A General Benevolence Dimension That Links Neural, Psychological, Economic, and Life-Span Data on Altruistic Tendencies

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Individual and life span differences in charitable giving are an important economic force, yet the underlying motives are not well understood. In an adult, life span sample, we assessed manifestations of prosocial tendencies across 3 different measurement domains: (a) psychological self-report measures, (b) actual giving choices, and (c) fMRI-derived, neural indicators of “pure altruism.” The latter expressed individuals’ activity in neural valuation areas when charities received money compared to when oneself received money and thus reflected an altruistic concern for others. Results based both on structural equation modeling and unit-weighted aggregate scores revealed a strong higher-order General Benevolence dimension that accounted for variability across all measurement domains. The fact that the neural measures likely reflect pure altruistic tendencies indicates that General Benevolence is based on a genuine concern for others. Furthermore, General Benevolence exhibited a robust increase across the adult life span, potentially providing an explanation for why older adults typically contribute more to the public good than young adults.

Keywords: altruism, personality, prosocial behavior, neuroimaging

Supplemental materials: http://dx.doi.org/10.1037/xge0000209.supp

The public good is funded in part through altruistic behavior, and much of this occurs through individuals in the later part of the life span. In the United States, charitable donations average about 2% of household income (Bekkers & Wiepking, 2011a) and donations more than double from about 1.7% among 21- to 29-year-olds to about 4.1% among those over 65 (e.g., Bekkers & Wiepking, 2011b; see also Freund & Blanchard-Fields, 2014; Midlarsky & Hannah, 1989). Thus, it is important to understand why some people give more than others and why contributions increase with age.

In this context, a longstanding question has been whether charitable acts are merely a means to a selfish end, such as signaling trustworthiness or wealth, or whether they are truly altruistic (Andreoni, 1990; Decety & Cowell, 2014; Eisenberg, 2014; Eisenberg, Fabes, & Spinrad, 2006; Harbaugh, Mayr, & Burghart, 2007). At least some prosocial behavior is most parsimoniously explained as arising from a true concern for others (Batson, 1987; Eisenberg, 2014). However, the attribution of a genuine altruistic motive requires highly sophisticated experimental designs (Batson, O’Quin, Fultz, Vanderplas, & Isen, 1983) that are difficult to apply when assessing individual differences or making comparisons across the life span (e.g., Eisenberg et al., 2006).

The present research utilizes the complementary information provided by an individual differences perspective, a behavioral economics perspective, and a neuroscience perspective on prosocial behavior. Specifically, we test the hypothesis that a large portion of the interindividual variability across these different measurement domains is driven by a single dimension that reflects a genuine, altruistic concern for others. We refer to this as the General Benevolence hypothesis. Furthermore, based on theories that emphasize motivational shifts across the life span toward a more ego-transcending focus (Carstensen, Isaacowitz, & Charles, 1999; Erikson, 1982; Freund & Blanchard-Fields, 2014; Roberts, Wood, & Caspi, 2008), we expected that the General Benevolence dimension is more strongly expressed in older than younger adults.

The Present Study

In order to assess participants’ genuine altruistic concern, we measured their neural activity in value/reward areas via functional MRI (fMRI) while they passively observed monetary transfers either to charities or to themselves. Theoretically, the difference in neural activity between the charity-gain condition and the self-gain
condition (i.e., the “charity-gain/self-gain contrast”) should indicate individuals’ “pure altruistic” motivation (Andreoni, 1990; Harbaugh, Mayr, & Burghart, 2007; Morelli, Sacchet, & Zaki, 2015). The fulfillment of a pure altruistic motive depends on the utility of the recipient, and not on who is responsible for the act of giving (Andreoni, 1990). Thus, a pure altruistic motive should be expressed even when individuals passively observe transfers to a charity. In contrast, “impure” altruistic motives (Andreoni, 1990), such as the prestige from signaling one’s good character or the “warm glow” from experiencing oneself as generous, require a voluntary act of giving and therefore are not fulfilled when individuals passively observe transfers to a charity.

In a life span sample of 80 participants, we used the charity-gain/self-gain contrast to derive at a “Neural Utility” signal. We also derived a measure of voluntary giving (i.e., “Giving Choices”), using a variant of the “dictator game.” Here, participants chose whether or not to endorse donations from their own account to several charities (Forsythe, Horowitz, Savin, & Sefton, 1994; Hoffman, McCabe, & Smith, 1996). In addition, we pooled information across self-report measures of agreeableness, empathic concern, perspective taking, and altruistic motivation (John, Donahue, & Kentle, 1991; Davis, 1980; Wood, Nye, & Saucier, 2010) to arrive at broad, “Prosocial Disposition” construct. As a test of our main hypothesis, we examined to what degree individuals passively observe transfers to a charity.

Based on previous evidence we expected positive age differences in the Prosocial Disposition (e.g., Roberts et al., 2006; Donahue, & Kentle, 1991; Davis, 1980; Wood, Nye, & Saucier, 2010) to arrive at broad, “Prosocial Disposition” construct. As a test of our main hypothesis, we examined to what degree individual differences in these three sets of constructs/measures could be accounted for by a second-order, General Benevolence factor. Based on previous evidence we expected positive age differences in the Prosocial Disposition (e.g., Roberts et al., 2006; Srivastava et al., 2003) and the Giving Choices factor (e.g., Freund & Blanchard-Fields, 2014; Midlarsky & Hannah, 1989). If these previously observed age differences reflect an increase in pure altruistic motives then there should also be age differences in the Neural Utility factor, and accordingly in the second-order, General Benevolence factor.

Method

Participants

Our sample consisted of 80 individuals between 18 and 67 years of age (M = 44.23, SD = 11.49; average years of education = 15.24, SD = 1.98; average annual income = $36,618, SD = 19,079). In order to maximize comparability of individuals across the life span, participants were recruited from a homogeneous pool of nonteaching (classified) staff at the University of Oregon. The correlation between age and years of education was nonsignificant (r = - .12, p = .28). Half of the participants were men, both within the subgroup of those above 45 and those below 45. The sample size was determined after considering available effect-size estimates for the pairwise correlations between the main constructs/variables in our design (see the online Supplemental Material).

Task, Stimuli, and Procedures

Prior to entering the scanner, participants read a booklet with information about each of 24 charities (Table S1) and were endowed with $100. Then, participants went through two separate tasks in the scanner, the passive-viewing task (see Figure S1) to assess the neural, “pure-altruism” signal, and the active-choice task, which we used to assess behavioral giving choices (see Figure S2).

In the passive-viewing task, participants acknowledged transfers involving either their own endowment or one of 12 randomly selected charities. There were four possible transfer conditions: money-to-oneself ($20 to participant, $0 to charity), money-to-charity ($0 to participant, $20 to charity), loss-to-oneself ($20 from participant, $0 to charity), and baseline ($0 to participant, $0 to charity). Each charity was presented once in each condition, for a total of 48 trials (i.e., 4 transfer conditions × 12 charities). Following previous work (Harbaugh et al., 2007), we only used the money-to-oneself and the money-to-charity conditions here across a set of a priori defined, neural valuation areas to construct the Neural-Utility construct (see the online Supplemental Material for detailed results about the remaining conditions and the fMRI procedures).

In the active-choice task each trial involved a transfer of $10, $20, or $40. The amount was always taken from the participant’s endowment and donated to the charity named on that trial. Participants had the option to “Accept” or “Reject” each transfer. In total, 72 choice trials were presented (3 transfer conditions × 24 charities). These 72 choice trials were split up into six “packages” to represent the Giving Choice factor (Little, Cunningham, Shahar, & Widaman, 2002).

In this phase we also manipulated whether choices were private or public on a trial-by-trial basis. This manipulation was originally included in order to experimentally vary the relevance of prestige/signaling motives. The private/public manipulation was effective on average as the rate of giving increased significantly in the public condition. However, a reliable individual differences factor could not be established from this condition, nor did the public/private manipulation interact with age. Therefore, we ignored this experimental factor within the main manuscript, but provide additional information in the online Supplemental Material.

Participants were instructed that one transaction from the passive phase and two from the choice phase would be chosen at random to affect both their own and the charity’s payoff. Participants were also carefully instructed that aside from the public condition, all of their responses and brain imaging results would be strictly anonymous and that out of principle, researchers conducting economics experiments cannot mislead participants in any manner.

Following the scanning phase, participants completed self-report questionnaires meant to reflect the Prosocial Disposition construct: the agreeableness scale from the Big F, which includes empathic concern and perspective-taking, and a scale of personality descriptive adjectives related to altruistic behavior (Wood, Nye, & Saucier, 2010). Participants also completed the remaining scales from the Big Five Inventory, a survey on basic demographic information, a detailed account of household income, dollar amounts and time spent volunteering for various causes, as well as a questionnaire on engagement for charitable causes (Moll et al., 2015).
was unusually strong compared to typically found age trends for standard personality measures. We attribute the strength of this relationship to the high degree of information aggregation across three measurement domains in the General Benevolence factor. In fact, the correlations between age and observed personality measures (e.g., agreeableness) were close to the range reported in the literature ($r_s = .18–.27$; see Table S2).

In the online Supplemental Material we present as robustness checks analyses that assess (a) the pattern of results in simplified models (Figure S4), (b) the construct relationships after controlling for age (Figure S5), and (c) the divergent validity with regard to the neural measures (Figure S6). In addition, we provide detailed analyses of the behavioral choices and the neural-level contrasts.

### Additional Measures

To put General Benevolence within a broader context and present additional information on convergent and divergent validity, we show in Table 1 relationships between the General Benevolence factor and a set of additional variables. Of the remaining Big 5 measures, neuroticism showed a moderate negative relationship and conscientiousness a tendency toward a positive relationship. The relationship with empathic distress was negative (though nonsignificant), consistent with previous results that altruistic tendencies cannot be explained in terms of a (selfish) desire to alleviate one’s distress from experiencing someone else’s suffering (Batson et al., 1983). Religiosity shows a moderate, positive relationship, a finding that is consistent with previous research (Lodi-Smith & Roberts, 2007), whereas gender and political orientation showed no relationship. Annual income was not reliably related to General Benevolence, indicating that the observed age difference was not simply due to older adults being generally wealthier (see also Bekkers & Wiepking, 2011a). Finally, General Benevolence exhibited a positive relationship with individuals’ amount of charitable giving and volunteering over the previous year, as assessed by a standard, and detailed economic survey.

### The Neural Basis of General Benevolence

Our main results are based on a priori defined neural areas. However, it is also useful to examine how both distinct and common elements of the General Benevolence model are reflected in the neural level in a whole-brain manner. Figure 3 shows the brain areas in which the charity-gain/self-gain contrast correlated with individuals’ Prosocial Disposition, Giving Choices, or age (see the online Supplemental Material). Correlations with the discipline-specific factors (or combinations of factors) lie in areas previously associated with the representation of value and reward, including the NAcc, caudate, anterior insula, and posterior cingulate cortex (Clithero & Rangel, 2014; Kable & Glimcher, 2007; D. J. Levy & Glimcher, 2012). Relationships with all three variables (i.e., Prosocial Disposition, Giving Choices, or age) converged in the medial prefrontal, perigenual anterior cingulate cortex (ACC), as well in the ventral striatum/nucleus accumbens (see Figure 4). The perigenual ACC region has been particularly associated with self-relevant processing (see Murray, Debbane, Fox, Bzdok, & Eickhoff, 2015, for a recent meta-analysis). This pattern is consistent with the general hypothesis that other-related and
Figure 1. Results from the structural equation models and analyses of unit-weighted aggregate scores. (A) The measurement model establishing three stable discipline-specific factors and their correlations with age, $\chi^2(97) = 112.72, p > .13$; comparative fit index (CFI) = .983, root-mean-square error of approximation (RMSEA) = .045, standardized root mean square residual (SRMR) = .056. (B) The structural model that tests the prediction that a second-order General Benevolence factor can explain individual differences across the three measurement domains, $\chi^2(99) = 113.63, p > .15$; CFI = .984, RMSEA = .043, SRMR = .058. In each panel, measured variables (i.e., indicators) are depicted as squares, and latent factors are indicated by ovals. Straight, single-headed arrows reflect directed relationships (in this case, factor loadings), while curved, double-headed arrows reflect undirected relationships (i.e., correlations) between variables. For between-factor correlations or second-order loadings we report both estimates from the structural-equation model (upper, bold numbers) and Pearson correlations from a unit-weighted model (bottom numbers). Confidence intervals for both types of models are reported in parentheses. For the unit-weighted analyses, aggregate scores were calculated as the mean of the z-scored indicators, and the second-order factor was calculated as the mean of those aggregates. Cronbach alphas of the unit-weighted scores for Prosocial Disposition, Giving Choices, and Neural Utility, were .80, .95, and .90, respectively. In Panel B, correlations between each first-order factor and General Benevolence were computed as item-total correlations (i.e., Pearson correlation between each factor and the average of the other two factors). AG = agreeableness; EC = empathic concern; PT = perspective taking; AT = altruistic adjectives; U = unobserved giving behavior (from giving task); O = observed giving behavior; VM = ventromedial prefrontal cortex; LN = left nucleus accumbens; RN = right nucleus accumbens; LC = left caudate; RC = right caudate.
self-related concerns can be mapped onto the same utility dimension (Zaki et al., 2014) and that pure altruism as defined by Andreoni (1990) is fueled by the utility that comes from knowing that the public good is increased.

General Discussion

We found that a substantial portion of the individual differences in self-reported prosocial disposition, actual altruistic choices, and neural measures of altruistic tendencies were accounted for by a common General Benevolence factor. Moreover, this is the first report of robust life span/cohort differences across multiple aspects of altruistic tendencies, including positive age differences in anonymous giving choices (see the online Supplemental Material), and in a neural, “pure-altruism” signal.

The neural index of altruistic tendencies is particularly important as it constrains the interpretation of the General Benevolence dimension. Likely, this index reflects an individual’s utility when the public good (represented through the charities) receives a windfall and therefore can be interpreted as an expression of a pure altruistic motive (Harbaugh et al., 2007; Zaki et al., 2014). The second-order factor in the structural equation model represents the common variance across all three domains and inherits the pure-altruism interpretation from the neural measure. Conversely, the suggested interpretation of the neural index is validated through its relationship with traditional measures of prosocial dispositions (e.g., agreeableness, empathy), with altruistic choices, and with real-world giving as measured through standard survey techniques (see Table 1). More generally, the converging evidence across three complementary domains of measurement supports the interpretation of General Benevolence as a broad, and behaviorally relevant dimension.

Life-Span Changes in General Benevolence?

Previous research had suggested that older adults often behave more charitable than younger adults (Bekkers et al., 2011b; Freund & Blanchard-Fields, 2014; Midlarsky & Hannah, 1989), but did not provide an explanation for this age-differential pattern. Our finding of a sizable age difference in General Benevolence indicates that older adults’ more generous behavior be attributed at least to a large part to a strengthening of pure-altruistic tendencies. Consistent with this conclusion, the age-giving relationship was fully present when giving decisions were anonymous and it did not further increase when decisions were observed by an audience (a condition that arguably evokes prestige/signaling motives; see Figure S3). These results are also consistent with a number of theories, which posit an age-related motivational shift toward ego-transcending goals (Brandstaetter, Rothermund, Krantz, & Kühn, 2010; Freund & Blanchard-Fields, 2014; Jonas, Schimel, Greenberg, & Pyszczynski, 2002; Lang & Carstensen, 2002).

Table 1

<table>
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<tr>
<th>Variable</th>
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<tr>
<td>Openness</td>
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<td>Conscientiousness</td>
<td>.19*</td>
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<td>Extraversion</td>
<td>.10</td>
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<tr>
<td>Neuroticism</td>
<td>-.31**</td>
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<tr>
<td>Distress</td>
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<tr>
<td>Religiosity</td>
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<td>Conservatism</td>
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<tr>
<td>Annual income</td>
<td>.10</td>
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<tr>
<td>Helping behavior</td>
<td>.40***</td>
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Note. The helping behavior measure reflects the standardized amount of (a) the money spent on charitable donations (log-transformed), (b) the total time spent volunteering, and (c) the sum of activities listed in the engagement questionnaire.

*p < .10. ** p < .01. *** p < .001.

Figure 2. Correlations between the General Benevolence factor score and age for each individual. Note that rather than the Age–General Benevolence relationship depicted in Figure 1B, here we show the more conservative assessment of this relationship (r = .47) based on a General Benevolence factor that is derived from a unit-weighted aggregation of standardized indicators (for details, see the online Supplemental Material).

Figure 3. Correlation between brain activity in the charity-gain/self-gain contrast and factor scores for the Prosocial Disposition, the Giving Choices factors, as well as age. All three aspects overlap in the perigenual anterior cingulate cortex and the striatum.
As nearly all life-span work in this domain, our study is cross-sectional in nature and therefore does not distinguish true developmental change from cohort differences. Indeed, the observed age difference might arise because younger cohorts are more self-centered than their parent generation. Yet empirical evidence for such secular changes is much more limited (Trzesniewski & Donnellan, 2010) than claims in the media might suggest (Textor, 2007) and in some instances points into the opposite direction (Inglehart, 2008). Moreover, longitudinal results on self-report measures of prosocial dispositions provide robust evidence for a positive age effect (Roberts et al., 2006), supporting the interpretation that the age effect for General Benevolence represents actual life-span growth.

Caveats

Our conclusions rely on a sample that, even though substantial for a neuroimaging study, is smaller than the standard sample size for structural equation models. Therefore, these results need to be replicated with a larger number of subjects and ideally using a longitudinal design. Nevertheless, there are several reasons to believe that our results are robust. First, we used a homogeneous sample with similar work/life experiences (i.e., all were University of Oregon, nonteaching staff). This reduces error variance and the influence of potential age confounds that can affect life-span comparisons within typical convenience samples. Second, many of the individual, construct-to-construct relationships underlying our model have strong a priori grounding in previous work (see the online Supplemental Material). Finally, our basic set of results survived several robustness checks (e.g., using unit-weighted aggregate measures, partialing out age, or assessing the divergent validity of the neural factor).

Broader Implications

In a recent review on prosocial development, Eisenberg and colleagues indicated the necessity to discuss prosocial behavior broadly “because it usually is impossible to differentiate between altruistically motivated actions and actions motivated by less noble concerns” (Eisenberg et al., 2006, p. 647). Our results suggest that a more differentiated analysis of the source of individual differences in prosocial behavior can be achieved. Specifically, neural measures that reflect a genuine concern for others can be used to validate more easily deployable self-report or behavioral assays of prosocial tendencies.

It should be particularly useful to clarify the motives that drive altruistic action when considering interventions to foster prosocial behavior. Interventions and socialization experiences are likely to be designed differently depending on whether they target either pure altruistic motives or behavior that is contingent on ultimately selfish concerns. Indeed, growing evidence indicates that a range of psychological dispositions, including the ones measured and investigated here, are affected by socialization experiences throughout the life span (Eisenberg et al., 2006; Roberts et al., 2005; Srivastava et al., 2003). This raises the possibility that positive development along the General Benevolence dimension can be promoted through appropriately targeted, individual-level (Klimecki, Leiberg, Ricard, & Singer, 2014) or policy-level interventions (Heckman & Masterov, 2007).

Conclusion

Our results indicate that data on prosocial tendencies from very different theoretical and measurement traditions can be represented in a parsimonious, low-dimensional manner. Such “information compression” comes with important advantages, as the resulting General Benevolence factor inherits the interpretational constraints of each approach. In particular, the loading on the neural factor clarifies that the individual and age differences in General Benevolence can be interpreted in terms of differences in “pure altruistic” tendencies.

References


Received March 15, 2016
Revision received June 16, 2016
Accepted June 20, 2016

**Correction to Hubbard et al. (2016)**

In the article “A General Benevolence Dimension That Links Neural, Psychological, Economic, and Life-Span Data on Altruistic Tendencies” by Jason Hubbard, William T. Harbaugh, Sanjay Srivastava, David Degras, and Ulrich Mayr (*Journal of Experimental Psychology: General*, Advance online publication. August 11, 2016, http://dx.doi.org/10.1037/xge0000209) there was an error in the **Task, Stimuli, and Procedures** section. In the 1st sentence in the 6th paragraph, “Following the scanning phase, participants completed self-report questionnaires meant to reflect the Prosocial Disposition construct: the agreeableness scale from the Big F, which includes empathic concern and perspective-taking, and a scale of personality descriptive adjectives related to altruistic behavior (Wood, Nye, & Saucier, 2010).” should have read: “Following the scanning phase, participants completed self-report questionnaires that contained scales to reflect the Prosocial Disposition construct: the Big Five Inventory (BFI; John et al., 1991), from which we used the agreeableness scale to measure prosocial disposition; the Interpersonal Reactivity Index (IRI; Davis, 1980), from which we used the empathic concern and perspective-taking scales; and a scale of personality descriptive adjectives related to altruistic behavior (Wood, Nye, & Saucier, 2010).”

http://dx.doi.org/10.1037/xge0000235