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Aging and Altruism: A Meta-Analysis

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Life span theories postulate that altruistic tendencies increase in adult development, but the mechanisms and moderators of age-related differences in altruism are poorly understood. In particular, it is unclear to what extent age differences in altruism reflect age differences in altruistic motivation, in resources such as education and income, or in socially desirable responding. This meta-analysis combined 16 studies assessing altruism in younger and older adults (N = 1,581). As expected, results revealed an age-related difference in altruism (M_g = 0.61, $p < .001$), with older adults showing greater altruism than younger adults. Demographic moderators (income, education, sex distribution) did not significantly moderate this effect, nor did aspects of the study methodology that may drive socially desirable responding. However, the age effect was moderated by the average age of the older sample, such that studies with young-old samples showed a larger age effect than studies with old-old samples. These findings are consistent with the theoretical prediction of age-related increases in altruistic motivation, but they also suggest a role for resources (e.g., physical, cognitive, social) that may decline in advanced old age.

Keywords: generosity, giving, motivation, prosociality

Global population aging, as well as the rising social and economic impact of philanthropy and charitable giving in many societies (e.g., Monnet & Panizza, 2017), have inspired a surge of interest in the relationship between aging and altruism. Altruism refers to the motivation to help others, even when doing so is costly (Andreoni, 1989). Converging evidence from studies using self-report, behavioral, and neural measures suggests that older adults show greater altruism than younger adults (e.g., Freund & Blanchard-Fields, 2014; Hubbard, Harbaugh, Srivastava, Degras, & Mayr, 2016; Midlarsky & Hannah, 1989), but the mechanisms underlying this relationship are not fully understood. In particular, it is unclear whether greater altruism in older adults stems from an age-related shift in intrinsic value orientations and motivational priorities (e.g., Brandtstädter, Rothermund, Kranz, & Kühn, 2010; Carstensen, Isaacowitz, & Charles, 1999; Erikson, 1982) or whether it reflects age-related increases in external resources such as time, money, and social capital (e.g., Bekkers & Wiepking, 2011; Wiepking & James, 2013), which may lower the bar for altruistic behavior. In other words, are older adults more altruistic than younger adults because they place greater value on the welfare of others, or are older adults more altruistic because they can afford to be? Of note, the two possibilities are not mutually exclusive. Age differences in altruism may result from a combination of motivational and resource-related factors (see also Mayr & Freund, in press). In the current study, we used meta-analysis as a tool to evaluate the strength of the evidence for age differences in altruistic motivation as well as the role of resources, broadly defined, that may support altruism.

Life span developmental theories have tended to focus on changes in motivational orientation across adulthood. These theories suggest that aging is associated with growing endorsement of ego-transcending goals (Brandtstädter et al., 2010) or generativity (Erikson, 1982), or with greater emphasis on emotion-regulation goals (Carstensen et al., 1999) whose pursuit may be supported by the warm glow that altruistic choices can elicit in decision makers (e.g., Harbaugh, Mayr, & Burghart, 2007). Although these theoretical perspectives differ in their specifics, they share the assumption that increased altruism in older adults arises from changes in intrinsic goals, values, and priorities. These changes are viewed either as a consequence of growth experiences over the life span (e.g., Erikson, 1982; Roberts, Walton, & Viechtbauer, 2006) or as a response to a shrinking future time horizon (Carstensen et al., 1999).

Access to resources (e.g., lifetime remaining; financial wealth; cognitive, affective, and physical health; social connections) may also contribute to age differences in charitable donations and other prosocial acts (Bekkers & Wiepking, 2011). The resource perspective is supported by observations of a drop in charitable giving among the oldest old, who on average experience resource declines relative to their young-old counterparts (see Wiepking et al., 2013,

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This meta-analysis was not preregistered. The PRISMA checklist and data spreadsheet are accessible at https://osf.io/xb4t9/.

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for a review). Whether low levels of charitable giving among the oldest old generalize to other forms of altruism (e.g., decisions about hypothetical resources in laboratory studies) has not been examined systematically to date. Although evidence for demographic and socioeconomic differences in the altruism literature is scarce at present, meta-analysis enables the combination of available evidence to explore these potential moderators. In the current meta-analysis, we therefore probed the influence of socioeconomic resources (i.e., income and education). We also considered gender because of prior reports of greater altruism in females compared with males (Nakavachara, 2018).

How altruism is measured may also affect the size of age differences. Greater agreeableness and socially desirable responding in older compared with younger adults (Roberts et al., 2006; Soubelet & Salthouse, 2011), in particular, may influence some altruism measures more than others. Along these lines, observed behaviors (e.g., sharing money in the dictator task, informal helping) may provide a more objective assessment of age differences in altruism compared with self-report measures (e.g., how often do you help others in need?). Similarly, choices that have real consequences (e.g., actual monetary donations) may offer a more accurate picture than hypothetical choices (but see Locey & Rachlin, 2015; Read, 2005). Finally, responses given anonymously may be less affected by social desirability and reputational concerns than responses witnessed by others.

The current study adopted a meta-analytic strategy to synthesize the current literature on adult age differences in altruism. To our knowledge, the only previous quantitative synthesis of this literature was undertaken by Engel (2011), who focused exclusively on the dictator game and found adult age to be a significant positive predictor of generosity in this paradigm. Here we included a wider variety of measures that operationalized altruism in terms of voluntary, nonreciprocal behaviors (e.g., dictator game, social and temporal discounting, charitable donations) or in terms of self-reported altruistic thoughts, beliefs, and actions. Tasks involving elements of reciprocity or cooperation (e.g., prisoner's dilemma, public goods game, ultimatum game) were excluded to avoid confounding altruism with other, more complex aspects of (social) cognition and prosociality. We also did not include civic engagement and volunteering. These behaviors fall under the umbrella of prosociality and have received growing attention from researchers (e.g., Serrat, Scharf, Villar, & Gómez, 2020) but may be influenced by factors other than altruism. Current multilevel conceptualizations of prosociality situate individual prosocial acts and the motives behind these acts at the micro or meso level (Penner, Dovidio, Piliavin, & Schroeder, 2005). In contrast, collective forms of civic engagement are situated at the macro level of analysis, which is characterized by the interaction between individuals and their environments (e.g., cultural norms and affordances). Thus, whereas volunteering is a type of prosociality, it may not exclusively, or even primarily, reflect altruism.

In sum, our specific aims were to (a) test the robustness of the age difference in altruism across a diverse set of studies and (b) examine potential moderators that may shed light on the mechanisms driving altruism across the adult life span. The list of potential moderators included the mean age of the younger and older samples, the proportion of female participants, education, income, and three aspects of the study methodology (behavioral vs. self-report format, real vs. hypothetical choice outcomes, and anonymous vs. nonanonymous responding).

Method

Literature Search

PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009) were followed at each stage of the meta-analysis. A computerized literature search was carried out using PsycINFO, PsycARTICLES, Web of Science, and AgeLine databases. The Boolean search term was (older adults OR younger adults OR seniors OR elderly OR late life OR aging OR ageing OR later life) AND (altruis* OR prosoci* OR philanthrop* OR generativity OR dictator game). The search returned 3,840 candidate studies (as of February 6, 2018). To locate gray literature such as unpublished theses, dissertations, articles, or conference proceedings, additional searches were carried out on the Educational Resources Information Center, Proquest database, and Google Scholar. These articles were submitted to two rounds of screening, described in detail below. A snowball search on the resulting set of studies, conducted on April 8, 2019, led to the inclusion of two additional, more recent publications in the final set of studies.

Inclusion Criteria

We limited our analysis to studies that met the following criteria:

1. Studies had to report results for at least one comparison between a group of younger adults (18–35 years) and a group of older adults (60-plus years). Within these limits, specific age ranges varied among studies. Studies with only one age group were excluded. Studies that treated age as a continuous predictor were included if the authors responded to our request for data needed to calculate results for younger and older groups, respectively (see Table 1). The rationale for treating age as a dichotomous rather than a continuous variable was that extreme-group comparisons (i.e., younger vs. older adults) were by far the most common effects reported in the literature.

2. Studies needed to operationalize altruism as observed or self-reported behavior benefitting another person or group at a cost to the decision maker. Tasks with an element of cooperation or reciprocity (i.e., those in which decision makers anticipated a tangible consequence such as money, favors, or reputational gain) were excluded. As a result, we did not include data from studies using common economic games such as the prisoner's dilemma, public goods, and ultimatum games.

3. Studies had to report a measure of altruism for each group in either numerical or graphical format. We contacted authors if the effect size for the age difference in altruism could not be directly extracted or calculated based on the information in the published article. If authors did not respond to our request, or no longer had access to the data, we did not include the study in the meta-analysis.

Table 1
Studies Included in the Meta-Analysis

Study	Measure	Operationalization of altruism	Country	Sample size		Age (mean or range)		Methodology		
				Yng	Older	Yng	Older	Beh. vs. self-report	Real vs. hyp.	Anon.
Bailey, Ruffman, and Rendell (2013)	Dictator Gaandme	Amount donated ($0–10) to confederate from endowment ($10)	Australia	35	34	21.3	73.9	Beh.	Hyp.	Low
Bailey, Brady, Ebner, and Ruffman (2018)	Helping Tasandk	Number of pamphlets compiled for experimenter	Australia	40	39	19.88	72.44	Beh.	Real	Low
Beadle, Sheehan, Dahlben, and Gutchess (2015)	Dictator Gaandme	Amount donated ($0–9) to confederate from endowment ($10)	United States	24	24	19.83	77.92	Beh.	Real	High
Freund and Blanchard-Fields (2014), Study 4	Donation	Amount donated	Switzerland	48	69	24.1	68.8	Beh.	Real	High
Gaesser, Dodds, and Schacter (2017)	Willingness to Handelp	Self-reported willingness to help in different situations	United States	30	30	21.97	73.63	Self-report	Hyp.	Low
Gong, Zhang, and Fung (2019)	Social discounting	Amount donated (HK $0–100,000), collapsed across social distances	China	89	66	30.12	69.39	Beh.	Hyp.	Low
Hubbard, Harbaugh, Srivastava, Degras, and Mayr (2016)[a]	Giving choices factor	Amount donated ($0, $10, $20) to charity from endowment ($100)	United States	19	5	27.95	63	Beh.	Real	High
Ojha and Mishra (2014)[b]	Altruism scale	20-item scale that provides altruistic, neutral, or egoistic response options	India	180	180	20–40	61–80	Self-report	Hyp.	Low
Pornpattananangkul, Chowdhury, Feng, and Yu (2019)	Social discounting	Amount donated, collapsed across social distances	Singapore	39	39	22.79	69.69	Beh.	Hyp.	Low
Roalf, Mitchell, Harbaugh, and Janowsky (2012)	Dictator game	Amount donated ($0–10) to unseen stranger from endowment ($10)	United States	29	30	30.14	71.3	Beh.	Real	High
Rosen, Brand, and Kalbe (2016)[c]	Moral decision making	Respond to a moral dilemma by selecting a morally desirable or personally preferable behavior	Germany	74	33	26.42	71.46	Self-report	Hyp.	Low
Rosi, Nola, Lecce, and Cavallini (2019)	Dictator game	Amount donated (€0–6) to pictured stranger from endowment (€6)	Italy	48	48	23.29	70.19	Beh.	Hyp.	High
Sparrow and Spaniol (2018), Experiment 1	Altruistic intertemp. choice	Increase in patient intertemporal choice for donation vs. loss-related decisions	Canada	32	30	25.28	70.57	Beh.	Real	Low
Sparrow and Spaniol (2018), Experiment 2	Altruistic intertemp. choice	Increase in patient intertemporal choice for donation vs. loss-related decisions	Canada	31	23	20.84	71.35	Beh.	Real	High
Sparrow, Armstrong, Fiocco, and Spaniol (2019)	Self-report altruism scale	Rated frequency of prosocial behavior throughout life	Canada	36	36	21	70.11	Self-report	Real	Low
Sze, Gyurak, Goodkind, and Levenson (2012)[d]	Donation	Amount donated ($0–10) to each of two charities introduced via videoclips	United States	71	70	23.07	66.43	Beh.	Real	High

Note. Yng = younger; Beh = behavioral; Hyp. = hypothetical; Anon. = anonymity; Intertemp. = intertemporal.
[a] Data from 56 participants aged 36–59 years did not enter the analysis. [b] Data from 120 participants aged 41–60 years did not enter the analysis. [c] Data from 90 participants aged 36–59 years did not enter the analysis. [d] Data from 72 participants aged 30–50 years did not enter the analysis.

4. Studies needed to observe altruism under normal conditions. Studies using experimental manipulations believed to heighten altruistic motivation (e.g., empathy inductions) were not included, with two exceptions. First, if a study featured an experimental control, we used only the data from the control group (between-subjects designs) or the control condition (within-subjects designs; Beadle, Sheehan, Dahlben, & Gutchess, 2015; Gaesser, Dodds, & Schacter, 2017). When the design did not include a control group but instead contrasted two extreme experimental conditions (e.g., induction of high vs. low empathy; Rosen, Brand, & Kalbe, 2016), we followed methodological recommendations (Borenstein, Hedges, Higgins, & Rothstein, 2009) and collapsed across the two conditions to derive an unbiased estimate of altruism.

We entered all available study data into a database and double checked for accuracy. We carried out two rounds of eligibility screening before selecting articles for inclusion. In the first round, we reviewed titles and abstracts, whereas in the second round, we review the full text of the articles. At least two of the authors screened each article at each stage. No interrater disagreements occurred during screening. Once an article was selected for inclusion, it was coded on all relevant dimensions. Interrater agreement at the coding stage was high (>95% for each dimension). Disagreements were resolved through discussion among the raters. Figure 1 provides an overview of the selection process, and Table 1 provides details for all included studies.

Data Extraction and Management

Because the focus of the current meta-analysis was on age differences in altruism, the dependent variable was the difference in the altruism measure (e.g., amount of money donated) for younger and older adults. We used Cohen's *d* as an estimate of effect size by subtracting the younger group mean from the older group mean and then dividing this difference by the pooled standard deviation. For one study (Freund et al., 2014, Study 4), means and standard deviations for younger and older groups were not provided, so we calculated *d* using a χ^2 test (Rosenberg, 2010). In all other cases, *d* was calculated from the group means and standard deviations using Comprehensive Meta-Analysis (CMA, version 3.0) software (Borenstein, Hedges, Higgins, & Rothstein, 2014). Cohen's *d* was then converted to Hedges' *g* to obtain unbiased effect size estimates from studies with small sample sizes. Using CMA, we next estimated a series of random-effects meta-analytic moderation models. We used random-effects models because we did not assume that the true effect sizes were identical across study characteristics (e.g., altruism may be more pronounced among samples with higher socioeconomic status).

Additional characteristics extracted from each article, separately for younger and older adults, included the sample size, and the percentage of female participants as well as mean age, educational attainment, and income. We also coded the publication year and country in which the data were collected as well as relevant country-level variables obtained from the Human Development Index (http://hdr.undp.org/

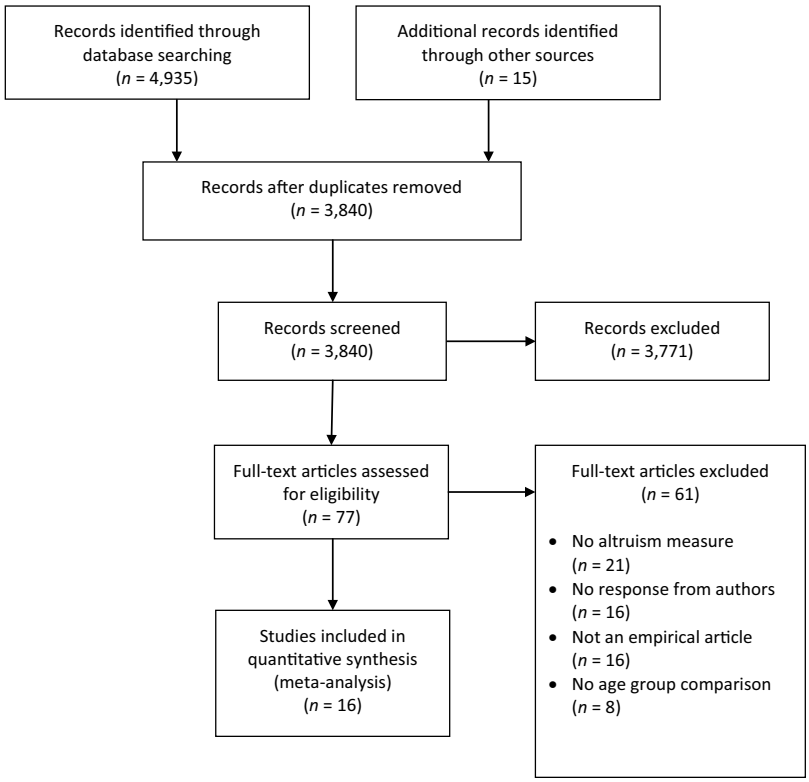

Figure 1. PRISMA flow diagram of the study selection process for the meta-analysis.

en/content/human-development-index-hdi). We additionally coded study methodology according to type of altruism measure (behavioral vs. self-report), realism of the behavioral outcome (real vs. hypothetical), and anonymity of responses (i.e., high vs. low).

This meta-analysis was not preregistered. The PRISMA checklist and data spreadsheet are accessible at https://osf.io/xb4t9/. To gauge the statistical power to find a mean effect of age significantly different from 0, we conducted a power analysis using a conservative effect size of $d = .20$ along with the observed average sample size of 39 for 16 studies (Valentine, Pigott, & Rothstein, 2010). Power estimates ranged from .93 when assuming low effect size heterogeneity to .51 when assuming high heterogeneity.

Results

The meta-analysis confirmed that older adults show significantly greater altruism than younger adults, as indicated by a significant grand mean age effect, $M_g = 0.61$, $SE = 0.07$, 95% CI [0.47, 0.75], $z = 8.34$, $p < .01$. Figure 2 presents a forest plot with the effect sizes (Hedges' g) and 95% confidence intervals for each study as well as this overall effect size estimated from the random-effects model. The effect sizes were significantly heterogenous, $Q(15) = 25.92$, $p = .04$. We next estimated a series of metaregression models to identify moderators of the age-related increase in altruism. Importantly, we included only one moderator in each model, rather than regressing Hedges' g on all moderators concurrently.

Mean Age

To assess the possible moderating role of the mean age of the younger and older adult samples, respectively, we estimated two random-model metaregression models. One study did not report mean age for younger and older adult samples (ranges only) and was therefore excluded from these analyses. The mean age of the older-adult sample significantly moderated the age effect, $Q_{between}(1) = 6.11$, $p = .01$, such that a higher mean age in the older group was a negative predictor of the age difference in altruism. To illustrate, studies with older adults whose mean age was below the median of 70.57 years had $M_g = 0.86$, whereas studies with older adults whose mean age was above the median had $M_g = 0.42$. The mean age of the younger adult sample, in contrast, did not significantly moderate the age effect, $Q_{between}(1) = 0.58$, $p = .45$.

Other Demographic Factors

For studies that did not report sex or gender distributions ($N = 3$), we interpolated the proportion of female participants either by assuming that samples were 50% female or by using the average proportion of female participants (58%) from studies that did report this information. Both methods yielded a similar conclusion; the proportion of females in each sample did not significantly moderate the age difference in altruism, $Q_{between}(1) < 0.01$, $p = .97$.

Given the heterogeneity among studies in whether and how they reported education and income, we opted to use education and income indicators from the Human Development Index for

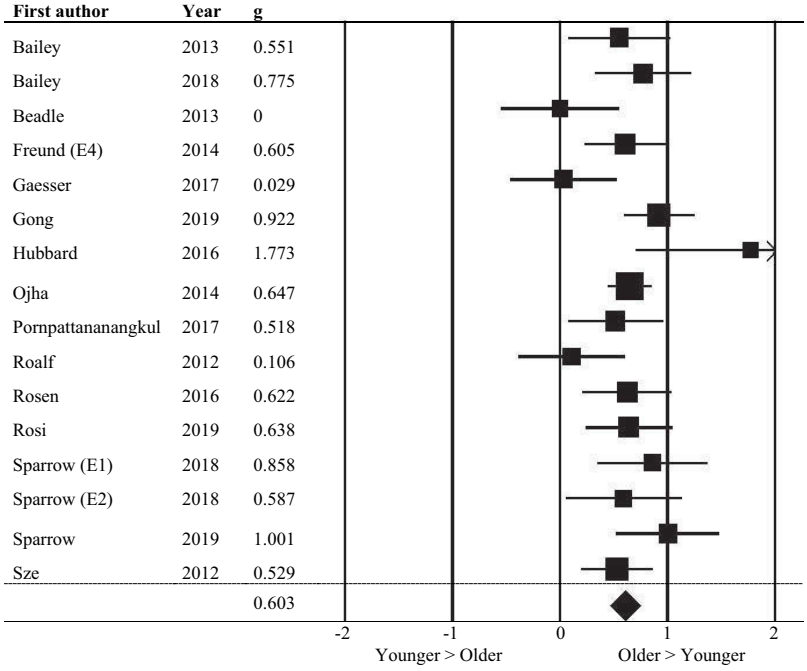

Figure 2. Forest plot for studies included in the meta-analysis. The effect size for each study is indicated by the position of each square on the horizontal axis. The horizontal bars indicate the 95% confidence interval for each effect size. The size of each square is proportional to the weight given to the study as a function of its sample size. E = experiment.

the country in which the study had taken place. The Human Development Index education index did not significantly moderate the age difference in altruism, $Q_{between}(1) = 2.09$, $p = .15$, nor did the gross national income index, $Q_{between}(1) = 3.41$, $p = .07$.

Study Methodology

Whether a study used a behavioral ($k = 12$) or a self-report ($k = 4$) measure of altruism did not significantly moderate the age effect, $Q_{between}(1) = 0.05$, $p = .83$.[1] Similarly, neither realism of decision outcomes (real [k = 9] vs. hypothetical [k = 7]), $Q_{between}(1) = 0.05$, $p = .82$, nor anonymity (high [k = 8] vs. low [k = 8]) of decisions, $Q_{between}(1) = 0.08$, $p = .77$, significantly moderated the age effect.

Check for Publication Bias

Because of the lack of available unpublished studies, we could not use a moderator analysis to examine the effect of publication status on the study effect size. Instead, we used CMA to produce a funnel plot (see Figure 3), which displays the distribution of effect sizes by study weight. In the absence of publication bias, we expect effect sizes to be distributed symmetrically around the mean effect size, which held for the current meta-analysis. Because the interpretation of funnel plot symmetry is subjective, we also tested publication bias using the tandem method (Ferguson & Brannick, 2012). First, we calculated a fail-safe N of 505, $z = 11.18$, $p < .001$. This indicates that the number of additional (i.e., unpublished, missing, or new) studies needed to reduce the overall effect size to nonsignificance ($\alpha > .05$) was more than 31 times the number of included studies. Second, we computed Egger's regression (Egger, Davey Smith, Schneider, & Minder, 1997), which yielded a nonsignificant bias intercept, $\beta = -.09$, $t(14) = .09$, $p = .93$. Finally, we conducted the trim-and-fill procedure (Duval & Tweedie, 2000), which yielded a point estimate of $g = .62$, 95% confidence interval (CI; .52, .72), similar to the estimate obtained in the main analysis. Jointly, these analyses yielded no evidence of substantial publication bias.

Discussion

The current study applied a meta-analytic approach to the relationship between adult age and altruistic decision making. Unlike an earlier meta-analysis (Engel, 2011), we included studies that used a variety of altruism measures (e.g., self-reported altruism; choice tasks with hypothetical outcomes; choice tasks resulting in real charitable contributions). Remarkably, the age-related increase in altruism was robust in this diverse set of studies, as indicated by a substantial mean age effect (Hedges' $g = .61$). Only one of several candidate moderator variables that we examined—the average age of the older group—significantly moderated the age-related increase in altruism, such that studies with relatively old older-adult samples showed a smaller difference in altruism between younger and older groups, compared with studies with relatively young older-adult samples. In contrast, the average age of the younger-adult samples, the average income and education levels of the study country, the gender composition of the samples, and methodological features that may give rise to varying levels of socially desirable responding were not influential across studies.

These findings support the prediction made by life span developmental theories (e.g., Brandtstädter et al., 2010; Carstensen et al., 1999; Erikson, 1982), according to which aging is accompanied by an increase in altruism. As such, the current results converge with observations made in individual studies that featured a more narrow range of measures or more homogenous samples (e.g., Freund et al., 2014; Hubbard et al., 2016; Sparrow & Spaniol, 2018). The meta-analytic results do not speak directly to the question of whether older adults' heightened generosity reflects pure altruism or a more self-serving motive (i.e., warm-glow altruism; Harbaugh et al., 2007), and thus cannot adjudicate among theories differing in their emphasis on the intrinsic or instrumental value of altruism in aging.

With respect to the role of resource availability, the current findings are somewhat mixed. The finding of a reduced age effect in studies with relatively old older-adult samples suggests that resources may indeed contribute to age-related variation in altruism. As noted in past studies of charitable giving and other real-world prosocial behaviors among U.S. retirees (for a review, see Wiepking et al., 2013), access to resources (e.g., health, finances, social networks) and practices (e.g., religious attendance) may promote altruism in young-old individuals. Conversely, reduced availability of these resources may explain lower altruism in old-old individuals. The replication of this finding in the current meta-analysis, across a set of studies marked by geographical and methodological diversity, lends additional indirect support to a resource account of altruism in older adults. It should be noted, however, that neither educational attainment nor income levels—the latter defined rather coarsely, in terms of country-level data—emerged as significant moderators. These null effects leave open the question of which specific resources may influence altruism across the life span.

Several limitations should be noted. First, whereas the application of strict inclusion criteria maximized the construct validity of the meta-analytic inferences, it also limited the power of the moderator analyses because of the small number of studies per moderator level (see Table 1). There was also some overlap between the methodological categories that we examined. Specifically, among the four studies that used self-report measures of altruism, three involved hypothetical (rather than real) decision outcomes, and none featured anonymous decisions. However, we do not view this as a major limitation because none of the methodological moderators emerged as significant, suggesting that reputational concerns or social desirability were not influential. A second limitation was that, despite several exceptions (Gong, Zhang, & Fung, 2019; Ojha & Mishra, 2014; Pornpattananangkul, Chowdhury, Feng, & Yu, 2019), studies conducted in the United States and Canada were overrepresented in the meta-analysis. Third, we were unable to examine several moderators of interest (e.g., cognition, affect, health, income, religiosity) because they were not reported in most of the studies. Fourth, all studies were cross-sectional, leaving open the possibility that age differences in altruism may have been influenced by cohort effects (see also Wiepking et al., 2013). Finally, age was treated as a categorical rather than as a continuous variable because this approach was the

[1] The behavioral versus self-reported altruism dimension overlapped almost completely with another dimension of potential interest, financial versus nonfinancial altruism, with a discrepancy of only one study. A separate moderated regression analysis using the financial versus nonfinancial moderator revealed no significant moderation, $Q_{between}(1) = 0.05$, $p = 0.83$.

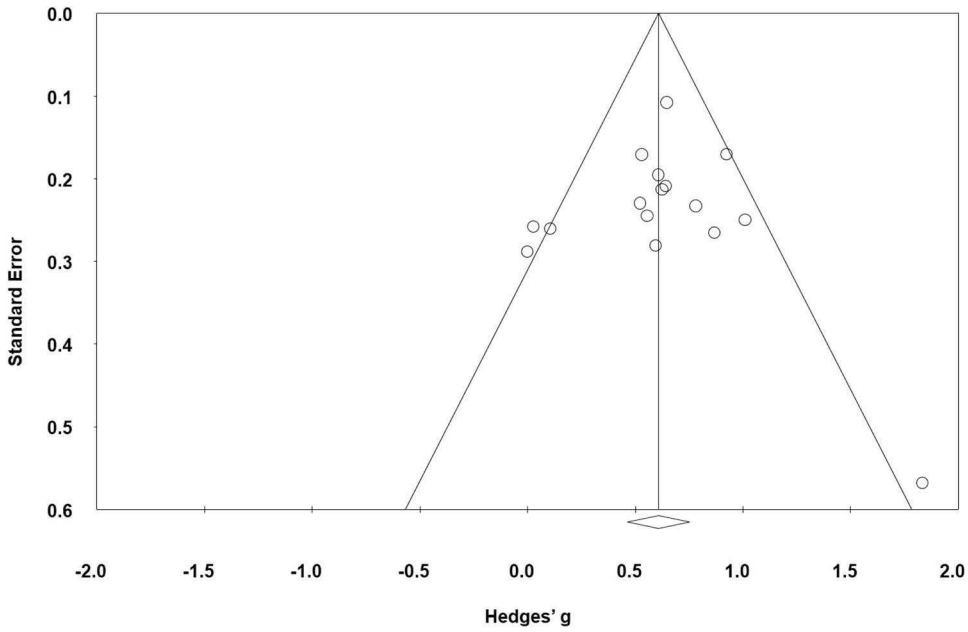

Figure 3. Funnel plot for the meta-analysis. The vertical line indicates the estimated mean effect size; the circles represent included studies.

one most commonly used in the literature. As a result, we were unable to test for a potential nonlinear relationship between age and altruism.

The current research highlights several avenues for future research. First and foremost, longitudinal data are needed to shed light on life span trajectories of altruism and to disentangle the effects of age and birth cohort (see also Mayr et al., in press). Second, to clarify the influence of motivational orientation and access to resources (e.g., cognitive, affective, social, and socioeconomic), it will be important to incorporate these measures in the design of future studies. For example, it is unclear how crystallized and fluid intelligence relate to altruism and whether age differences would vary across financial and nonfinancial forms of altruism. Other understudied factors of interest include cultural context (e.g., individualistic vs. collectivist societies) as well as critical life cycle events such as grandparenthood and retirement (e.g., Van den Boogaard, Henkens, & Kalmijn, 2014).

In conclusion, the current meta-analysis supports the idea that old age is associated with higher levels of altruistic motivation, but it also indicates that access to age-varying resources may be a limiting factor. There was no meta-analytic evidence for a differential impact of social desirability on expressions of altruism in younger and older adults. Going forward, a better understanding of the mechanisms underlying age-related differences in altruism may shed light on how prosocial values and behaviors can be cultivated across the life span.

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