make a decision.
3. I sometimes try to understand others better by imagining how things look from their perspective.
4. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
5. I believe that there are two sides to every question and try to look at them both.
6. When I'm upset at someone, I usually try to "put myself in their shoes" for a while.
7. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

Coded on a scale from 1 = "*Does not describe me well*" to 5 = "*Describes me very well*".

*Perceived Shared and Non-Shared Agency Scale – Collaboration (Chang et al., 2010).*

1. My acquaintance will take on my responsibilities so that I can accomplish my goals.
2. If I am busy, my acquaintance will not tell me about their difficulties and needs.
3. My acquaintance and I tend to negotiate when we disagree.

Coded on a scale from 1 = "*Strongly disagree*" to 4 = "*Strongly agree*".

*Partner Empathy (Fischer et al., 2012).*

1. I share my acquaintance's emotions.
2. I empathize with my acquaintance.
3. I see that my acquaintance feels the same emotions as I do.
4. I feel a strong bond with my acquaintance.

Coded on a scale from 1 = "*Do not agree at all*" to 7 = "*Strongly agree*".

### ***Vignettes presented in Study 3.***

#### ***Vignette 1***

Imagine that your acquaintance has received a promotion at their job. They have been working really hard for this company for some time, and are very excited about this new opportunity. This promotion will give your acquaintance more financial stability and the ability to invest in the future.

#### **Questions**

*How good do you feel about your acquaintance receiving this promotion?*

1 = "Not at all" to 7 = "Really good"

*How do you feel this promotion will influence you?*

1 = "This will have no influence on me" to 7 = "This will have a positive influence on me"

#### ***Vignette 2***

Imagine that your acquaintance recently lost both of their parents in a car accident. Your acquaintance is devastated about their loss. Without his/her parents, your acquaintance has lost their main source of emotional and social support, and they do not know how to cope.

#### **Questions**

*How bad do you feel about your acquaintance losing their parents?*

1 = "Not at all" to 7 = "Really bad"

*How do you feel this loss will influence you?*

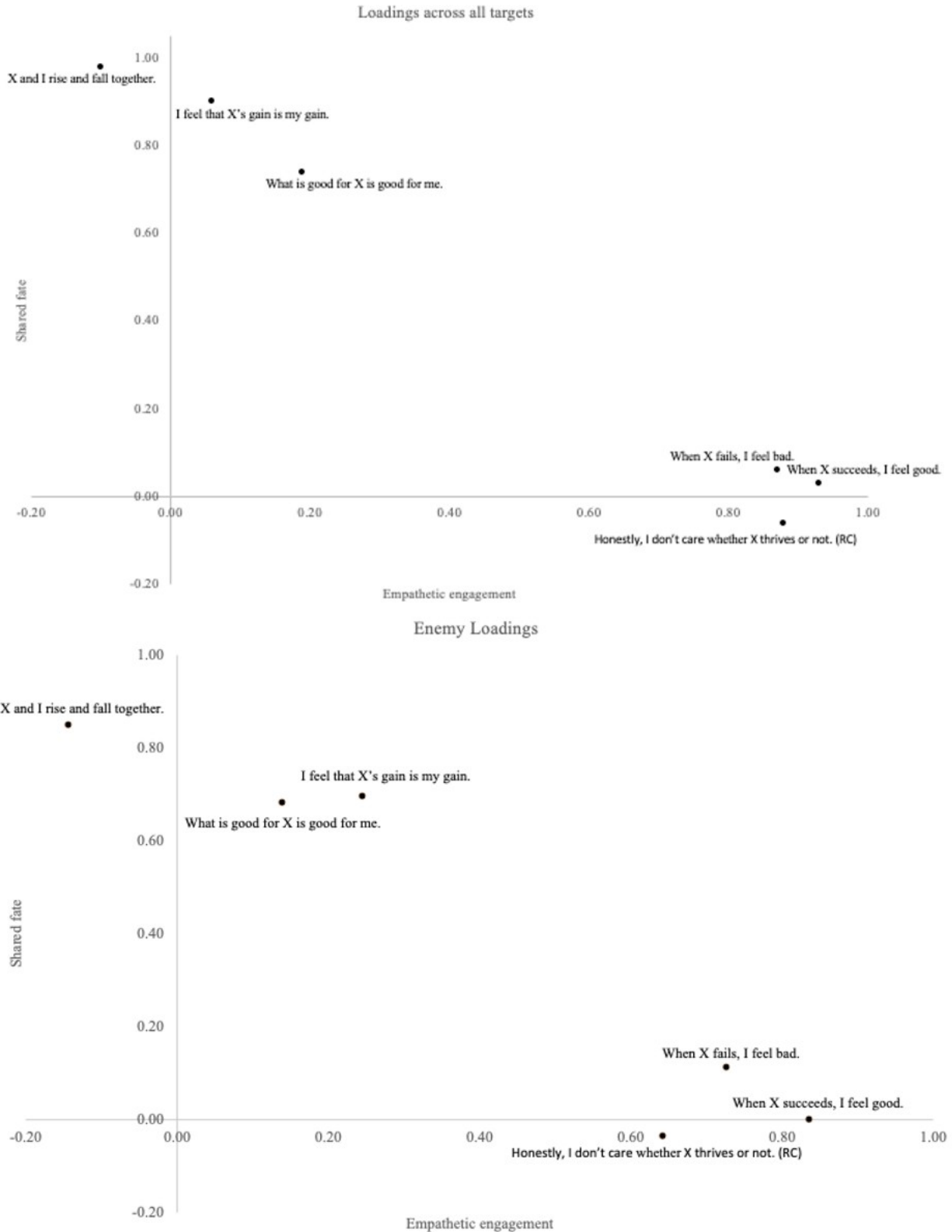
1 = "This will have no influence on me" to 7 = "This will have a negative influence on me"

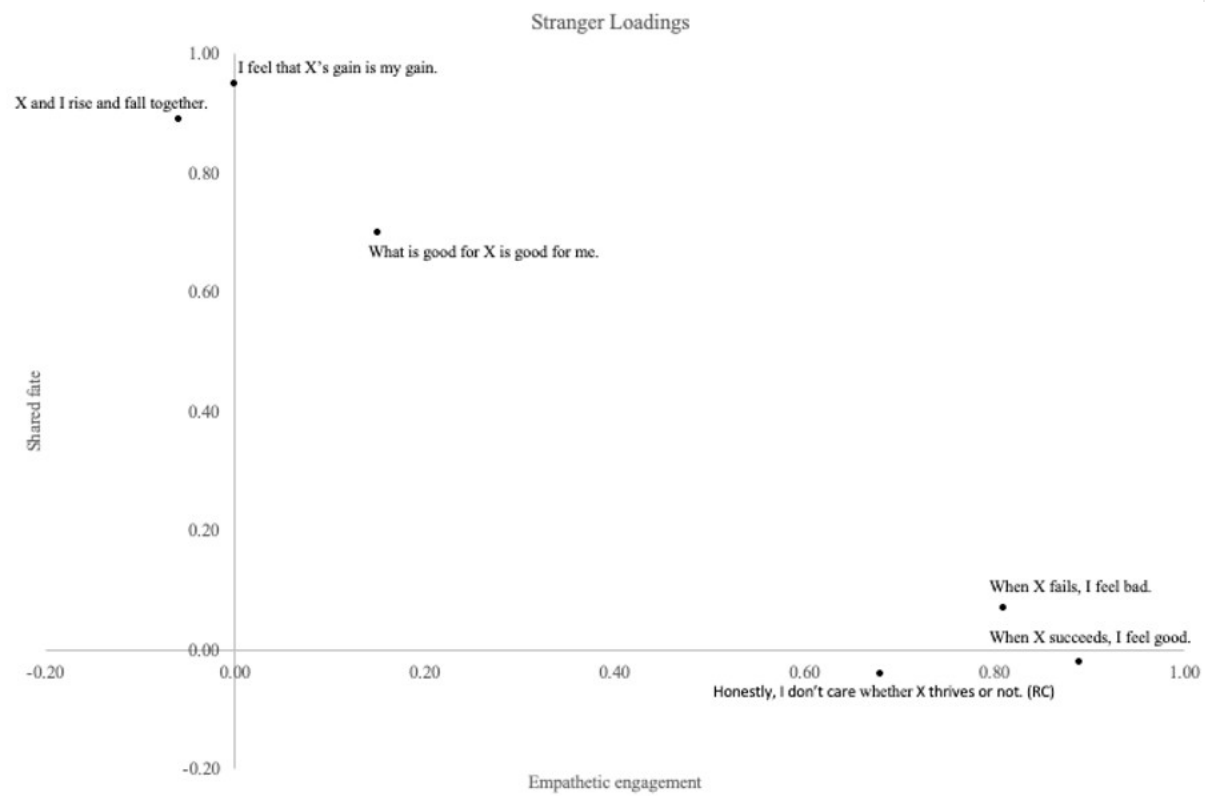
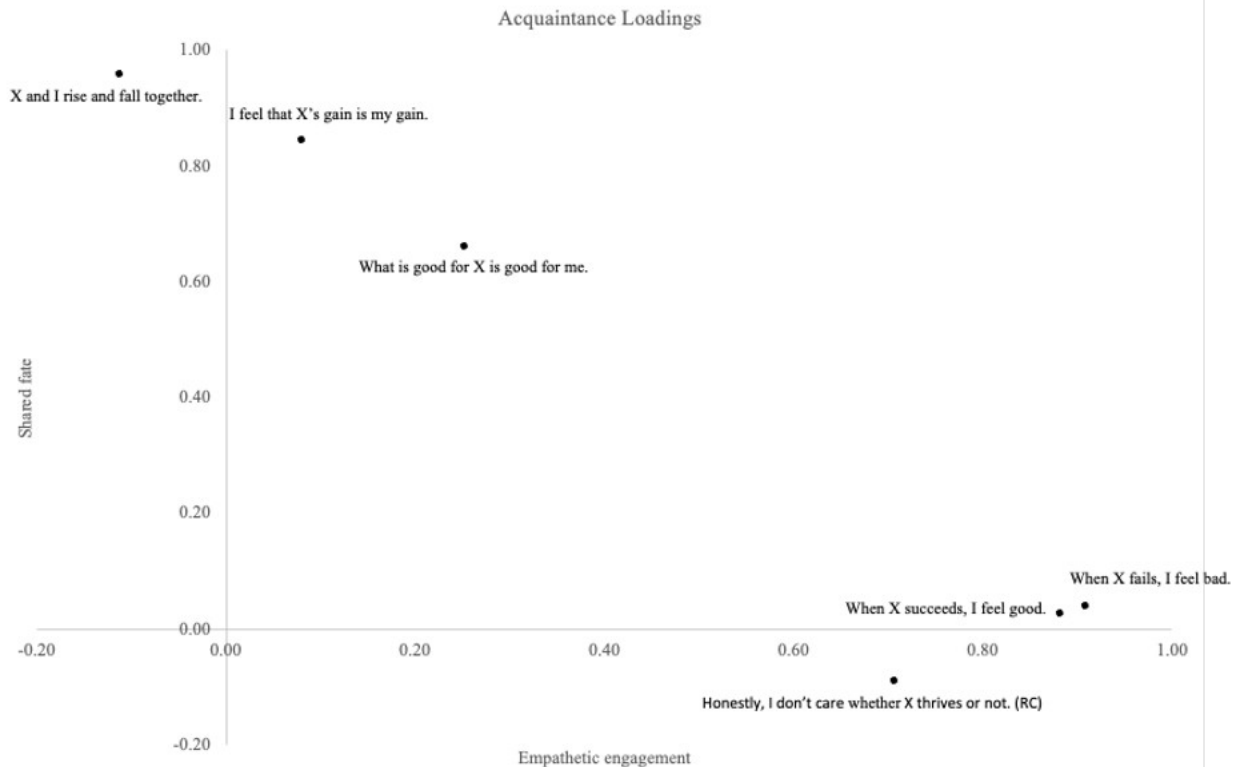
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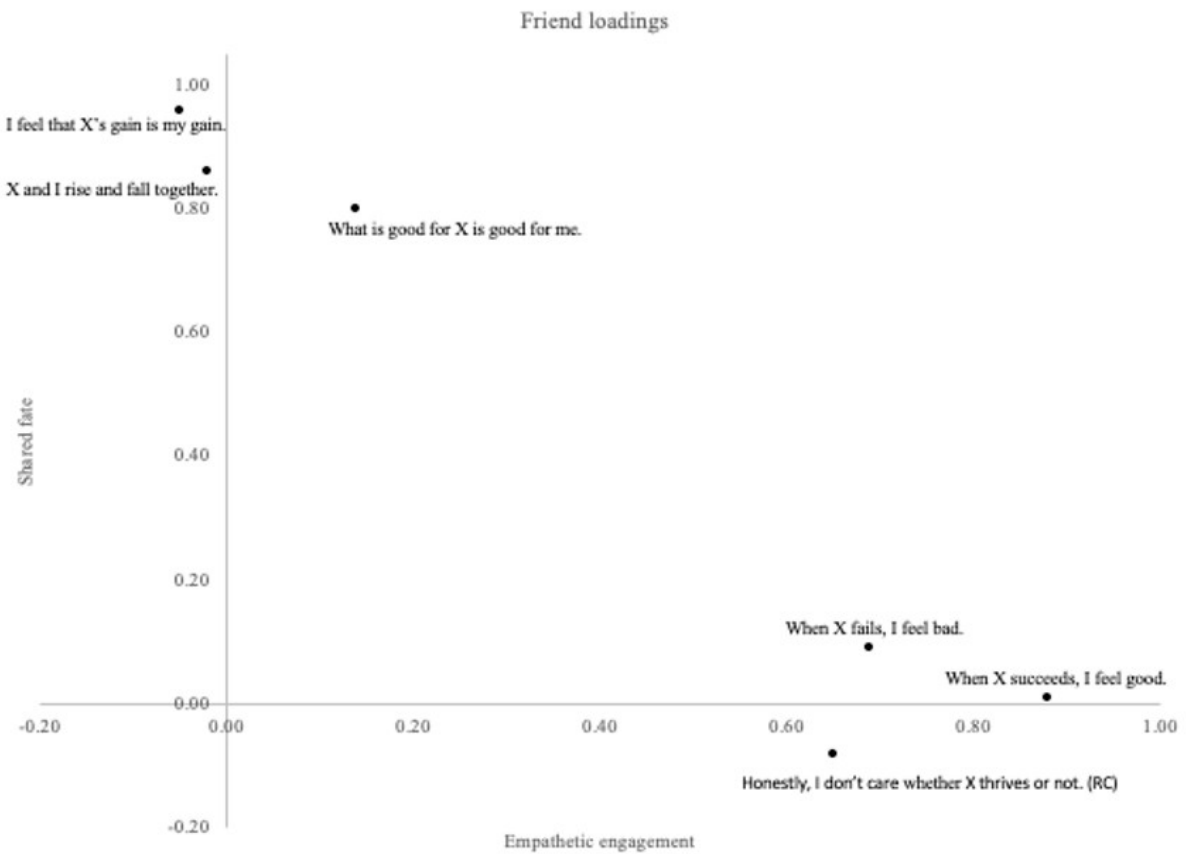
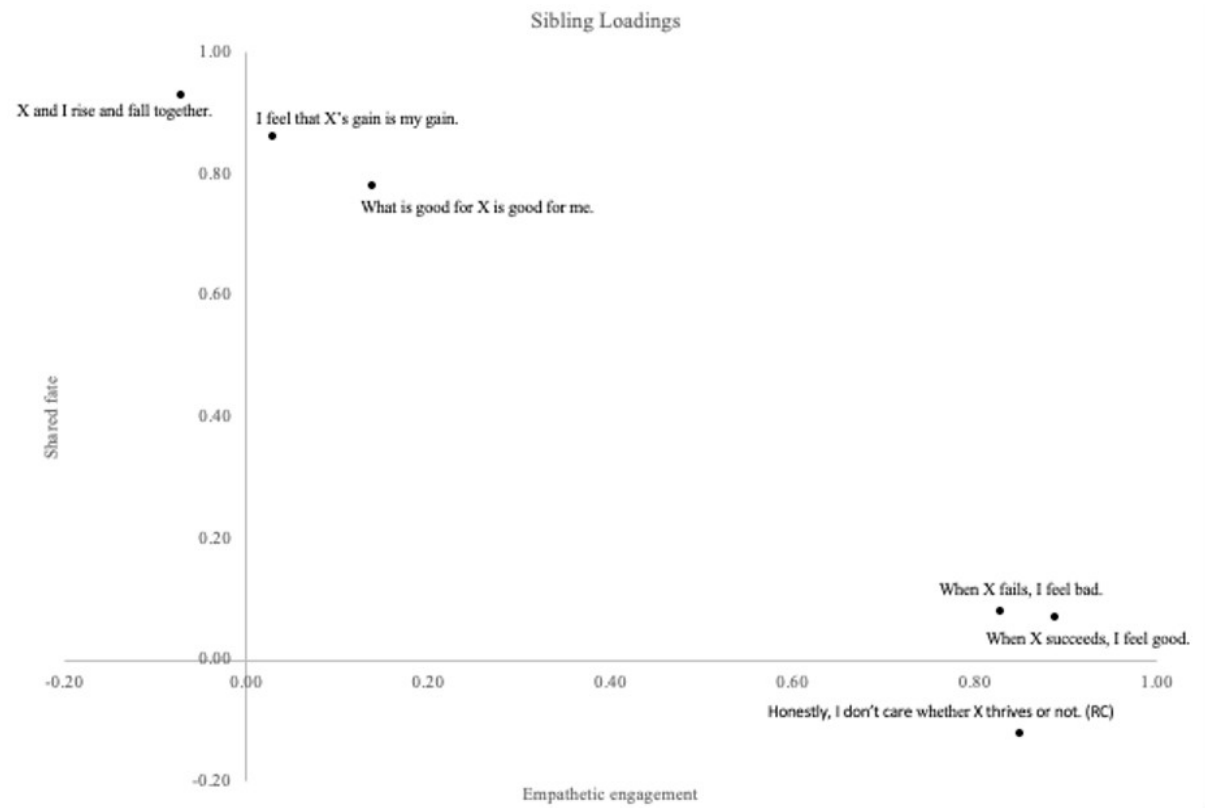


**Figure S1.**

Plots of Shared Fate item loadings in study 1 for all targets individually and across targets.







Supplementary Tables

### *Correlational Shared Fate scale exploratory factor analyses.*

In addition to the Shared Fate scale reported in the main body of the article, we also created a measure of interdependence that would allow us to assess situations where the participant's outcomes are negatively correlated with the target's outcomes on a -3 (*very bad for me/ very bad/ my loss*) to +3 (*very good for me/ very good/ my gain*) scale. We then conducted an exploratory factor analysis to determine the factor structure of the correlational shared fate across targets. The factor analysis was conducted in R with oblimin rotation, which allows factors to be correlated with one another. We compared the one-factor and two-factor solutions using data from study 1 and study 2 separately, but no factor structure emerged as the most interpretable solution with acceptable fit statistics in either sample. Resulting factor structures are shown in Table S2 (study 1) and Table S3 (study 2).

There are multiple reasons that might explain why we were not able to fully assess the factor structure of Shared Fate-2. First, participants might have been opposed to reporting negative interdependence on this scale, as it is not seen to be a socially desirable way to respond (i.e., participants might not have felt comfortable saying that "When something good happens to [X], that is..." really bad for them (-3)). We see evidence for this in that it was very uncommon to see participants using the negative response options. Finally, the targets that we used in this study (e.g., sibling, close friend) may not have been appropriate to capture the effects of negative shared fate. However, if the items are considered globally, the 6 items seem to be assessing one overall measure of positive or negative shared fate. Future research could look to expand on the shared fate-2 scale with more appropriate alters to determine if this one-factor solution remains the most interpretable solution for the data.

**Table S2.**

*Exploratory factor loadings for the Correlational Shared Fate scale from sample 1.*

	One Factor Solution	Two Factor Solution	
When something good happens to X, that is ...	<b>0.78</b>	<b>0.87</b>	-0.04
When something bad happens to X, that is ... (RC)	<b>0.78</b>	0.47	0.36
When X succeeds, I feel ...	<b>0.82</b>	<b>0.50</b>	0.38
When x fails, I feel ... (RC)	<b>0.79</b>	0.00	<b>1.00</b>
X's gain is ...	<b>0.81</b>	<b>0.92</b>	-0.06
X's loss is ... (RC)	<b>0.81</b>	<b>0.52</b>	0.35
	SS loading = 3.82 Variance explained = 0.64	SS loading = 2.64 Variance explained = 0.44	SS loading = 1.71 Variance explained = 0.29

$\chi^2(9) = 462.00, p < 0.001,$ TLI = 0.815, SRMR = 0.06, RMSEA = 0.225 [0.207, 0.242]	Factors correlated $r = 0.66$ $\chi^2(4) = 151.54, p < 0.001,$ TLI = 0.864, SRMR = 0.03, RMSEA = 0.193 [0.167, 0.219]
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\*Note. Bolded loadings indicate which factor the items best indicated.

**Table S3.**  
*Exploratory factor loadings for the Correlational Shared Fate scale from sample 2.*

	One Factor Solution	Two Factor Solution	
When something good happens to X, that is ...	<b>0.73</b>	<b>0.79</b>	-0.03
When something bad happens to X, that is ... (RC)	<b>0.75</b>	<b>0.63</b>	0.18
When X succeeds, I feel ...	<b>0.69</b>	0.33	<b>0.50</b>
When x fails, I feel ... (RC)	<b>0.65</b>	-0.02	<b>1.01</b>
X's gain is ...	<b>0.81</b>	<b>0.92</b>	-0.07
X's loss is ... (RC)	<b>0.76</b>	<b>0.71</b>	0.09
	SS loading = 3.24 Variance explained = 0.54	SS loading = 2.60 Variance explained = 0.43	SS loading = 1.45 Variance explained = 0.24
	$\chi^2(9) = 570.32, p < 0.001,$ TLI = 0.726, SRMR = 0.09, RMSEA = 0.239 [0.222, 0.256]	Factors correlated $r = 0.54$ $\chi^2(4) = 124.10, p < 0.001,$ TLI = 0.868, SRMR = 0.04, RMSEA = 0.166 [0.141, 0.191]	

\*Note. Bolded loadings indicate which factor the items best indicated.

**Table S4.**  
*Mixed-linear model predicting willingness to help in the absence of reciprocity (Study 1)*

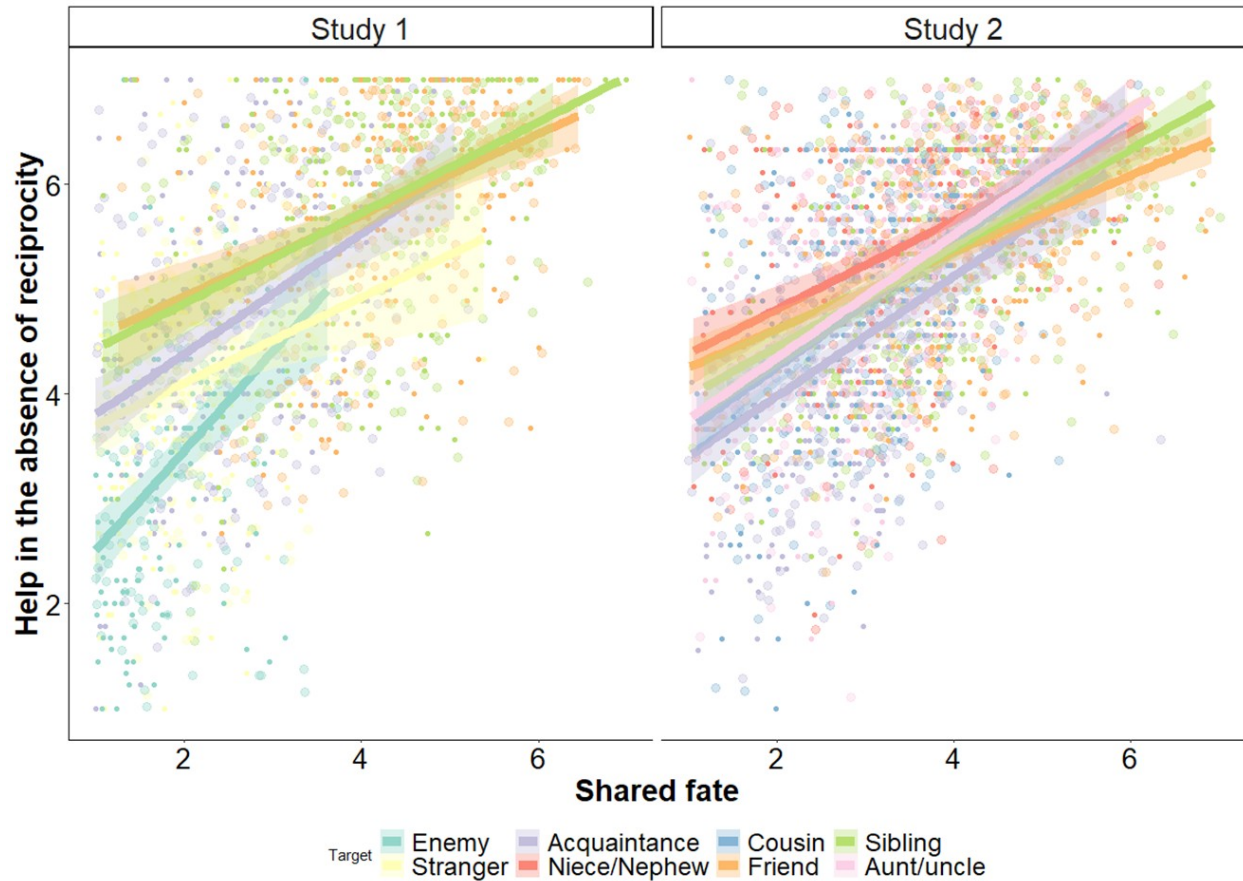
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*Note.*  $N = 200$ ,  $ICC = 0.06$ ,  $\tau_{\text{intercept}} = 0.35$  ( $z = 7.68^{***}$ ),  $\tau_{\text{perceived SF}} = 0.04$  ( $z = 2.34^{**}$ ),  $\tau_{\text{emotional SF}} = 0.05$  ( $z = 2.1^*$ ),  $\tau_{\text{intercept.perceived SF}} = -0.39$  ( $z = -2.14^*$ ),  $\tau_{\text{intercept.emotional SF}} = 0.20$  ( $z = 1.05$ ),  $\tau_{\text{perceived SF.emotional SF}} = 0.06$  ( $z = 0.16$ ).  $\sigma^2_{\text{acquaintance}} = 0.41$  ( $z = 6.86^{***}$ ),  $\sigma^2_{\text{friend}} = 0.25$  ( $z = 5.42^{***}$ ),  $\sigma^2_{\text{sibling}} = 0.51$  ( $z = 7.29^{***}$ ),  $\sigma^2_{\text{stranger}} = 0.53$  ( $z = 7.15^{***}$ ),  $\sigma^2_{\text{enemy}} = 0.63$  ( $z = 6.51^{***}$ ).

## Supplemental figures

**Figure S2**

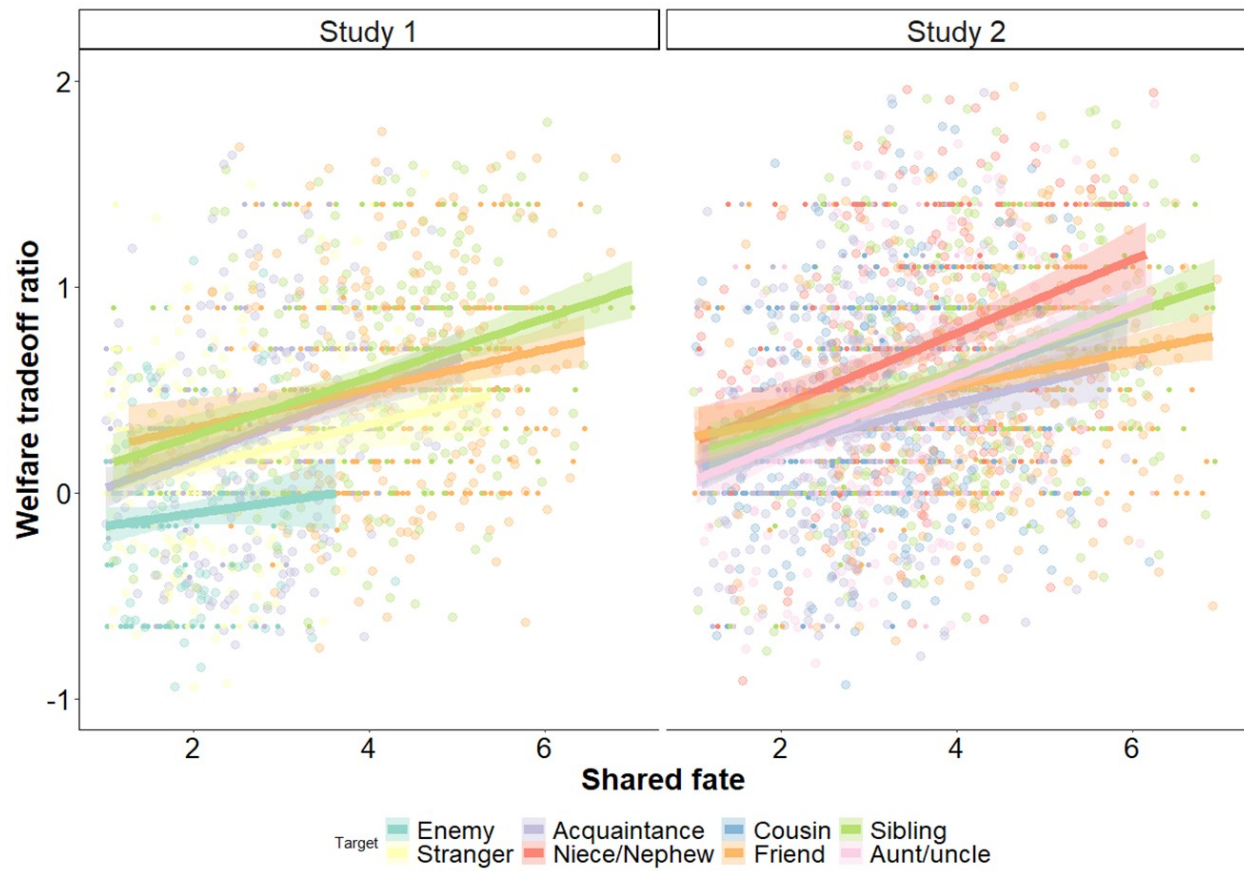
*Emotional shared fate predicts greater willingness to help in the absence of reciprocity*



*Note.* Emotional Shared Fate positively predicted willingness to help in the absence of reciprocity in both Study 1 (left) and Study 2 (right). This effect was constantly positive across relationships in Study 2, but showed the strongest positive effect for an enemy in Study 1.

**Figure S3**

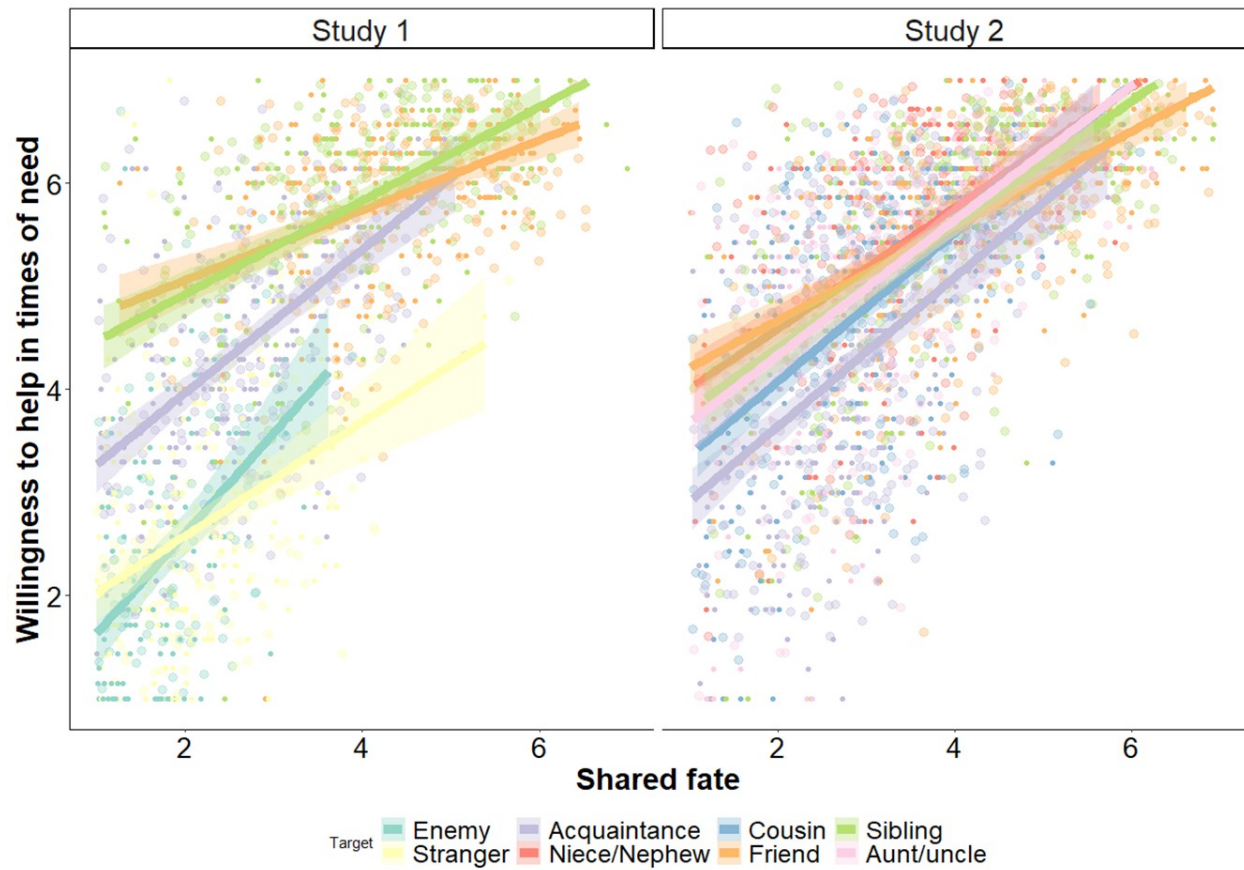
*Emotional shared fate predicts higher welfare tradeoff ratios*



*Note.* Emotional shared fate positively predicted welfare tradeoff ratios across relationship partners in both Study 1 (left) and Study 2 (right).

**Figure S4**

*Emotional shared fate predicts greater willingness to help in times of need*



*Note.* Emotional Shared Fate positively predicted willingness to help during times of need in both Study 1 (left) and Study 2 (right). The positive effect of emotional shared fate was constantly positive across relationships in Study 2, but showed the strongest positive effect for an enemy in Study 1.