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Generosity and Cooperation Across the Life Span: A Lab-in-the-Field Study

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Understanding persistence and changes in prosociality across the life span is fundamental to inform theory and practice. As life expectancy increases and pressing societal challenges demand increasing generosity and cooperation among individuals, it is crucial to understand intergenerational interactions. We present the findings from a novel lab-in-the-field experiment (N = 359, 18–90 years) that examines generosity and cooperation between generations. Our methodological approach allows us to study the effect of age on prosocial behavior as a function of the age of an unknown partner. We ask participants to make several decisions, and to state their expectations for their partners' behavior, in a dictator game and a prisoner's dilemma game with real monetary outcomes. The dictator game serves as a measure of generosity, whereas the prisoner's dilemma serves as a measure of cooperation. We find that individuals used age as key information to condition behavior. Generosity was greater among older adults in response to young and older relative to middle-aged partners. Among younger adults, cooperation was greater in response to middle-aged and older partners relative to their own age cohort. All age groups expect less cooperation from young partners than from older and middle-aged partners. However, relative to young adults, older adults are more cooperative with young partners. Our study has crucial implications for the understanding of human generosity and cooperation across the life span.

Keywords: cooperation, generosity, aging, prosociality, experiment

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Life expectancy in modern human societies increased dramatically in the last century. Consequently, societies are expanding and aging. Relevant societal, familial, and personal health decisions require interactions across generations. Many pressing challenges demand, and are facilitated by, prosocial behaviors such as generosity and cooperation. Therefore, it is of paramount importance to understand differences in prosocial behavior across the human life span. Previous research on differences across the life span found that older people

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showed more generalized trust (Li & Fung, 2013), were more forgiving (Allemand, 2008; Cheng & Yim, 2008), and were less likely to reject unfair divisions of money (Bailey, Ruffman, & Rendell, 2013; Roalf, Mitchell, Harbaugh, & Janowsky, 2012).

Although there is extensive research on cognitive processing and aging, little research has been conducted to understand how aging affects two aspects of prosociality: generosity and cooperation (Lim & Yu, 2015; Matsumoto, Yamagishi, Li, & Kiyonari, 2016; Mienaltowski & Wichman, 2020; Yamagishi et al., 2013). Generosity is often modeled through the Dictator Game, whereas cooperation is commonly studied through the Prisoner's Dilemma (Forsythe, Horowitz, Savin, & Sefton, 1994; Van Lange & Kuhlman, 1994). In the Dictator Game, individuals are endowed with resources (e.g., a certain amount of money) that they can allocate freely between themselves and another participant—the recipient (Forsythe et al., 1994). The part of the endowment shared with the other participant is a measure of the giver's generosity. Behavior in the Prisoner's Dilemma game has a strategic component because the outcome of each participant's decision also depends on their partner's choice. The individual has to decide to either cooperate or defect with a partner (Van Lange, Joireman, Parks, & Van Dijk, 2013). The highest payoff may be achieved when one individual chooses to defect but their partner chooses to cooperate. However, if both defect, the pair receive lower payoffs than in the case when they both cooperate. Therefore, cooperators are at risk of being exploited by others.

The above paradigms have been extensively used in the past 70 years across the social sciences (Van Lange et al., 2013). They provide not only a controlled setting in which to study decision making but have also been shown to be ecologically valid across several domains (Balliet & Van Lange, 2013; Barr & Zeitlin, 2010; Bem & Lord, 1979; Peysakhovich, Nowak, & Rand, 2014; Thomae, Zeitlyn, Griffiths, & Van Vugt, 2013). For instance, people who are more cooperative in social dilemmas are also more likely to report being engaged in socially oriented activities during their studies (Heinz & Schumacher, 2017). Moreover, behavior in social dilemmas predicts real-life decisions and outcomes in many contexts, such as productivity at work (Englmaier & Gebhardt, 2016), the extent to which fisherman exploit common pools (Fehr & Leibbrandt, 2011), the management of forest commons (Rustagi, Engel, & Kosfeld, 2010), and contributions to open-source projects by software developers (Algan, Benkler, Henry, & Hergueux, 2014). Past research also found that giving in the Dictator Game successfully predicts charitable giving (Benz & Meier, 2008) and actual helping behavior in an online setting (Peysakhovich et al., 2014). Giving in the Dictator Game is also associated with other generous actions, such as investing hours in teaching (Barr et al., 2010) or returning a misdirected letter with money inside (Franzen & Pointner, 2013).

To date, the empirical evidence on intergenerational cooperation among nonkin is scarce. To the best of our knowledge, there is little experimental work examining whether people condition both their generosity and cooperation with strangers on the age of their interaction partners.

Proself Versus Prosocial Growth Hypothesis

Previous research on the development of prosocial behavior over the life span proposed two competing hypotheses (Matsumoto et al., 2016; Van Lange, Otten, De Bruin, & Joireman, 1997). According to the pro–self-growth hypothesis, age decreases prosociality because older people need to focus on their safety and therefore trust less and act less prosocially with others (Matsumoto et al., 2016; Van Lange et al., 1997). In contrast, the prosocial growth hypothesis suggests that aging increases prosociality. The reason is that people have different motives for guarding or sharing resources during the course of their development (Van Lange et al., 1997). For example, young people need to compete over scarce resources, so at this stage of life competitive motivation may be relatively more adaptive. As people age, they will be either more responsible for others (e.g., children or employees) or they may depend on others for care. Prosociality is an important facilitator in both cases (Van Lange et al., 1997). Evolutionary accounts that underline the importance of learning and norms also allow for predictions about the development of prosocial behavior with age. In particular, they predict that experienced members within a group exhibit high levels of generosity (Henrich, Chudek, & Boyd, 2015; Henrich & Gil-White, 2001).

Empirical evidence appears relatively more supportive of the latter hypothesis (i.e., prosocial growth). Older generations have been found to be more prosocial and generous than younger generations across different economic games (Bellemare, Kröger, & Van Soest, 2008; Raihani & Bshary, 2012; Van Lange et al., 1997). These include cooperation games such as the Prisoner's Dilemma and the Public Goods Game (Charness & Villeval, 2009; Gutiérrez-Roig, Garcia-Lázaro, Perelló, Moreno, & Sánchez, 2014) but also redistribution games such as the Ultimatum Game (Bailey et al., 2013; Lim et al., 2015; Mienaltowski & Wichman, 2020). Other research found that older adults are less involved in helping friends but spend more time volunteering (Gallagher, 1994). Similar results were found in intergenerational experiments involving interactions among family members (Peters, Ünür, Clark, & Schulze, 2004; Molina et al., 2019). There is also evidence that older adults show relatively more prosocial behavior in situations involving empathy (Bailey, Brady, Ebner, & Ruffman, 2018; Beadle, Sheehan, Dahlben, & Gutchess, 2015).

Generosity and Cooperation Conditional on Age

There is less evidence on whether humans condition their cooperation and generosity on the age of the partners with whom they are matched. Theoretical contributions do not offer a unique prediction in this case. An indirect reciprocity perspective would predict ingroup favoritism, such that people will be more cooperative and generous with members of the same age group (Tajfel, Billig, Bundy, & Flament, 1971; Yamagishi, Jin, & Kiyonari, 1999). Other accounts suggest that there might be social cues—such as forms of respect, trustworthiness, and deference—which steer cooperation and generosity toward specific members of the society—in particular, toward older individuals (De Cremer, 2003; Tyler & Blader, 2013). There is indeed evidence that older people tend to be perceived as more prestigious and experienced than younger individuals because they are likely to have accumulated more knowledge (Henrich et al., 2001). Other research suggests that elderly people are perceived as more trustworthy, rather than competent (Cuddy, Fiske, & Glick, 2008; Fiske, Cuddy, Peter, & Xu, 2002). The above perspectives suggest that younger generations would be particularly prosocial toward older people.

Past research on behavioral decision making with same- versus other-age partners focused on behavior in the Trust Game or the Ultimatum Game, respectively (Bailey et al., 2013, 2015). This research showed that older participants divide money more generously, are less likely to reject unfair offers from younger participants, trust independently of their partner's age (although these differences diminish in face-to-face interactions), and are generally considered more trustworthy (Bailey et al., 2013, 2015). Other research studied the effect of mortality reminders over the life cycle and its effect on generativity (i.e., adults' desire to use their own experience to guide younger generations). Older people are relatively more sensitive to induced thoughts of mortality and this translates into higher levels of generativity (Major, Whelton, Schimel, & Sharpe, 2016; Maxfield et al., 2014). Past studies also highlighted potential confounds related to the financial cost of donation. Midlarsky and Hannah (1989) showed that older people donate relatively less than younger people in absolute terms, but this gap reverses when financial cost is controlled for.

Critically, previous research on intergenerational cooperation has not allowed for the disentangling of different mechanisms related to cooperation and generosity, such as expectations that is, beliefs about one's partner's cooperative behavior (Pletzer et al., 2018; Yamagishi et al., 2013). Expectations have proven to be one of the most prominent drivers of behavior in economic games (Balliet et al., 2013; Yamagishi et al., 2013). Forming expectations is central to increasing the likelihood of engaging in mutually beneficial interactions and not being exploited by others (Pletzer et al., 2018). Previous research found that expectations of others' generosity correlate with actual generosity in the Dictator Game (Yamagishi et al., 2013). Yet a prosocial growth hypothesis would posit that older people are more generous than younger people, and previous work demonstrated that older people are also less likely to reject unfair offers (Bailey et al., 2013). Under this reasoning, older people may rely less on expectations of others' behavior (i.e., cooperate regardless of the expected return), compared with younger people.

The Current Research

Here we aim to contribute to this debate about cooperation and generosity across the life span. To address the gap in the literature, we tested whether (a) people of different ages behave differently when making decisions about generosity and cooperation with strangers and whether (b) people condition their generosity and cooperation on the age of the partners with whom they interact. Furthermore, we address the role of expectations in explaining behavior conditional on the age of the interaction partner. Notably, our setup also allows us to test whether expectations drive decisions to cooperate across age and whether decisions are conditioned on the age of the interaction partner.

To address these questions, we devised a new experimental paradigm in which participants could make decisions in two incentivized games—the Dictator Game (Forsythe et al., 1994) and the Prisoner's Dilemma (Van Lange et al., 1994)—and in which decisions could be conditioned on the age cohort of three potential matched partners: young (18–39 years), middle aged (40–59 years), and older (60–90 years, see Figure 1, a–c). Such a classification is commonly used by statistical offices to report the main population statistics in Austria (e.g., Austrian National Bank, 2019; Statistics Austria, 2017). The Dictator Game served as a measure of generosity and the Prisoner's Dilemma a measure of cooperation.

Under the proself growth perspective, older people are relatively less generous toward strangers compared with younger people ($H1_{proself}$), whereas a prosocial growth perspective predicts that as people age, they will become more generous ($H1_{prosocial}$). The same logic applies to cooperation: A proself growth perspective predicts that aging decreases cooperative behavior ($H2_{proself}$), whereas a prosocial growth perspective predicts that older people are more cooperative than younger ones ($H2_{prosocial}$). Available evidence seems to be more in line with a prosocial growth perspective (e.g., Bailey et al., 2013; Van Lange et al., 1997). Regarding generosity and cooperation conditional on the age of the interaction partner, an indirect reciprocity perspective predicts ingroup favoritism, that is, people are more generous and cooperative toward people of the same age cohort, compared with people from other cohorts (H3). Other accounts claim that age is a proxy of experience, trustworthiness, and prestige in a group and predict that people will be more generous and cooperative with older people, compared with with younger people (H4). Empirical evidence on H3 and H4 is mixed: Older people seem to be considered more trustworthy, but the same is not true for trust and generosity conditional on the age of the partner (Bailey et al., 2013, 2015).

We also investigate whether expectations drive decisions in intergenerational interactions. First, previous research suggests that expectations predict generosity and cooperation (H5; Pletzer et al., 2018). Second, because a prosocial growth hypothesis and previous literature suggest that older people are more generous than younger people, another prediction would be that cooperation by older people will be conditional their partner's expected cooperation to a lesser extent when their partner is from the younger cohort ($H6_{prosocial}$).

Method

Participants

The study was approved by the Ethical Board of the University of Innsbruck (Certificate of Good Standing, 35/2016). All locations involved in the study granted us permission to collect data in their facilities. In addition, all participants signed an informed consent form. All data were treated confidentially. No association was made between real names and answers in the study. We ran a lab-in-the field experiment with adult participants ($N = 359$) drawn from the Austrian general population (see Table 1 and online supplemental material). The study used a within-subjects design such that each participant had one interaction partner from each of the three age cohorts (18–39 years, 40–59 years, 60–90 years). We used a convenience sampling procedure. We approached passersby in shopping malls and a senior fair. An a priori power analysis indicated 327 participants were necessary to achieve 95% statistical power to detect a small effect ($d = 0.20$) of partner's age on behavior (within-subjects difference). The experiment was conducted in North Tyrol, Austria, and participants were recruited over three consecutive weekends in shopping malls and at a senior fair (November 12, 2016 through November 26, 2016; see Table 1 for an overview of sociodemographic charac-

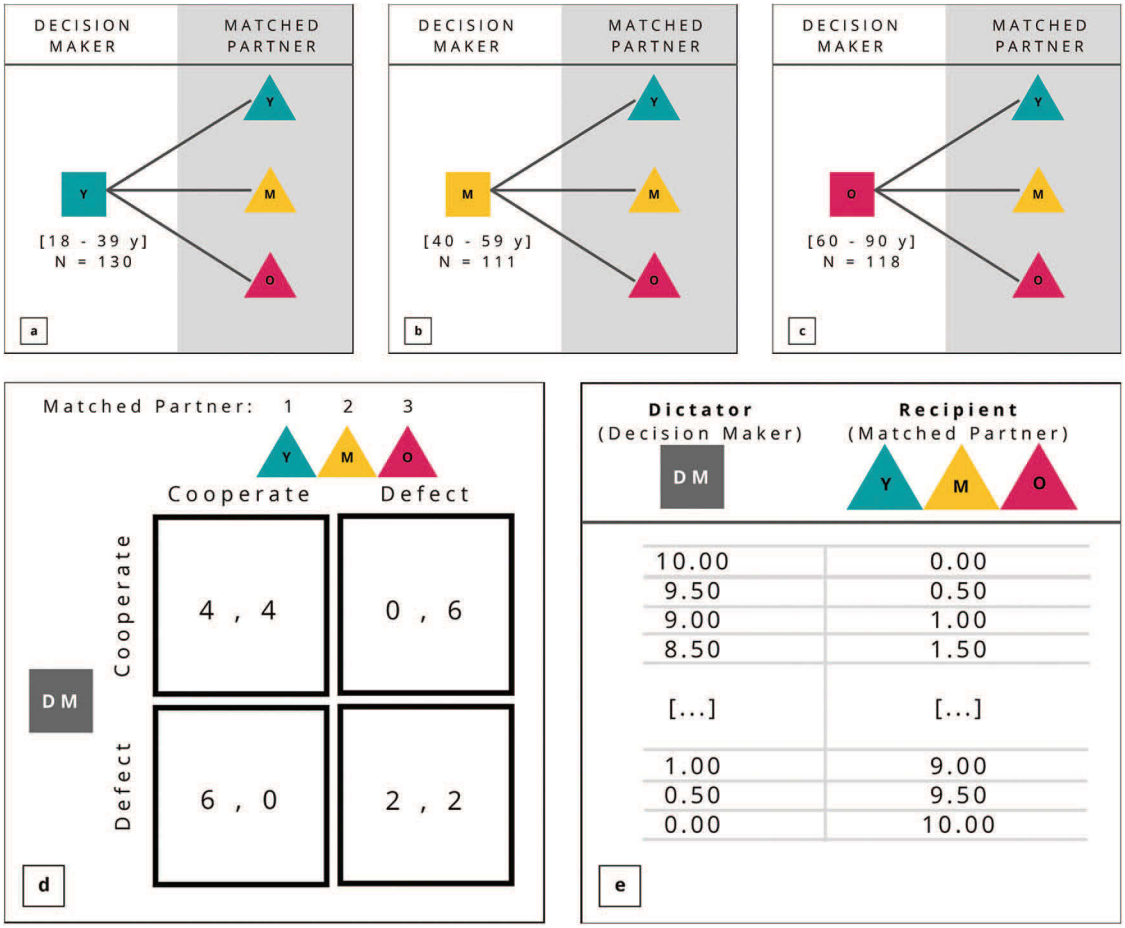

Figure 1. Conditional decisions and experimental games. Panels a–c give an overview of the decision environment for both games. Panels d and e summarize both experimental games. For all panels, a square indicates the decision maker (DM) and triangles the interaction partners. The letters Y, M, and O specify the age cohort and stand for Young (18–39 years), Middle (40–59 years), and Older (60–90 years), respectively. In the Instructions (see SI), we always used the age brackets and did not use loaded terms (Young, Middle, and Older). Panels a–c indicate that decision makers from each age cohort made three choices—in each game—conditional on the potential age cohort of the matched partner (following a within-subjects design). Panel d shows the Prisoner's Dilemma Game. A decision maker could either choose to cooperate or defect, depending on the age cohort of their partner. The first number in each of the four possible outcomes indicates the decision maker's payoff and the second number the payoff for the matched partner. Panel e summarizes the Dictator Game. A decision maker received 10 euros and could choose how many euros he or she wanted to transfer to a partner, depending on the age cohort of the partner. See the online article for the color version of this figure.

teristics of the participants conditional on the location of the experimental sessions). To exclude potential environmental demand effects, we ran control tests and detected no differences in behavior across age cohorts between data collected in shopping malls versus the senior fair.

Procedure and Measures

Participation in the paper-and-pencil experiment was voluntary. Both shopping malls were located in small towns (10,000–15,000 inhabitants) located 30 and 60 km west of Innsbruck, the capital of North Tyrol. The senior fair took place in Innsbruck (130,000 inhabitants, Supplemental Figure 1 (a) in online supplemental material). We chose our recruitment strategy to reach the widest possible audience from different walks of life. The elderly are particularly difficult to reach. Recruiting them required us to consider an event specifically designed for this target age group. The senior fair from which we recruited takes place annually and does not have political or religious affiliation.

We set up two teams, each one consisting of one experienced experimenter and three trained experimenters. The team of experimenters was recruited from the pool of students at the University of Innsbruck in their 20s. They were trained by the experienced experimenters and received a script with which to approach potential participants. The two teams rotated over the two shopping malls, whereas one larger team with five experimenters and one experienced experimenter was in charge of the data collection at

Table 1
Sociodemographic Characteristics of the Participant Pool Conditional on the Location of the Experimental Session (Shopping Mall or Senior Fair) and the Respective Age Cohort

	Shopping malls			Senior fair		
Characteristics	Young 18–39 years	Middle 40–59 years	Older 60–90 years	Young 18–39 years	Middle 40–59 years	Older 60–90 years
Number of participants	114	73	32	16	38	86
Share females	56.14%	63.01%	43.75%	68.75%	63.16%	58.14%
Average age, years	28 (7.01)	49 (5.01)	69 (6.89)	28 (5.40)	53 (5.39)	70 (7.25)
Education						
High school	30.70%	27.40%	31.25%	50.00%	26.32%	23.26%
College	22.81%	28.77%	21.88%	37.50%	18.42%	23.26%
Employment status						
Employee	78.07%	83.56%	6.25%	50.00%	60.53%	10.47%
Self-employed	3.51%	5.48%	6.25%	6.25%	7.89%	5.81%
Resident in Innsbruck	2.63%	0.00%	0.00%	81.25%	31.58%	40.70%

Note. The standard deviation of the age variable is shown in parentheses.

the senior fair. All experimenters wore official badges of the University of Innsbruck and made it clear to potential participants that the study was a research project approved by the University of Innsbruck with no commercial purpose. The recruitment process followed the same strict protocol in all locations. Once a person agreed to participate in the paper-and-pencil experiment, he or she was led to a quiet place and given a booklet with detailed instructions of the games and the decision sheets (see Instructions in online supplemental material). The experimenter instructed the participants that they would escort them to the experimenter desk for the random draws and payments once they had completed all the tasks.

At the beginning, participants read that their decisions could affect their own and the other players' earnings. Then participants were informed that they were about to make decisions in two games. After that, the instructions for the Dictator Game and the Prisoner's Dilemma were presented in a neutral frame. In each game, they were asked to make three decisions, each with a partner from a different age cohort. The age cohorts of the matched partners were: 18–39 years ($N = 130$); 40–59 years ($N = 111$); and 60–90 years ($N = 118$). We informed participants that for each game we would have paired them with a different partner. Only one decision per game was paid. We reversed the order of the games for the last visit in the shopping malls to control for potential order effects. As a robustness check, in all the regression analyses, we controlled for the order of the games by including a dummy variable (i.e., Prisoner's Dilemma first).

For the Prisoner's Dilemma, the decision maker was matched with someone who had the same role as they in the Dictator Game. Whereas the interaction partner changed from one game to the next, the age cohort of the partner was the same in both games (note that this information was not provided to participants in advance to avoid any unwanted strategic decision in the Dictator Game when that game was played first). Following common practice in these types of lab-in-the-field experiments, the matching of the participants was made on a rolling basis (see for instance Buchan et al., 2009). To have matching partners for the first participants in the first visit to the shopping malls, we collected data from six volunteers—two per age cohort—who were paid at a later date. We applied the same matching procedure for volunteers as in the field. To ensure comparability, we did not include these six observations in the data set. Once a participant completed the decision booklet, he or she was accompanied to the experimenter desk at which role assignment in the Dictator Game and matching were performed. First, the experimenter tossed a coin to determine the participant's role in the Dictator Game—either dictator or recipient. For a participant assigned the role of dictator, an additional random draw was performed to determine the age cohort of the recipient. A participant assigned the role of recipient received a payment from a member of the age cohort with whom they previously indicated as their preference to be matched, in the event that they were assigned the role of recipient. Once a participant's role in the Dictator Game and the age cohort of their counterpart were determined, the participant was matched with someone from the relevant age group with a different role.

At the end of the two games, we collected sociodemographic information such as age, gender, residence, education, number of children, and employment. The team of experimenters maintained the privacy of participants but remained available in case they had questions. The average completion time was 10 min and the average payment was €8.70. The payment comprised the sum of earnings from the Dictator Game and the Prisoner's Dilemma. Participants were paid in cash and in private at the end of the experiment.

Dictator Game

The Dictator Game is a widely established measure of generosity (Forsythe et al., 1994). In the present study (Figure 1e), all participants made a decision in the role of dictator. As dictators, they were asked how much of a €10 endowment they wanted to keep for themselves and how much they wanted to give to a recipient that belonged to the Young, Middle, and Older cohort, respectively. As recipients, participants also had to state how much they expected to receive from a dictator from the Young, Middle, or Older cohort, respectively. At the end of the experiment, participants were assigned to the role of either dictator or recipient and the relevant choices were implemented and paid in cash. After stating their expectations about dictators' behavior, participants chose the age cohort of the dictator they wished to be matched with in the event they were assigned the role of recipient. This is an

incentive-compatible way of eliciting a participant's preference for whom to be matched with.

Prisoner's Dilemma

The Prisoner's Dilemma serves as a measure of cooperation (Van Lange et al., 1994). Participants played a simultaneous one-shot Prisoner's Dilemma (Figure 1d) in which mutual cooperation yields the largest overall outcome (€4 each), but each individual has an incentive to deviate from cooperation. The Nash Equilibrium of the game predicts that both players defect, hence ending up with less (€2 each) than what they would have obtained if they both had cooperated. Participants made three decisions, one for each possible age cohort of the partner (Young, Middle, Older). Participants were also asked whether they expected cooperation or defection from each of their three potential matched partners, allowing us to determine the extent to which cooperation decisions were based on these expectations. At the end of the experiment, participants were matched with a partner from one of the three age cohorts and paid accordingly.

Results

Generosity Across the Life Span

First, we tested whether levels of generosity differ with age by examining aggregate behavior in the Dictator Game. Aggregate behavior captures the average generosity of participants, regardless of the age of the counterpart. For each game, we pooled together all three decisions. We found that age (in years) is positively correlated with generosity, even after controlling for sociodemographic characteristics such as education (Model 2 with controls $b = .019$, $p = .050$, see Figure 2 and Supplemental Table 2 in the online supplemental material).

Cooperation Across the Life Span

In the Prisoner's Dilemma, the aggregate cooperation levels are similar across age (see Figure 3). We found no difference when regressing the age (in years) of the decision maker on the average cooperation level (Model 4 with controls $b = -.008$, $p = .427$,

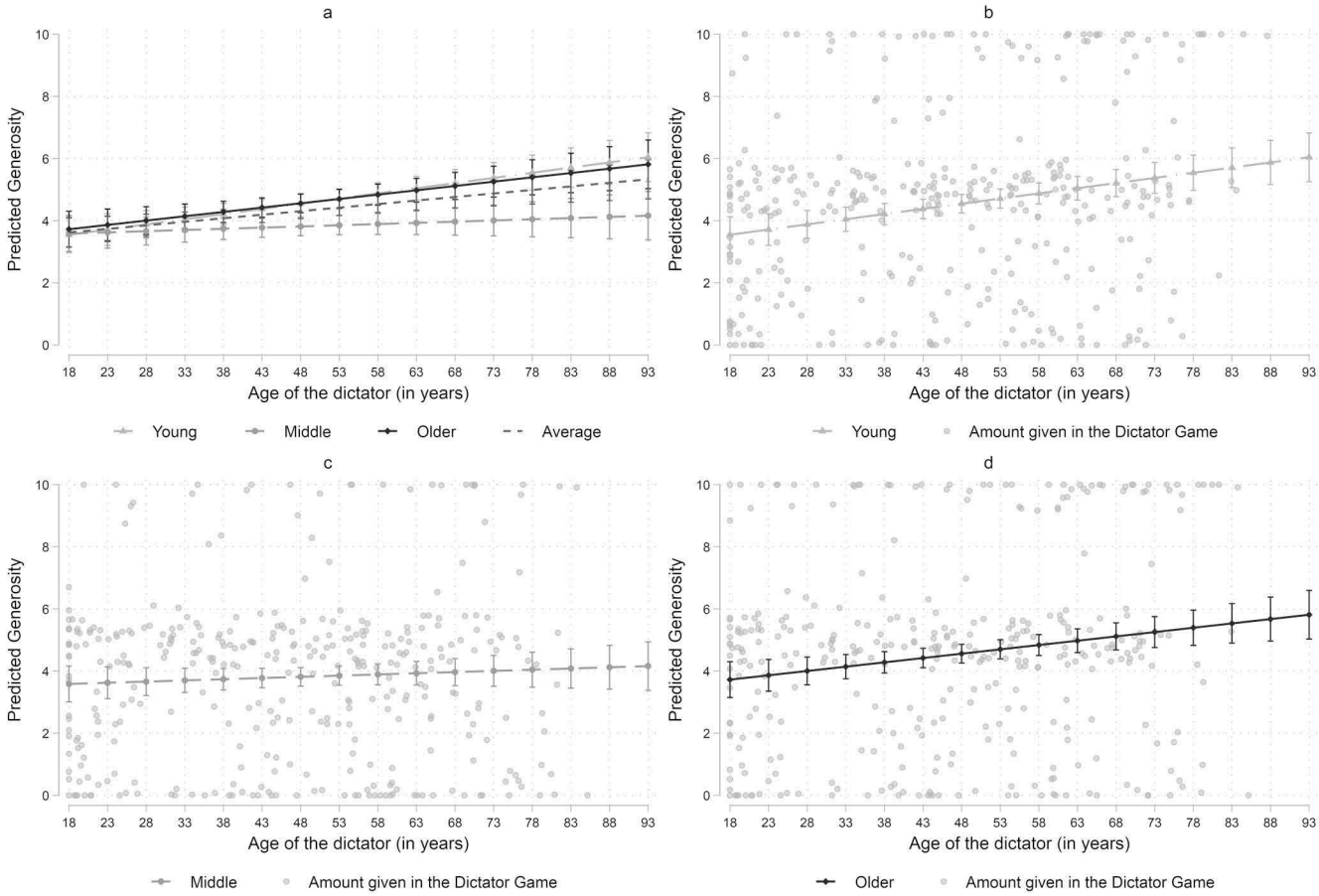

Figure 2. Generosity in the Dictator Game. The figure shows the linear predictions (and 95% confidence intervals) for the amount given in the Dictator Game, by age (in years) of the dictator and the age cohort of the recipient (Supplemental Table 3, Model 3). In panel a, we report the predicted generosity for each of the three cohorts of the recipient. In panels b–d, we report the predicted generosity and the actual individual behavior (light gray dots) for each cohort.

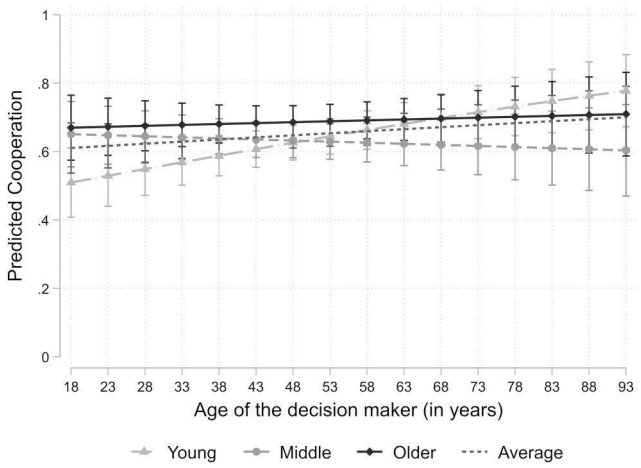

Figure 3. Cooperation in the Prisoner's Dilemma. The figure shows the linear predictions (and 95% confidence intervals) for the decision in the Prisoner's Dilemma, by age (in years) of the decision maker and conditional on the age of the matched partner (Supplemental Table 4, Model 3).

odds ratio [*OR*] = .992, 95% confidence interval [CI: .974, 1.011]; see Table S2 in the online supplemental material), suggesting that sensitivity to opportunities for strategic cooperation is not driven by age.

Generosity Conditional on the Age of the Matched Partner

In the next step, we focused on the age cohort of the matched partner. First, we investigated whether indirect reciprocity explains our findings by examining whether results could be driven by ingroup favoritism, that is, the tendency to be nicer to people of the same group—in our case, the same age cohort. To do so, we tested whether people were more generous when they knew that their partner was from the same age cohort. Results from panel random-effects Generalized Least Squares (GLS) regression analysis with a dummy for ingroup (1 = *partner from own cohort*, 0 = *partner from a different cohort*) show that people did not discriminate in favor of their own age cohort in the Dictator Game (Model 2 with controls $b = .117$, $p = .416$, Supplemental Table 3 in online supplemental material). Next, we ran a panel random-effects GLS regression to test whether generosity, as measured in the Dictator Game, is conditional on the age of the matched partner (see Supplemental Table 3). We also interacted age (in years) of the decision maker with the age cohort of the matched partner (see Figure 2 and Model 4 in Supplemental Table 3). In particular, we found that this increase in generosity across age is targeted toward partners from the Young (Model 4, Age × Partner from Middle cohort: $b = -.026$, $p = .004$) and the Older cohort (Wald test: Age × Partner from Middle cohort = Age × Partner from Older cohort, $p = .025$), compared with when partners are from the Middle cohort. Moreover, there are no differences in generosity when the matched partner is from the Young cohort, compared with the Older cohort (Age × Partner from Older cohort: $b = -.006$, $p = .511$).

Cooperation Conditional on the Age of the Matched Partner

Again, we first checked whether people cooperate more with others of the same age, compared to partners from a different age. For cooperation, we found no evidence of ingroup favoritism in the Prisoner's Dilemma (Model 2 with controls $b = -.247$, $p = .141$, $OR = .781$, 95% CI [.562, 1.085], Supplemental Table 4 in online supplemental material). As before, we interacted the age (in years) of the decision maker with the cohort of the matched partner (Figure 3 and Supplemental Table 4). The results show that people are more cooperative with older generations (Middle and Older cohort), Model 4, Supplemental Table 4, Middle cohort: $b = 1.388$ and $p = .012$, $OR = 4.007$, 95% CI [1.355, 11.843]; Older cohort: $b = 1.480$ and $p = .008$, $OR = 4.394$, 95% CI [1.460, 13.222]. However, this tendency decreases with age (Model 4, Age × Partner from Middle cohort: $b = -.028$, $p = .009$, $OR = .972$, 95% CI [.952, .993]; Age × Partner from Older cohort: $b = -.022$, $p = .046$, $OR = .978$, 95% CI [.958, 1.000]). Moreover, participants are not more cooperative when the partner is from the Older cohort compared with when the partner is from the Middle cohort (Wald test between two dummies, Partner from the Middle and Partner from the Older cohort, $p = .869$).

Expectations

We also tested whether expectations drive generosity and cooperation across age. In both games, expectations are very good predictors of actual choices. With respect to the relationship between generosity and expectations, expectations about partner's generosity are positively correlated with actual generosity when the partner is Young; $r(353) = .315$, $p < .001$; Middle aged; $r(353) = .327$, $p < .001$; and Older; $r(349) = .350$, $p < .001$. People expect more generosity from the Older ($M = 3.89$, $SD = 3.16$), compared with the Middle ($M = 3.57$, $SD = 2.63$) or the Young cohort ($M = 2.81$, $SD = 2.78$), respectively. Nonparametric analysis confirms this trend ($p < .001$, Wilcoxon's rank-sum extension for trend; similar results are obtained with a Page test). People also expect more cooperation when matched with a partner from the Older ($M = 64.79\%$, $SD = 47.83$) and Middle ($M = 61.97\%$, $SD = 48.61$) cohort, compared with the Young cohort ($M = 43.79\%$, $SD = 49.68$, $p < .001$ for both comparisons with McNemar tests). There is no significant difference in expected cooperation between a partner from the Middle or Older cohort ($p = .309$, McNemar test).

For the Prisoner's Dilemma, we also regressed cooperation on a decision maker's expectation about the matched partner's cooperation in the Prisoner's Dilemma, a continuous age variable, and an interaction between expectations and age of the decision maker (in years). Expectations significantly predict cooperation when the partner is from the Young and Older cohorts (Young: $b = 2.864$, $p < .001$, $OR = 17.528$, 95% CI [4.111, 74.724]; Older: $b = 2.463$, $p = .001$, $OR = 11.735$, 95% CI [2.684, 51.309]), whereas there is not a significant effect of expectations on cooperation when the partner is from the Middle cohort (although in the same direction: $b = 1.187$, $p = .096$, $OR = 3.277$, 95% CI [.811, 13.242]). However, when we consider the age of the decision maker and his or her expectations when the matched partner is young, we uncover an interesting pattern. We found that as people

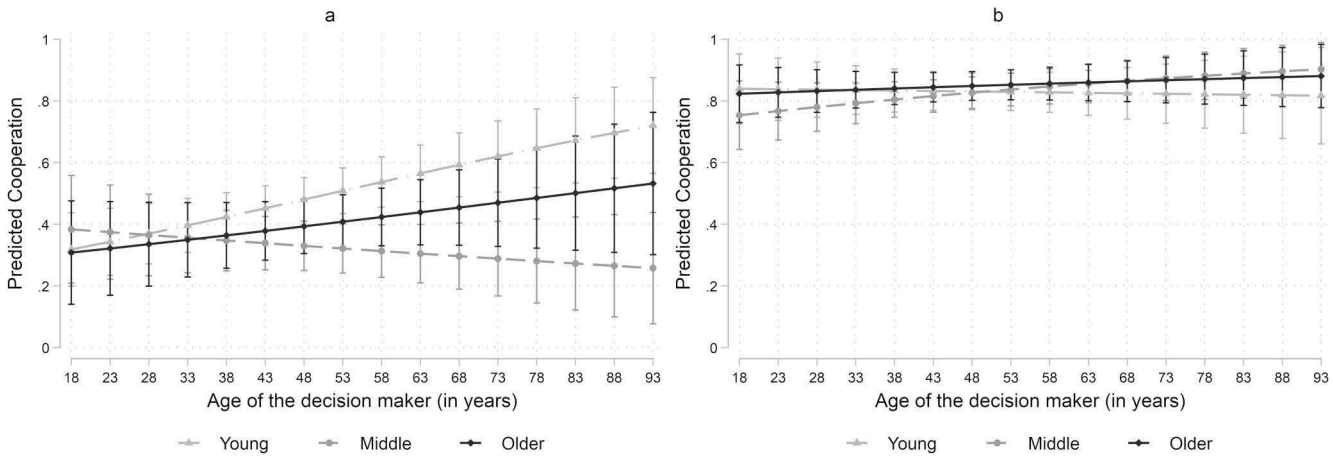

Figure 4. Cooperation in the Prisoner's Dilemma Game with respect to the expectations of the matched partner's cooperation by age of the decision maker. Panel (a) shows the linear predictions (and 95% confidence intervals) of cooperation when the decision maker expects the partner not to cooperate. Panel (b) shows the linear predictions (and 95% confidence intervals) of cooperation when the decision maker expects the partner to cooperate.

age, they start to cooperate more with the Young, even if they expect the Young to defect (age of decision maker, $b = .023$, $p = .005$, $OR = 1.023$, 95% CI [1.007, 1.039], see Figure 4a). There are no differences in the predicted cooperation levels across ages when people expect their partners to cooperate (see Figure 4b and Supplemental Table 5). Hence, relative to younger people, older individuals are more likely to cooperate when they expect defection from the Young cohort.

General Discussion

Modern societies are characterized by surprisingly high levels of cooperation among strangers. Furthering our understanding of the mechanisms that promote and maintain generosity and cooperation is arguably paramount in facing societal challenges. In this study, we tested several predictions about whether generosity and cooperation increase or decrease with age. Moreover, we examined whether people change their behavior based on the age of their partner, either by favoring their ingroup (i.e., same-age partner) or by directing their generosity and cooperation toward a specific cohort of the population. Furthermore, we shed light on the mechanism driving these behaviors by considering expectations of a partner's cooperation and generosity.

We found different results across strategic (cooperation in the Prisoner's Dilemma) and nonstrategic (generosity in the Dictator Game) situations. Older people were more generous on average than younger generations. This result supports the prosocial growth hypothesis and is in line with previous research that found that generosity increases with age in diverse settings and games (Bailey et al., 2013, 2018; Beadle et al., 2015; Lim et al., 2015; Matsumoto et al., 2016; Mienaltowski & Wichman, 2020; Van Lange et al., 1997). Regarding cooperation, we found no robust differences in average cooperation levels across age. Older people showed similar levels of cooperation relative to younger generations. This result aligns with studies that investigate differences in trust behavior across age in face-to-face interactions (Bailey et al., 2015). This intriguing asymmetry between generosity and cooperation suggests an age-independent role for the expression of strategic cooperative behavior and a more age-dependent role for the expression of nonstrategic benevolent behavior. Our results suggest that, on average, our participants—regardless of their age—are willing to sacrifice personal interest for the collective good but that the older age group may be particularly sensitive to opportunities that allow for the expression of generosity.

An analysis of the role of the matched partner further illuminated these results. First, we found no evidence of ingroup favoritism in both generosity and cooperation, a finding that suggests indirect reciprocity might not play a major role in interactions among people from different generations (Yamagishi & Kiyonari, 2000). This observation may be partly explained by the fact that people have experienced themselves at different ages and this may increase empathy, for example, older adults were once young (Chasteen, 2005). By contrast, we found evidence that people have optimistic expectations about the generosity and cooperation of older generations. This is consistent with previous research that found that people consider older people to be more trustworthy (Bailey et al., 2015). These positive expectations translated into high levels of cooperation with older people (Middle and Older cohorts), whereas with respect to generosity, we found that expectations were positively correlated with actual behavior. Moreover, both younger and older people were treated more generously, compared with middle-aged people. These findings partially support accounts that emphasize the role of experienced members of the group as more trustworthy facilitators or triggers of cooperation (Cuddy et al., 2008; Henrich et al., 2001; Major et al., 2016; Maxfield et al., 2014). Hence, older people may have a crucial role in transmitting norms of cooperation (Richerson et al., 2016).

This special role played by older people is also supported by our analysis on the role of expectations for cooperation. Whereas Young and Middle-aged groups were influenced by their expectations for their partner's behavior, the Older age group was more

likely to cooperate with young people, even when their counterpart was expected to defect (see Figure 4). This result is in line with previous research that found older people to be more forgiving (Allemand, 2008; Cheng et al., 2008) and less likely to reject unfair offers from younger participants (Bailey et al., 2013). Thus, in our controlled setting, older people appear to cooperate, regardless of expectations, which is compatible with the prosocial growth hypothesis as well as with the transmission of cooperative norms as social role models (Richerson et al., 2016; Van Lange et al., 1997).

Limitations and Future Research

The present results are clearly just a first step in identifying and explaining differences in cooperation and generosity across the life span through the use of experimental games. As such, the present work is not without limitations. It is possible that part of our findings is confounded by other factors that change across the life span that we did not measure in our study, such as differences in how people take risks across age (Dohmen, Falk, Golsteyn, Huffman, & Sunde, 2017). Future research needs to measure these other components (e.g., risk) and examine how they influence cooperation across age. Another explanation for our findings could be related to differences in wealth across the different age cohorts. However, differences in wealth cannot explain why (relatively poorer) young generations should cooperate more with richer older people (Austrian National Bank, 2019; Statistics Austria, 2017). Next, an explanation for the higher generosity toward young people could be that elderly people give more to younger generations because they perceive them as needier. Yet if this stereotype were true, we should also have observed the middle-aged giving more to young people, a pattern that is not supported by our data. Future research will need to disentangle the different psychological channels (trustworthiness, norm transmissions, etc.) underlying the specific behavioral patterns observed in this study.

We also acknowledge a few methodological limitations. First, our experimental design devises situations characterized by impersonal interactions with strangers. Whereas many real-life interactions share this feature, personal interaction also frequently characterizes daily life. Future research is needed to investigate how these insights translate to different contexts in which participants would be allowed to interact in person with their matched partner. Such an extension would also make the age dimension less salient and other factors—such as gender, ethnicity, religion, and so forth—could also play a role. A second limitation may be the age of the experimenters who collected the data in the field. One could posit that older people felt compelled to cooperate with and be generous toward younger participants because this category was triggered by the presence of the (relatively young) experimenters. Yet it is important to note that there was no such priming effect for young participants—recall that we did not find any evidence of ingroup favoritism. Finally, older participants were not screened for signs of dementia or cognitive decline. Although we controlled for education level, future research will need to investigate whether cognitive decline or dementia may partially affect generous and cooperative decisions with age.

Conclusion

To conclude, our study has crucial implications for the understanding of human generosity and cooperation across the life span. Our results suggest that older people are more generous than younger generations, whereas no differences in cooperation emerge across the life span. Young people are more cooperative with middle-aged and older partners. Moreover, although participants across all ages hold negative expectations for their young partners, older adults engage in more cooperation regardless of their expectations with young generations. These tendencies enlighten us regarding how dynamics in cooperation and generosity may unfold with age. In particular, they may inform theory and practice in understanding crucial developmental differences when studying intergenerational generosity and cooperation.

References

Algan, Y., Benkler, Y., Henry, E., & Hergueux, J. (2014). *Social motives and the organization of production: Experimental evidence from open source software* [Working paper]. Paris, France: SciencesPo.

Allemand, M. (2008). Age differences in forgivingness: The role of future time perspective. *Journal of Research in Personality, 42,* 1137–1147. http://dx.doi.org/10.1016/j.jrp.2008.02.009

Austrian National Bank. (2019). Household finance and consumer survey. Retrieved from https://www.hfcs.at/ergebnisse-tabellen/hfcs-2017.html

Bailey, P. E., Brady, B., Ebner, N. C., & Ruffman, T. (2018). Effects of age on emotion regulation, emotional empathy, and prosocial behavior. *The Journals of Gerontology: Series B,* gby084. http://dx.doi.org/10.1093/geronb/gby084

Bailey, P. E., Ruffman, T., & Rendell, P. G. (2013). Age-related differences in social economic decision making: The ultimatum game. *Journals of Gerontology Series B, Psychological Sciences and Social Sciences, 68,* 356–363. http://dx.doi.org/10.1093/geronb/gbs073

Bailey, P. E., Slessor, G., Rieger, M., Rendell, P. G., Moustafa, A. A., & Ruffman, T. (2015). Trust and trustworthiness in young and older adults. *Psychology and Aging, 30,* 977–986. http://dx.doi.org/10.1037/a0039736

Balliet, D., & Van Lange, P. A. (2013). Trust, punishment, and cooperation across 18 societies: A meta-analysis. *Perspectives on Psychological Science, 8,* 363–379. http://dx.doi.org/10.1177/1745691613488533

Barr, A., & Zeitlin, A. (2010). *Dictator games in the lab and in nature: External validity tested and investigated in Ugandan primary schools* (No. 2010–11). Oxford, United Kingdom: Centre for the Study of African Economies, University of Oxford.

Beadle, J. N., Sheehan, A. H., Dahlben, B., & Gutchess, A. H. (2015). Aging, empathy, and prosociality. *Journals of Gerontology Series B, Psychological Sciences and Social Sciences, 70,* 215–224. http://dx.doi.org/10.1093/geronb/gbt091

Bellemare, C., Kröger, S., & Van Soest, A. (2008). Measuring inequity aversion in a heterogeneous population using experimental decisions and subjective probabilities. *Econometrica, 76,* 815–839. http://dx.doi.org/10.1111/j.1468-0262.2008.00860.x

Bem, D. J., & Lord, C. G. (1979). Template matching: A proposal for probing the ecological validity of experimental settings in social psychology. *Journal of Personality and Social Psychology, 37,* 833–846. http://dx.doi.org/10.1037/0022-3514.37.6.833

Benz, M., & Meier, S. (2008). Do people behave in experiments as in the field? Evidence from donations. *Experimental Economics, 11,* 268–281. http://dx.doi.org/10.1007/s10683-007-9192-y

Buchan, N. R., Grimalda, G., Wilson, R., Brewer, M., Fatas, E., & Foddy, M. (2009). Globalization and human cooperation. *Proceedings of the National Academy of Sciences of the United States of America, 106,* 4138–4142. http://dx.doi.org/10.1073/pnas.0809522106

Charness, G., & Villeval, M. C. (2009). Cooperation and competition in intergenerational experiments in the field and the laboratory. *American Economic Review, 99,* 956–978. http://dx.doi.org/10.1257/aer.99.3.956

Chasteen, A. L. (2005). Seeing eye-to-eye: Do intergroup biases operate similarly for younger and older adults? *International Journal of Aging & Human Development, 61,* 123–139. http://dx.doi.org/10.2190/07Q7-BWYT-NC9E-51FX

Cheng, S. T., & Yim, Y. K. (2008). Age differences in forgiveness: The role of future time perspective. *Psychology and Aging, 23,* 676–680. http://dx.doi.org/10.1037/0882-7974.23.3.676

Cuddy, A. J., Fiske, S. T., & Glick, P. (2008). Warmth and competence as universal dimensions of social perception: The stereotype content model and the BIAS map. *Advances in Experimental Social Psychology, 40,* 61–149. http://dx.doi.org/10.1016/S0065-2601(07)00002-0

De Cremer, D. (2003). Noneconomic motives predicting cooperation in public good dilemmas: The effect of received respect on contributions. *Social Justice Research, 16,* 367–377. http://dx.doi.org/10.1023/A:1026361632114

Dohmen, T., Falk, A., Golsteyn, B. H., Huffman, D., & Sunde, U. (2017). Risk attitudes across the life course. *Economic Journal, 127,* 95–116. http://dx.doi.org/10.1111/ecoj.12322

Englmaier, F., & Gebhardt, G. (2016). Social dilemmas in the laboratory and in the field. *Journal of Economic Behavior & Organization, 128,* 85–96. http://dx.doi.org/10.1016/j.jebo.2016.03.006

Fehr, E., & Leibbrandt, A. (2011). A field study on cooperativeness and impatience in the tragedy of the commons. *Journal of Public Economics, 95,* 1144–1155. http://dx.doi.org/10.1016/j.jpubeco.2011.05.013

Fiske, S. T., Cuddy, A. J., Peter, G., & Xu, J. (2002). A model of (often mixed) stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of Personality and Social Psychology, 82,* 878–902.

Forsythe, R., Horowitz, J. L., Savin, N. E., & Sefton, M. (1994). Fairness in simple bargaining experiments. *Games and Economic Behavior, 6,* 347–369. http://dx.doi.org/10.1006/game.1994.1021

Franzen, A., & Pointner, S. (2013). The external validity of giving in the dictator game. *Experimental Economics, 16,* 155–169. http://dx.doi.org/10.1007/s10683-012-9337-5

Gallagher, S. K. (1994). Doing their share: Comparing patterns of help given by older and younger adults. *Journal of Marriage and the Family, 56,* 567–578. http://dx.doi.org/10.2307/352868

Gutiérrez-Roig, M., Gracia-Lázaro, C., Perelló, J., Moreno, Y., & Sánchez, A. (2014). Transition from reciprocal cooperation to persistent behaviour in social dilemmas at the end of adolescence. *Nature Communications, 5,* 4362–4369. http://dx.doi.org/10.1038/ncomms5362

Heinz, M., & Schumacher, H. (2017). Signaling cooperation. *European Economic Review, 98,* 199–216. http://dx.doi.org/10.1016/j.euroecorev.2017.06.017

Henrich, J., Chudek, M., & Boyd, R. (2015). The Big Man Mechanism: How prestige fosters cooperation and creates prosocial leaders. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 370,* 20150013. http://dx.doi.org/10.1098/rstb.2015.0013

Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige: Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior, 22,* 165–196. http://dx.doi.org/10.1016/S1090-5138(00)00071-4

Li, T., & Fung, H. H. (2013). Age differences in trust: An investigation across 38 countries. *Journals of Gerontology Series B, Psychological Sciences and Social Sciences, 68,* 347–355. http://dx.doi.org/10.1093/geronb/gbs072

Lim, K. T. K., & Yu, R. (2015). Aging and wisdom: Age-related changes in economic and social decision making. *Frontiers in Aging Neuroscience, 7,* 120. http://dx.doi.org/10.3389/fnagi.2015.00120

Major, R. J., Whelton, W. J., Schimel, J., & Sharpe, D. (2016). Older adults and the fear of death: The protective function of Generativity. *Canadian Journal on Aging/La Revue canadienne du vieillissement, 35,* 261–272.

Matsumoto, Y., Yamagishi, T., Li, Y., & Kiyonari, T. (2016). Prosocial behavior increases with age across five economic games. *PLoS ONE, 11,* e0158671. http://dx.doi.org/10.1371/journal.pone.0158671

Maxfield, M., Greenberg, J., Pyszczynski, T., Weise, D. R., Kosloff, S., Soenke, M., . . . Blatter, J. (2014). Increases in generative concern among older adults following reminders of mortality. *International Journal of Aging & Human Development, 79,* 1–21. http://dx.doi.org/10.2190/AG.79.1.a

Midlarsky, E., & Hannah, M. E. (1989). The generous elderly: Naturalistic studies of donations across the life span. *Psychology and Aging, 4,* 346–351. http://dx.doi.org/10.1037/0882-7974.4.3.346

Mienaltowski, A., & Wichman, A. L. (2020). Older and younger adults' interactions with friends and strangers in an iterated prisoner's dilemma. *Aging, Neuropsychology, and Cognition, 27,* 153–172. http://dx.doi.org/10.1080/13825585.2019.1598537

Molina, J. A., Ferrer, A., Giménez, J. I., Gracia-Lazaro, C., Moreno, Y., & Sanchez, A. (2019). Intergenerational cooperation within the household: A public good game with three generations. *Review of Economics of the Household, 17,* 535–552. http://dx.doi.org/10.1007/s11150-018-9414-4

Peters, H. E., Ünür, A. S., Clark, J., & Schulze, W. D. (2004). Free-riding and the provision of public goods in the family: A laboratory experiment. *International Economic Review, 45,* 283–299. http://dx.doi.org/10.1111/j.1468-2354.2004.00126.x

Peysakhovich, A., Nowak, M. A., & Rand, D. G. (2014). Humans display a 'cooperative phenotype' that is domain general and temporally stable. *Nature Communications, 5,* 4939. http://dx.doi.org/10.1038/ncomms5939

Pletzer, J. L., Balliet, D., Joireman, J., Kuhlman, D. M., Voelpel, S. C., & Van Lange, P. A. (2018). Social value orientation, expectations, and cooperation in social dilemmas: A meta-analysis. *European Journal of Personality, 32,* 62–83. http://dx.doi.org/10.1002/per.2139

Raihani, N. J., & Bshary, R. (2012). A positive effect of flowers rather than eye images in a large-scale, cross-cultural dictator game. *Proceedings Biological Sciences, 279,* 3556–3564. http://dx.doi.org/10.1098/rspb.2012.0758

Richerson, P., Baldini, R., Bell, A. V., Demps, K., Frost, K., Hillis, V., . . . Zefferman, M. (2016). Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences, 39,* e30. http://dx.doi.org/10.1017/S0140525X1400106X

Roalf, D. R., Mitchell, S. H., Harbaugh, W. T., & Janowsky, J. S. (2012). Risk, reward, and economic decision making in aging. *Journals of Gerontology Series B, Psychological Sciences and Social Sciences, 67,* 289–298. http://dx.doi.org/10.1093/geronb/gbr099

Rustagi, D., Engel, S., & Kosfeld, M. (2010). Conditional cooperation and costly monitoring explain success in forest commons management. *Science, 330,* 961–965. http://dx.doi.org/10.1126/science.1193649

Statistics Austria. (2017). *Jährliche personeneinkommen* [Yearly income per capita]. Retrieved from https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/personen-einkommen/jaehrliche_personen_einkommen/index.html

Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology, 1,* 149–178. http://dx.doi.org/10.1002/ejsp.2420010202

Thomae, M., Zeitlyn, D., Griffiths, S. S., & Van Vugt, M. (2013). Intergroup contact and rice allocation via a modified dictator game in rural Cameroon. *Field Methods, 25,* 74–90. http://dx.doi.org/10.1177/1525822X12466981

Tyler, T., & Blader, S. (2013). *Cooperation in groups: Procedural justice, social identity, and behavioral engagement*. New York, NY: Routledge. http://dx.doi.org/10.4324/9780203782842

Van Lange, P. A., Joireman, J., Parks, C. D., & Van Dijk, E. (2013). The psychology of social dilemmas: A review. *Organizational Behavior and Human Decision Processes, 120,* 125–141. http://dx.doi.org/10.1016/j.obhdp.2012.11.003

Van Lange, P. A., & Kuhlman, D. M. (1994). Social value orientations and impressions of partner's honesty and intelligence: A test of the might versus morality effect. *Journal of Personality and Social Psychology, 67,* 126–141. http://dx.doi.org/10.1037/0022-3514.67.1.126

Van Lange, P. A., Otten, W., De Bruin, E. M., & Joireman, J. A. (1997). Development of prosocial, individualistic, and competitive orientations: Theory and preliminary evidence. *Journal of Personality and Social Psychology, 73,* 733–746. http://dx.doi.org/10.1037/0022-3514.73.4.733

Yamagishi, T., Jin, N., & Kiyonari, T. (1999). Bounded generalized reciprocity: Ingroup boasting and ingroup favoritism. *Advances in Group Processes, 16,* 161–197.

Yamagishi, T., & Kiyonari, T. (2000). The group as the container of generalized reciprocity. *Social Psychology Quarterly, 63,* 116–132. http://dx.doi.org/10.2307/2695887

Yamagishi, T., Mifune, N., Li, Y., Shinada, M., Hashimoto, H., Horita, Y., . . . Simunovic, D. (2013). Is behavioral pro-sociality game-specific? Pro-social preference and expectations of pro-sociality. *Organizational Behavior and Human Decision Processes, 120,* 260–271. http://dx.doi.org/10.1016/j.obhdp.2012.06.002

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