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The Structure of Human Prosociality: Differentiating Altruistically Motivated, Norm Motivated, Strategically Motivated, and Self-Reported Prosocial Behavior

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Abstract

Prosocial behavior is crucial for functioning societies. However, its reliable scientific assessment and the understanding of its underlying structure are still a challenge. We integrated 14 paradigms from diverse disciplines to identify reliable and method-independent subcomponents of human prosociality; 329 participants performed game theoretical paradigms and hypothetical distribution tasks commonly used in behavioral economics and completed interactive computer tasks and self-reports typically employed in psychology. Four subcomponents of prosociality were identified by exploratory factor analysis and verified by confirmatory factor analysis in an independent sample: altruistically motivated prosocial behavior, norm motivated prosocial behavior, strategically motivated prosocial behavior, and self-reported prosocial behavior. Altruistically motivated behavior was related to gender, to enhanced cognitive skills, and to reduced negative affect. Our study provides a crucial step toward an overarching framework on prosocial behavior that will benefit future research on predictors, neural underpinnings, and plasticity of human cooperation and prosociality.

Keywords

altruism, prosocial behavior, social decision-making, interindividual differences, economic games, factor analysis

Introduction

Societies depend on prosocial behavior of their members, ranging from offering seats to the elderly to taking in refugees. Recently, the study of human cooperation and altruism has moved into scientific focus. Disciplines such as economics, psychology, and neuroscience have started to reveal preconditions, constraints, and underpinnings of prosocial behavior (e.g., Batson, 2011; Boyd & Richerson, 2009; Fowler, 2005; Henrich et al., 2006; Nowak & Sigmund, 2005; Ohtsuki, Hauert, Lieberman, & Nowak, 2006; Rekers, Haun, & Tomasello, 2011; Steinbeis, Bernhardt, & Singer, 2012; Warneken & Tomasello, 2009). Typically, however, these disciplines employ different methods and focus on different facets of prosociality.

Economists preferentially use game theoretical paradigms that are based on strict payoff matrices and real monetary earnings to operationalize concepts like generosity (e.g., dictator game [DG]; Camerer, 2003), trust (e.g., trust game [TG]; Berg, Dickhaut, & McCabe, 1995), and altruistic punishment (e.g., punishment games; Fehr & Fischbacher, 2004). This research has shown, for instance, that people reciprocate favors specifically to those who have previously favored them (Falk & Fischbacher, 2006) and invest resources to punish those who behave unfairly (Henrich et al., 2006), findings that indicate the critical role of social norms in interpersonal behavior. In turn, people behave more generously when they can be punished for ungenerous offers, a behavior that has been termed "strategic" (Spitzer, Fischbacher, Herrnberger, Gron, & Fehr, 2007).

Psychologists, on the other hand, assess prosociality with self-report measures that ask for people's inclination to help and support others (e.g., Prosocialness Scale, Caprara, Steca, Zelli, & Capanna, 2005; interpersonal reactivity index [IRI], Davis, 1983) or to behave according to self-interest (e.g., Machiavellianism Scale; Henning & Six, 1977). Also, paradigms involving more ecologically valid interactions are employed, ranging from charitable donations (e.g., Hare, Camerer, Knoepfle, & Rangel, 2010) to investing time to help others (e.g., Latané & Nida, 1981; Leiberg, Klimecki, &

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Singer, 2011). A recent paradigm, the Zurich Prosocial Game (ZPG), combines the implicit assessment of altruistic helping behavior with the assessment of the degree to which helping depends on reciprocity and helping costs. When this paradigm was employed in an intervention study assessing the effects of training compassion, the amount of practice specifically predicted increases in altruistic behavior (i.e., helping) but not in the tendency to rely on reciprocity and cost considerations. This differential finding suggests that different motivations may underlie altruistic, norm-based, and cost-oriented behaviors (Leiberg et al., 2011).

This short overview demonstrates that human prosociality has been studied in a multidisciplinary fashion using various specific assessments, typically implemented in isolation. Comprehensively comparing and integrating these findings, however, requires a shared, interdisciplinary nomenclature and an overarching framework on the facets of human prosociality. This framework would allow describing (i) how various assessments employed in different disciplines relate to each other and (ii) what latent constructs they assess (see Peysakhovich, Nowak, & Rand, 2014, for attempts focusing on game theoretical paradigms). To this end, the current study assessed the most frequently used measures of prosociality from disciplines such as behavioral economics, neuroscience, and psychology and employed factor analyses to reveal meaningful, reliable, and measurement-independent subcomponents of prosocial behavior. Specifically, we hypothesized that different subcomponents might reflect distinct underlying motivations, ranging from pure altruism to more strategically or norm-guided motivations (see Leiberg et al., 2011). Identifying such a factor structure provides a crucial step toward a unified and overarching framework of human prosociality and allows selecting prosocial paradigms that target specific subcomponents and motivations of altruistic behavior.

A further goal was to characterize the identified subcomponents of prosociality by differentially linking them to trait affect and cognitive skills. Previous research suggests that negative *state* affect reduces altruistic behavior (Rudolph, Roesch, Greitemeyer, & Weiner, 2004). Furthermore, it has been argued that purely altruistic behavior requires the inhibition of one's prepotent selfish impulses, which depends on cognitive skills (Batson, 2011; Knoch, Pascual-Leone, Meyer, Treyer, & Fehr, 2006). Extending and generalizing previous attempts to capture the link between prosociality and individual differences in affective styles and cognitive skills, the present study assessed *trait* affect and cognitive skills with a large battery of questionnaires and performance-based computer tasks.

In the context of a longitudinal intervention study (ReSource Study; Singer et al., in press), data of two independent samples were collected at baseline. Both samples completed 14 measures frequently used to investigate prosocial decision-making. Data of the first sample were subjected to an exploratory factor analysis, and the identified factors were verified using confirmatory factor analysis (CFA) on data of the second sample. Based on previous findings (Leiberg et al., 2011; Peysakhovich et al., 2014), we expected to differentiate purely altruistic behavior (e.g., unconditional giving and helping) from norm-based behavior (e.g., fairness-based punishment) and/or strategic prosocial behavior (e.g., giving only when the other can punish). If self-reports assess similar constructs as behavior-based assessments, we would expect them to load on the same factor(s). Specifically, machievellistic traits might load together with strategic behavior (see Spitzer et al., 2007), whereas self-reported helping and caring should cluster with behavior-based measures of helping and giving. Finally, the subcomponents of prosociality in the first sample were related to trait affect and cognitive skills.

Methods

Participants

The first sample consisted of 187 participants (age mean $= 40.9$ years, $SD = 9.5$, 114 female, 185 right-handed[1]). Data of prosocial measures obtained for this sample were used for exploratory factor analysis and for subsequent correlational analysis with sociodemographic, affective, and cognitive variables. Data on the same measures of prosociality of an independent sample ($n = 142$, mean age $= 41.0$ years, $SD = 9$, 82 female, 139 right-handed; matched on age, sex, income, and intelligence, ps $> .2$) were used for CFA.

The assignment of participants to samples was predefined by the longitudinal design (Singer et al., in press).

Data Acquisition

Computer-based tasks were assessed on 17-in. thin film transistor monitors in five testing sessions completed in pseudorandomized order across participants. Questionnaires were filled in via an Internet platform. All assessments were approved by the Research Ethics Committee of the University of Leipzig and the Humboldt University of Berlin, Germany, and complied with the Declaration of Helsinki. Sample sizes (ns $= 187/142$) were selected based on recommendations for factor analyses (Gorsuch, 1983) and on a minimum ration of sample size to the number of variables (Nunnally, 1978). Sample sizes also ensured the detection of small-to-medium effect sizes (Comrey & Lee, 1992; Vazire, 2015) in correlation analyses of identified factors. For example, to detect a moderate correlation ($r = .30$) with a power of .80, an $n = 84$ is necessary to discover effects at the .05 significance level (G*Power, version 3:1; Faul, Erdfelder, Lang, & Buchner, 2007).

Measures of Prosociality

Game theoretical paradigms. Prior to testing, participants were informed about the online gaming platform that connected them to a pool of anonymous players.[2] Game theoretical paradigms were followed by control questions to ensure participants understood the implications of the different payoff functions (endowments are depicted in Table 1). Participants were aware that they were playing for monetary units (MUs) that were later transferred into real money (1 MU $=$ 10 euro

Table 1. Endowment Options.

Economic Games	Option 1	Option 2	Option 3	Option 4	Option 5
Dictator game (DG), Player A	60	80	100	120	140
Trust game (TG), Player A	120	100	140	80	60
Risk game (RG), Player A	120	100	140	80	60
Second person punishment game (2nd PPG, Player A	90	120	150	180	210
Second person punishment game (2nd PPG), Player B	30	40	50	60	70
Third person punishment game (3rd PPG), Player C	50	30	40	70	60

Note. Different endowment options were assigned to participants in a pseudorandomized order, ensuring that each option was assigned to a comparable amount of participants. Monetary units (MUs) are depicted; 1 MU corresponds to 10 euro cents.

cents). Participants played anonymous one-shot versions of the following economic games:

DG. Participants completed two rounds of the DG (Camerer, 2003) as Player A ("giver"). They were first informed about the MUs at their disposal and could subsequently choose how many MUs (increments of 1 MU) they wanted to give to Player B ("receiver"). The percentage of MUs participants transferred to Player B (average across two trials) was calculated for each participant.

TG and risk game (RG). Participants played one round of the TG and one round of the RG, both as Player A ("trustor"; Berg et al., 1995). After being informed about the endowments, participants chose how many MUs to invest in the other player (TG) or in the computer algorithm (RG) in steps of 1 MU. Participants knew that the transferred amount would be tripled before being assigned to the other player/computer. The percentage of MUs invested in the other was calculated for the TG and RG. The difference score of TG minus RG served as an indication for participants' trust (controlling for general risk behavior; Bohnet & Zeckhauser, 2004).

Second person punishment game (2nd PPG). In the 2nd PPG (Fehr & Fischbacher, 2004, conceptually similar to the ultimatum game), participants played two rounds as Player A and three rounds as Player B. Participants were informed about the endowments, and then, Player A chose how many MUs he or she wanted to transfer to Player B (increments of 1 MU). Subsequently, Player B could invest MUs to punish Player A: For every assigned MU, three MUs were subtracted from Player A. Player B received the following amounts of MUs from (simulated) Player A in pseudorandomized order: 2%, 17%, or 30% of Player A's endowment. Two measures were calculated: Player B's average percentage of invested MUs served as a measure for second person punishment (Fehr & Fischbacher, 2004). The average percentage of MUs given as Player A minus the percentage of MUs given in the DG served as a measure of strategic giving (Steinbeis et al., 2012).

Third person punishment game (3rd PPG). Participants played three rounds of the 3rd PPG (Fehr & Fischbacher, 2004) as Player C. Participants were informed about Player A's endowment and saw how many MUs Player A transferred to another anonymous Player B. Player C then had the possibility to punish Player A according to the same logic as in the 2nd PPG, receiving similar amounts of MUs from (simulated) Player A as in the 2nd PPG. The mean percentage of MUs invested to punish the Player A was calculated for each participant and served as a measure for third person punishment.

Interactive computer tasks. Participants played for actual money in the two computerized games obtaining ecologically valid measures of helping behavior and altruistic giving. Hence, contrary to self-report measures, prosocial choices in economic games and interactive computer tasks directly affected participants' payoffs.

ZPG. Participants played several rounds of the ZPG (Leiberg et al., 2011), in which they navigated a figure as quickly as possible through a maze in order to receive a treasure (=50 euro cents). Participants had a limited amount of keys which they could use to remove obstacles that blocked their way. While playing, participants saw another anonymous player moving on a separate route. Three measures were derived: the amount of keys participants invested to remove obstacles from the *other player's* paths (percentage of times helped). The degree to which helping depended on different factors was assessed: (a) reciprocity (percentage of times helped when the other player had helped minus had not helped before; reciprocity effect) and (b) helping cost (percentage of times helped when helping was costly minus not costly (i.e., when participants couldn't use keys for themselves anymore; cost effect). The task followed a 2 (reciprocity) $\times$ 2 (cost) factorial design.

Donation task. Participants performed eight trials of a donation task (Hare et al., 2010; Tusche, Böckler, Trautwein, Kanske, & Singer, in press). In each trial, they saw a short description of a real-life charitable organization and indicated how much of an endowment of 50 euro cents they wanted to donate to each charity. Participants were informed that one trial would be randomly chosen and implemented according to participants' choice. Mean donations for every participant (in %) were derived.

Hypothetical distribution tasks

Social discounting. Participants filled in a computerized version of a social discounting task (Jones & Rachlin, 2006), assessing the hypothetical amount of money participants are willing to forgo for the sake of others holding different social distances to them. Participants imagined a list of 100 acquaintances in such a way that #1 would be the person closest and dearest to them and #100 would be a very distant acquaintance. Participants then made distribution choices for #1, #2, #5, #10, #20, #50, and #100 of the acquaintance list. For each of these people, participants made nine choices that could either be selfish (benefitting only themselves) or be altruistic (equally benefitting themselves and other). The amount people were willing to forgo for the sake of the other was calculated from the crossover point between the last selfish choice and the first altruistic choice. Following the previous studies, we excluded participants with more than one crossover point. The crossover point was determined for each social distance, and the degree of discounting (k, log-transformed) was derived assuming a hyperbolic function between social distance and amounts participants were willing to forgo (Jones & Rachlin, 2006).

Social value orientation (SVO) scale. Participants filled in a computerized version of the SVO (Van Lange, 1999) that entails 9 items that required participants to choose between three distribution options, namely, prosocial (optimizing the other's gain), individualistic (optimizing one's own gain), and competitive (maximizing the difference in gains). Participants were defined as prosocial, individualistic, or competitive type if they selected this option more than 5 times (Van Lange, 1999). Because this measure left a substantial amount of participants nonclassified, we calculated the absolute number of prosocial choices for each participant to generate a more differentiated and normally distributed measure.

Psychological trait questionnaires. Participants completed the *Prosocialness Scale* (Caprara et al., 2005), a questionnaire that assesses the propensity to help and support others on a 5-point scale (1 = *never*, 5 = *always*; e.g., "I am available for volunteer activities to help those who are in need."). Mean scores were derived for each participant.

Participants filled in the *Machiavelli Index* (Henning & Six, 1977), a questionnaire that assesses participants' self-reported tendency to favor strategic self-interest over moral-based behavior on a 2-point scale (0 = *I agree*, 1 = *I disagree*; e.g., "Acquaintances should be selected according to whether they are beneficial."). Sum scores were derived.

Finally, participants filled in the *IRI* (Davis, 1983), a questionnaire containing the subscale of empathic concern, personal distress, perspective taking, and empathic fantasy on a 5-point scale (1 = *does not describe me*, 5 = *describes me very well*; e.g., "When I see someone being taken advantage of, I feel protective toward them."). Sum scores were derived for each participant.

Factor Analyses

Exploratory factor analysis. The 14 measures of prosocial behavior obtained for the first participant sample were z-transformed and subjected to a principal component analysis (PCA) using oblique rotation. The number of extracted factors was determined using parallel analysis (10.000 permutations of the original data set; O'Connor, 2000).

CFA. CFA was used on data of the second participant sample to examine how well the identified structure of human prosociality generalized across samples. We obtained data of the exact same paradigms in an independent sample. All variables were standardized to ensure identical distributions. Our sample sizes complied with traditional guidelines commonly used in factor analyses (Comrey & Lee, 1992).

Measures of Trait Affect, Cognitive Skill, Socioeconomic Variables

To assess affective disposition, participants of the first sample completed the Adult Temperament Questionnaire (Rothbart, Ahadi, & Evans, 2000), the Short Affect Intensity Scale (SAIS; Geuens & De Pelsmacker, 2002), the Positive Affect Negative Affect Scale (Krohne, Egloff, Kohlmann, & Tausch, 1996), the Types of Positive Affect Scale (Gilbert et al., 2008), the NEO-Five Factor Inventory and the NEO-Personality Inventory (Borkenau & Ostendorf, 1993; Ostendorf & Angleitner, 2004), the Beck Depression Inventory II (Beck, Steer, Ball, & Ranieri, 1996), and the Mental Health Continuum Short Form (Keyes, 2009). In order to reduce data and receive data-driven composites of trait affect, the questionnaires/subscales on affective dispositions were subjected to a PCA using oblique rotation. Three factors were revealed: positive affect, negative affect, and serenity (low arousal positive affect; Table 2; see also Singer et al., in press).

To assess cognitive skills, participants completed the CFT-R20 culture fair intelligence measure (Weiß, 2006), a working memory task (adapted from Sternberg, 1966), a stop signal reaction time (SSRTm) task (response inhibition; Boehler, Appelbaum, Krebs, Hopf, & Woldorff, 2012), and a cued Flanker task (conflict control; adapted from Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000). Due to distribution characteristics, performance measures were log-transformed for further correlational analyses.

Participants also provided information on their sex, age, marital status, whether or not they have children, and their monthly income (see Singer et al., in press, for a complete description of the study and the measures).

Results

Measures of Prosociality

Results of individual measures of prosociality are depicted in Figure 1 and Table 3.

Game theoretical paradigms. Participants gave more MUs in the DG than in the 2nd PPG, ts(186/140) $\geq$ 2.7, ps < .01, ds $\geq$ .23, confidence intervals (CIs) $\geq$ [.06, .39], reflecting strategic giving (Steinbeis et al., 2012). Participants invested significantly more MUs in the TG than in the RG, ts(186/140) $\geq$ 2.0, ps < .05, ds $\geq$ .17, CIs $\geq$ [.01, .33]. In the 2nd and the 3rd PPG, participants' punishment increased significantly when Player A offered less MUs, Fs(186/140) $\geq$ 40.2, ps < .001, η^2s $\geq$

Table 2. Exploratory Factor Analysis. Factor Loadings of the Measures of Affective Dispositions (Pattern Matrix) in the First Sample.

Measures	Factor 1	Factor 2	Factor 3
Factor 1: positive affect (35% variance)			
NEO_PIR_positive_emotion	.866	.032	−.082
ATQ_positive_affect	.761	−.064	.047
NEO_positive_affect	.759	−.050	.122
MHC_EWB	−.719	.045	−.109
NEO_PIR_warmth	.675	.143	−.151
PANAS_positive	.635	−.240	−.115
TTPAS_warmth	.613	.031	.557
TTPAS_active	.556	−.193	−.539
Factor 2: negative affect (16% variance)			
ATQ_negative_affect	.047	.947	.017
ATQ_fear	.056	.911	.199
ATQ_sadness	.098	.740	−.046
NEO_negative_affect	−.209	.688	−.058
ATQ_frustration	.174	.542	−.146
BDI_affective	−.378	.394	−.064
PANAS_negative	−.333	.307	−.208
Factor 3: serenity (8% variance)			
TTPAS_relaxed	.091	−.076	.773
SAIS_serenity	−.407	−.216	.509

Note. N = 187. PIR = Personality Inventory; ATQ = Adult Temperament Questionnaire; MHC = Mental Health Continuum; PANAS = Positive Affect Negative Affect Scale; TTPAS = Types of Positive Affect Scale; EWB = emotional well-being; BDI = Beck Depression Inventory; SAIS = Short Affect Intensity Scale.

.178, CIs ≥ [.089, .273]. The extent of giving, trust, and punishment was comparable to previous reports (Bohnet & Zeckhauser, 2004; Camerer, 2003; Fehr & Fischbacher, 2004).

Interactive computer tasks. All findings were in line with the original studies (Hare et al., 2010; Leiberg et al., 2011; Tusche et al., in press). In the ZPG, helping was significantly affected by reciprocity, Fs(1, 183/142) ≥ 41.1, ps < .001, η^2s ≥ .183, CIs ≥ [.092, .279], and cost, Fs(1, 183/142) ≥ 18.2, ps < .001, η^2s ≥ .090, CIs ≥ [.027, .175], as participants helped more when the other had helped them before and when helping was not costly. An interaction between reciprocity and cost, Fs(1, 183/142) ≥ 6.4, ps < .05, η^2s ≥ .034, CIs ≥ [.002, .099], indicates that helping decreased particularly in costly and nonreciprocal trials.

Hypothetical distribution tasks. The degree of social discounting and choices in the SVO complied with previous findings (Jones & Rachlin, 2006; Van Lange, 1999). The average amount of participants' prosocial choices correlated with the type classification (rs ≥ .91, ps < .001, CIs ≥ [.82, .98]).

Factor Analyses

Exploratory factor analysis. Four factors were extracted (Table 4).

Factor 1 entailed different measures of costly behaviors that unconditionally benefited another person and was therefore termed altruistically motivated prosocial behavior. In particular, the factor comprised generosity in game theoretical paradigms (giving in DG and TG), helping and charitable donations in psychological tasks, prosocial distribution choices in SVO, and the tendency to give independent of the perceived social closeness of another (social discounting). Factor 2 comprised measures from economic games and psychological measures that reflect participants' proneness to punish unfair distribution choices (2nd and 3rd PPG) and to make helping dependent on reciprocity (reciprocity effect in the ZPG). As punishment behavior is regarded as norm enforcement and "helping when I have been helped" reflects complying to reciprocity norms (Fehr & Fischbacher, 2004; Leiberg et al., 2011), this factor was named norm motivated prosocial behavior. Factor 3 was composed of measures from game theoretical paradigms (giving in the 2nd PPG minus in the DG) and the ZPG (cost effect) that signify strategic giving and helping based on cost–benefit calculations (Leiberg et al., 2011; Steinbeis et al., 2012) and was hence termed strategically motivated prosocial behavior. Note that given money in the DG also depicted a substantial negative loading on Factor 3. This is due to the fact that given money in the DG is used to calculate the strategic giving measure (given money in the 2nd PPG minus given money in the DG). Given this artificial interdependence, giving in the DG was assigned to Factor 1, a choice that was confirmed by the CFA. Factor 4 entailed psychological self-report measures of generosity, inclination to help and support others, care for others in distress, and (negatively) selfish attitudes and was therefore named self-reported prosocial behavior.

Crucially, even though explicitly allowed in the PCA, participants' scores on the factors of prosociality were not correlated with each other (ps > .2).

CFA. CFA was employed to examine the generalization of the identified structure of human prosociality. Figure 2 illustrates the hypothesized relationship of measures and latent variables and the standardized regression weights obtained when data of the control sample were fitted. Due to the effects of the sample size and other data characteristics (such as nonnormality) on the χ^2 test, χ^2(72, n = 121) = 87.5, p = .077), model fit of the proposed structure of prosociality was assessed using the comparative fit index (CFI), Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). The model showed a good fit, with CFI = .91, TLI = .86, and RMSEA = .042 (Hu & Bentler, 1999). Overall, the CFA confirmed the structure identified in the PCA.[3]

Relations to Socioeconomic, Affective, and Cognitive Variables

Results of these variables and their correlations with the factor scores are reported in Table 5.

Correlations between the factors of prosociality and other assessments were corrected for multiple comparisons

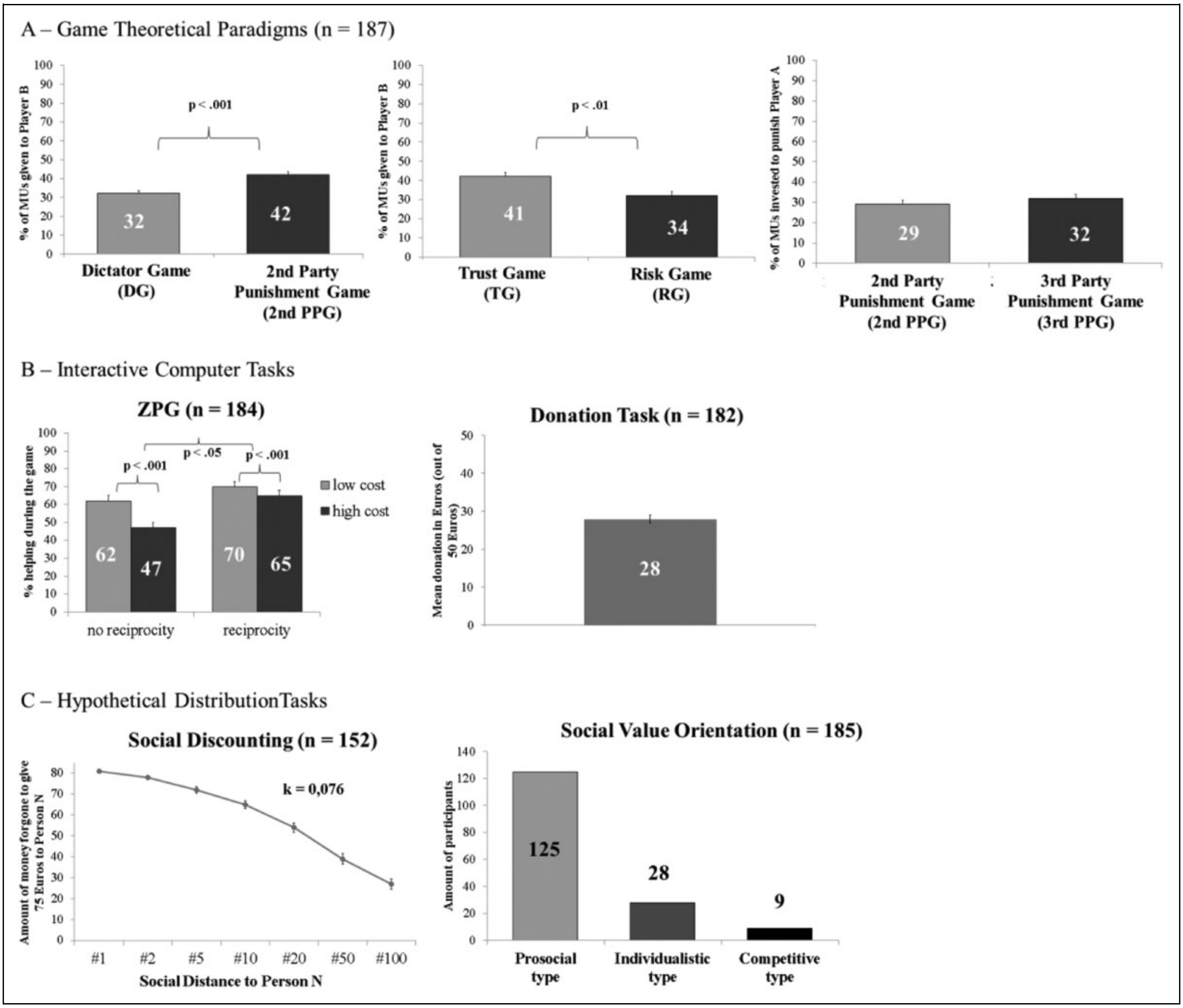

Figure 1. Results of the computerized tasks of the first participant sample. (Panel A) Mean and *SE* for the given monetary units (MUs) of Player A in the dictator game and the second person punishment game (2nd PPG). Mean and *SE* for the MUs invested in Player B (trust game) and a computer (risk game). Mean and *SE* for MUs assigned to punish Player A in direct interactions (2nd PPG) and in observed interactions (third PPG). (Panel B) Mean and *SE* of percentage helping in the Zurich Prosocial Game (ZPG) for different levels of reciprocity and helping cost. Mean and *SE* of the donations participants made in the donation task. (Panel C) Mean and *SE* of amount of money people forgo for another person *N* at different social distances, together with the degree of social discounting (*k*). Amount of participants classified as having a prosocial, individualistic, or competitive social value orientation and amount of prosocial choices.

(performed separately for each factor, Benjamini & Hochberg, 1995). Participants' scores on the factor negative affect were negatively correlated with altruistically motivated prosocial behavior, while self-reported prosocial behavior was positively correlated with positive affect. These correlations held when controlling for age, gender, and cognitive skills.

Scores on altruistically motivated prosocial behavior were positively correlated with intelligence quotient (IQ), response inhibition (SSRTm), working memory capacity, and conflict control. These correlations held when controlling for IQ, gender, and negative affect. All correlations of altruistically motivated prosocial behavior with measures of cognitive skills held when controlling for age, except for response inhibition ($r = .11$, $p = .12$).

Women scored higher than men on the factor self-reported prosocial behavior, $t(141) = 3.5$, $p < .01$, $r = .30$, CI [.14, .45]; mean women = .5, mean men = −.33, but lower on altruistically motivated prosocial behavior, $t(141) = 2.9$, $p < .01$, $r = -.23$, CI [−.39, −.07]; mean women = −.18, mean men = .11. Altruistically motivated prosocial behavior was negatively correlated with age (Spearman's $\rho = -.33$, $p < .001$, $r = -.26$, CI [−.41, −.10]) and income ($\rho = -.26$, $p < .01$, $r = -.21$, CI [−.37, .04]) and was reduced in participants with children, $t(141) = 2.6$, $p < .05$, $r = -.29$, CI [−.44, .12].

Table 3. Results of Individual Measures in the First Sample (Dark Grey) and the Second Sample (Light Grey).

			Correlations													
Variables	Mean	*SD*	DG	TG−RG	2nd PPG−DG	2nd PPG, B	3rd PPG, B	ZPG, help	ZPG, reciprocity.	ZPG, cost	Donation task	*k*	SVO	IRI	Prosocialness Scale	Machiavelli Index
DG (given MUs)	32.3 | 36.6	17.8 | 16.5		.14	−.51**	−.12	.12	.32**	.11	−.15*	.16*	−.32**	.32	.09	.14	−.04
TG−RG (MUs)	6.3 | 4.1	25.4 | 24.3	−.01		.00	−.03	.01	.13	.11	.04	.28**	−.01	.18*	.04	.11	−.10
2nd PPG, A−DG	9.8 | 4.1	23.1 | 18.0	−.44**	−.07		−.03	.03	−.00	−.07	.24**	−.00	.16*	−.04	−.07	−.07	−.09
2nd PPG, B	28.9 | 31.5	22.1 | 22.4	.06	−.04	.16		.58**	−.26**	.08	.05	−.18*	.17*	−.11	.08	.02	.09
3rd PPG, C	32.0 | 33.2	23.1 | 23.5	.13	−.08	.06	.64**		−.02	.05	−.01	−.14	−.12	.07	.16*	.12	−.03
ZPG, helping	61.8 | 68.5	25.7 | 23.5	.27**	.09	−.07	−.17*	−.04		−.01	.03	.08	−.21**	.26**	−.10	−.02	−.05
ZPG, reciprocity effect	13.2 | 16.5	27.9 | 26.9	−.08	−.13	.10	.07	.02	−.22**		−.05	.04	−.02	.01	−.04	−.00	.04
ZPG, cost effect	9.6 | 7.0	30.7 | 31.1	−.12	.02	−.22*	−.09	−.09	−.05	−.07		.07	−.01	−.04	−.05	.01	.05
Donation task	55.8 | 56.2	28.2 | 27.7	.11	−.01	−.06	−.03	.08	.17*	−.20*	.00		−.12	.14	.03	.19**	−.16*
Social discounting (log *k*)	.076 | .074	.210 | .122	−.25**	−.06	−.09	.08	.01	−.13	.00	.14	−.14		−.35**	.00	−.21*	.29**
SVO (prosocial)	6.2 | 5.6	3.5 | 3.9	.37**	−.04	.02	−.08	.02	.31**	.10	−.15	.05	−.33**		.09	.13	−.10
IRI	22.6 | 22.5	2.3 | 2.4	−.01	−.11	−.14	−.14	−.05	−.01	.14	.03	−.00	−.10	.12		.41**	−.14
Prosocialness Scale	3.3 | 3.5	0.5 | 0.6	.00	−.01	.04	.06	.01	.02	.15	.02	.07	−.26**	.13	.40**		−.18*
Machiavelli Index	2.9 | 3.0	2.5 | 2.8	−.13	−.06	−.01	.12	.01	−.01	−.04	−.00	−.15	.38**	−.22**	−.14	−.26**	

Note. Means and standard deviations (*SD*s) for samples 1 and 2 are reported. Correlation coefficients are reported for the first sample (upper diagonal) and the second sample (lower diagonal). ZPG = Zurich Prosocial Game; SVO = social value orientation; DG = dictator game; TG = trust game; RG = risk game; 2nd PPG = second person punishment game; 3rd PPG = third person punishment game; IRI = interpersonal reactivity index; MU = monetary unit.

Significant correlations: $^{**}p < .01$ (two-tailed). $^{*}p < .05$ (two-tailed).

Table 4. Exploratory Factor Analysis. Factor Loadings of the 14 Measures of Human Prosociality (Pattern Matrix) and Communalities (Com).

Measures	F1	F2	F3	F4	Com
Factor 1: altruistically motivated prosocial behavior (15% variance)					
Overall helping in ZPG	.667	−.118	.035	−.295	.500
Prosocial SVO	.662	.064	−.025	.061	.453
Social discounting (log *k*)	−.602	−.012	.130	−.150	.425
Given money in DG	.596	.044	−.582	.019	.720
Given money in TG > RG	.420	.009	.214	.123	.247
Donations to charity (donation task)	.342	−.303	.132	.287	.365
Factor 2: norm motivated prosocial behavior (13% variance)					
3rd PPG (2nd PPG)	.140	.882	.104	.165	.788
2nd PPG (3rd PPG)	−.208	.857	.131	.080	.776
Reciprocity effect in ZPG	.166	.202	−.093	−.134	.099
Factor 3: strategically motivated prosocial behavior (11% variance)					
Strategic giving (2nd PPG−DG)	−.107	.005	.823	−.026	.691
Cost effect in ZPG	.128	.104	.626	−.093	.396
Factor 4: self-reported prosocial behavior (10% variance)					
Prosocialness Score	.093	.070	−.082	.763	.604
Interpersonal Reactivity Index	−.144	.140	−.170	.758	.594
Machiavelli Index	−.211	.113	−.147	−.466	.339

Note. ZPG = Zurich Prosocial Game; SVO = social value orientation; DG = dictator game; TG = trust game; RG = risk game; 2nd PPG = second person punishment game; 3rd PPG = third person punishment game.

Because both income and having children were strongly correlated with age (ρs > .48, *p*s < .001, *r*s ≥ .42, CIs ≥ [.28, .55]), partial correlations were performed, showing that neither income nor having children was correlated with altruistic behavior when age was controlled for (*p*s > .4).

Discussion

Human prosociality is a complex phenomenon, a fact that is reflected in the number and diversity of measures that are used to assess prosocial behavior across different disciplines. The present study proposes the first data-driven framework of prosocial behavior that integrates various measures across different disciplines, revealing their interrelation as well as their underlying constructs.

Two representative samples completed a large battery of measures of prosocial behavior typically employed in economic, neuroscientific, and psychological research, ranging from self-reports and game theoretical paradigms to computerized interactions with real-life resemblance. Results of individual measures consistently replicated previous findings, indicating reliable assessment and representativeness of our findings. Exploratory factor analysis based on data of the first sample revealed four factors of prosociality: altruistically motivated prosocial behavior, norm motivated prosocial behavior, strategically motivated prosocial behavior, and self-reported prosocial behavior. The factor structure was validated by confirmatory factor analysis on data of the second sample, demonstrating the robustness of the proposed topology of human prosociality.

We propose that the subcomponents reflect different motivational sources that underlie prosocial decision-making: the motivation to benefit others even at the cost to oneself, the motivation to comply to and enforce social norms, and the motivation to base decisions on strategic cost–benefit calculations. This interpretation is consistent with previous evidence for a differential influence of compassion on truly altruistic as opposed to reciprocity-based and cost-based behavior (Leiberg et al., 2011) and complies with driving factors that are suggested by previous research (Boyd & Richerson, 2009; Fowler, 2005; Henrich et al., 2006; Nowak & Sigmund, 2005; Ohtsuki et al., 2006; Peysakhovich et al., 2014; Steinbeis et al., 2012; Warneken & Tomasello, 2009). Future research will need to validate the suggested motivational underpinnings using a priori manipulations, for instance by priming care and compassion versus norm orientation or selfish and power motives and investigating the effects on the individual factors.

With the exception of the self-report factor, all factors comprised various assessment methods from different disciplines, overcoming methodological specificities and tapping into measurement-independent facets of prosociality. Altruistically motivated behavior, for instance, comprised measures from behavioral economics (e.g., giving in the DG), spontaneous helping in a computerized maze game (ZPG), charitable donations, and the tendency to give independent of social closeness (social discounting). At this point, we can't say whether the self-report factor reflects an underlying construct (e.g., the tendency to describe oneself in positive terms; Stone et al., 2000) or is mainly driven by shared method variance (i.e., trait questionnaires). Note, however, that trait questionnaires were selected specifically to assess similar concepts as behavior-based measures (e.g., helping and generosity in the Prosocialness Scale; strategic behavior in the Machiavelli Index, see Spitzer et al., 2007). While trait questionnaire measures correlated with some behavior-based assessments both on the level of individual measures and on the factor level (CFA), they clustered together more strongly than they did with the behavior-based equivalents. Interestingly, even though the present measures of SVO and social discounting were based on self-reported and purely hypothetical distribution choices, they did not cluster with trait questionnaires but with behavior-based assessments. This suggests that it is not self-reports per se but trait questionnaires that strongly cluster together. In the future, multitrait–multimethod approaches can help to further assess the convergent and divergent validities of the various different measures of prosociality. Another important avenue for future studies will be to investigate the link of the identified subcomponents to spontaneous everyday-life prosocial behavior *outside* the laboratory, ranging from blood donations to time-consuming helping behavior (for a recent external validation of the DG, see Franzen & Pointner, 2013).

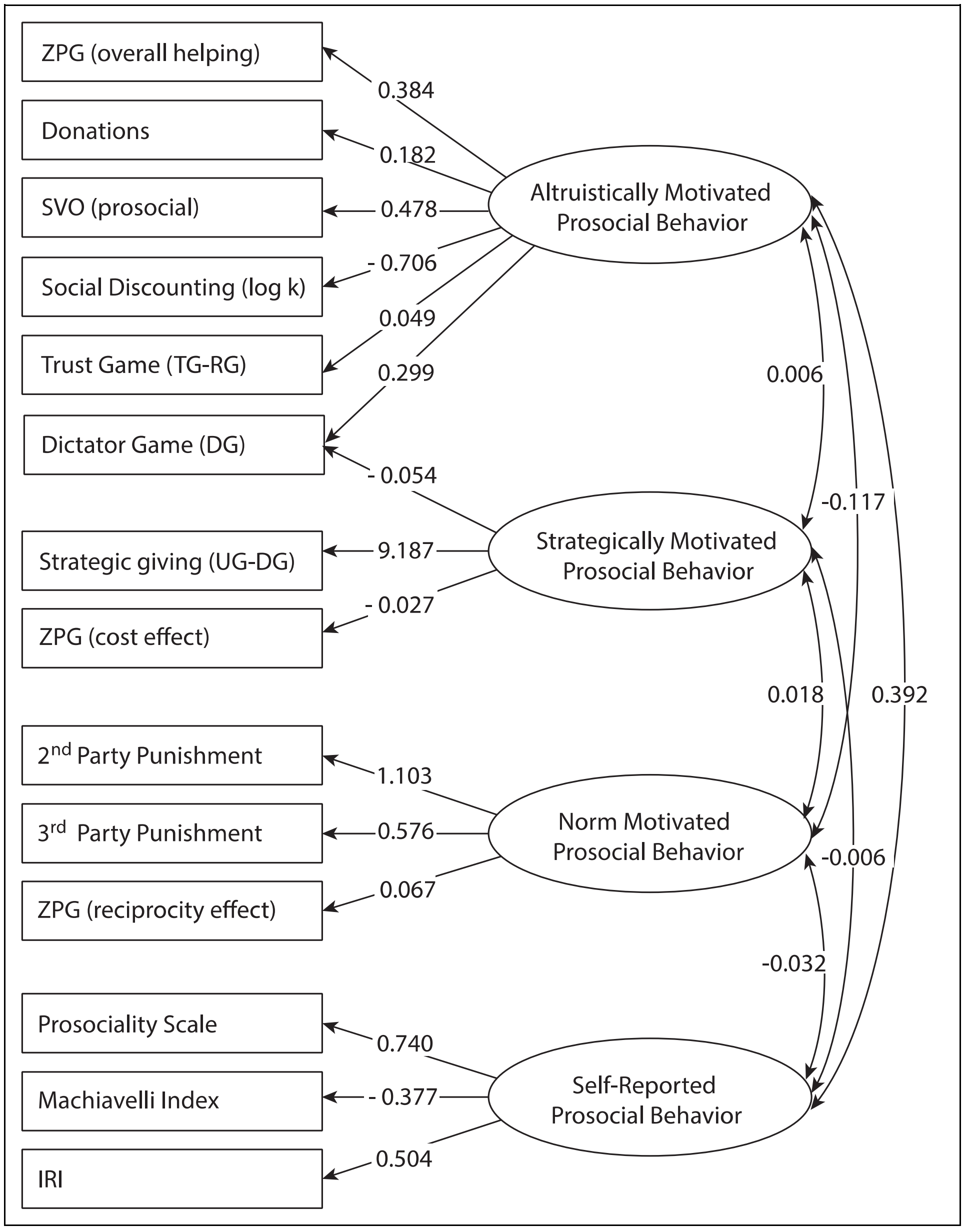

Figure 2. Confirmatory factor analysis (CFA). The figure displays standardized parameter estimates for measures of human prosociality as well as correlations between the factors.

We further characterized the identified subcomponents of prosociality by differential relations to affective and cognitive dispositions. People with higher altruistically motivated behavior reported reduced negative affect and had better cognitive skills, ranging from enhanced inhibition to improved working memory and IQ. Negative state affect has previously been linked to decreased altruistic behavior (Rudolph et al., 2004), suggesting that emotional distress in the face of another's suffering results in withdrawal from—instead of helping—the suffering person (Batson, 2011). Also, altruistic behavior has been argued to require executive skills such as inhibition of one's own prepotent selfish impulses (Batson, 2011; Knoch et al., 2006). The present findings provide evidence for these arguments and extend previous findings by revealing a more general role of (balanced) affective dispositions and cognitive skills in prosocial behavior. By contrast, people with high self-reported prosocial behavior also reported higher positive trait affect, which may point toward a general positivity bias.

Interestingly, women described themselves as more prosocial than men but behaved in a less altruistic manner. While there is contradicting evidence concerning gender effects in prosocial decision-making (e.g., Tscheulin & Lindenmeier, 2005; Veldhuizen, Doggen, Atsma, & de Kort, 2009), the differential relation of gender with two subcomponents of prosociality corroborates the interpretation that different motivations may underlie self-reports and behavior-based measures.

Table 5. Results of Socioeconomic Variables, Affective Disposition Factor Scores, and Cognitive Skill Tasks in the First Sample.

Variables	Mean	*SD*	Factor 1	Factor 2	Factor 3	Factor 4
Socioeconomic status						
Age	40.9	9.5	−.26* [−.41, −.10]	.08 [−.09, .24]	−.18* [−.34, −.02]	.02 [−.15, .18]
Gender (*female* = 1, *male* = 0)	0.59	0.49	−.23* [−.39, −.07]	.00 [−.16, .17]	.08 [−.08, .24]	.30* [.14, .45]
Married (*yes* = 1, 0 = *no*)	0.36	0.35	.19* [.02, .35]	−.05 [−.21, .12]	−.06 [−.23, .11]	.12 [−.05, .29]
Children (*yes* = 1, 0 = *no*)	0.53	0.50	−.29* [−.44, .12]	.06 [−.12, .22]	.01 [−.16, .18]	−.06 [−.23, .11]
Monthly income (in euro cents)	3,120	1,842	−.21* [−.37, .04]	−.19* [−.35, .02]	.00 [−.17, .17]	−.18* [−.33, .01]
Affective dispositions (factor scores)						
Positive affect	0.136	0.921	.05 [−.12, .21]	−.03 [−.19, .13]	.06 [−.10, .21]	.30* [−.13, .44]
Negative affect	0.023	0.881	−.17* [−.37, .00]	.17* [.00, .35]	.06 [−.10, .24]	.08 [−.09, .25]
Serenity	0.114	0.949	−.09 [−.25, .08]	−.12 [−.29, .05]	−.03 [−.19, .17]	−.05 [−.21, .12]
Cognitive skills						
CFT-R20	114.2	14.8	.17* [.00, .33]	−.15 [−.32, .02]	−.01 [−.17, .17]	−.08 [−.25, .09]
Cued Flanker task—Flanker effect log RTs	75.2	42.7	−.18* [−.61, .00]	.04 [−.25, .36]	.01 [−.35, .28]	−.05 [−.36, .27]
Cued Flanker task—Flanker effect log errors	7.3	6.9	−.09 [−.11, .35]	−.04 [−.28, .18]	.05 [−.15, .30]	.12 [−.08, .38]
Stop signal RT task—log SSRTm	292.5	55.7	−.20* [−.34, −.02]	.08 [−.09, .25]	−.03 [−.19, .14]	.03 [−.14, .20]
Working memory task—load effect log RTs	143.8	88.5	−.20* [−.39, −.03]	.05 [−.15, .23]	.13 [−.07, .30]	.05 [−.22, .15]
Working memory task—load effect log errors	17.6	8.8	−.21* [−.38, −.04]	−.02 [−.20, .16]	−.11 [−.29, .06]	.13 [−.04, .31]

Note. $N = 187$. Means and standard deviations (*SDs*) are reported, followed by correlation coefficients with factor scores on the factors of prosociality. 95% confidence intervals are provided in square brackets [lower bound, upper bound]. RT = reaction time.
*$p < .05$ (two-tailed).

Summary and Conclusion

By integrating various measures of prosociality from different research disciplines, the present study introduces an overarching framework of prosocial behavior that describes (i) the relation between different paradigms originating from different research disciplines, (ii) the latent constructs that underlie these measures, and (iii) the differential link of these constructs to trait affect and cognitive skills. The proposed data-driven classification is a crucial step toward a unified theory of human prosociality which—much like the Big Five in personality research (Goldberg, 1990)—needs to provide a comprehensive account of the motivational factors that are at the basis of different kinds of interpersonal behavior. This framework will benefit prosociality research by providing a common nomenclature and by helping researchers to select appropriate measures when investigating the underpinning, preconditions, and malleability of human cooperation and prosociality. For example, plasticity research can employ these motivationally informed and method-independent subcomponents of human prosociality to identify differential effects of different types of interventions. In times of global crises like the climate, financial and refugee crisis, the matter of changing human prosocial behavior to move toward global responsibility is certainly a pressing one.

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Author Contribution

Anne Böckler, Anita Tusche, and Tania Singer developed the experiments and wrote the article. Anne Böckler and Anita Tusche collected and analyzed the data.

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Notes

1. Participants were screened for handedness to account for lateralization effects in neural data that were obtained as part of the large scale longitudinal study.
2. Because of the specific requirements of our longitudinal study, predefined configurations were used to simulate other players. Participants will be informed of the deception after study completion.
3. To investigate the contribution of method variance, an additional CFA modeled factors based on the underlying methodology: Factor 1 entailed economic game measures, Factor 2 comprised psychological computer tasks, Factor 3 included questionnaires, and Factor 4 modeled hypothetical distribution measures. This model

yielded poor model fit (CFI = .65, TLI = .49, RMSEA = .08), suggesting that the various measures of prosociality cluster conceptually rather than based on methodological similarity.

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