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Margoni, F, Geipel, J, Hadjichristidis, C orcid.org/0000-0002-9441-6650 et al. (1 more author) (2021) *Inequity Aversion in Old Age: An Outcome Bias in Older Adults' Socio-Economic Decisions*. *Cognitive Development*, 58. 101016. ISSN 0885-2014

<https://doi.org/10.1016/j.cogdev.2021.101016>

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**Inequity Aversion in Old Age:
An Outcome Bias in Older Adults' Socio-Economic Decisions**

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Article accepted for publication in *Cognitive Development*, 2021-2-4

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We thank Silvia Dada and Francesca Bonazzi for assisting with data collection.

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Abstract

Little is known about how healthy aging affects decision making. Here we studied how the social economic decisions of younger (19–39 years) and older (75–100 years) adults depend on the intentions of agents and the outcomes of their actions. Participants played the role of a responder (R) in an Ultimatum Game. A proposer (P) offered them a specific division of lottery tickets, which they could either accept or reject. Crucially, in each trial they were told that P was constrained to choose between two divisions of lottery tickets, resulting sometimes in an intended unfair offer and others in an unintended unfair offer. In the critical intended unfair offer, P kept 8 tickets and offered 2 to R , but he could have chosen a fair $5P/5R$ split. In the critical unintended unfair offer, P kept 8 tickets and offered 2 to R , but the alternative involved the same $8P/2R$ split. The unintended unfair offer was rejected by most of older adults (67%), but only by a minority of younger adults (28%). In general, older adults were less affected than younger adults by contextual constraints relevant to inferring P 's intentions. These findings suggest that aging brings about an outcome bias in social economic decision making.

Keywords: decision making, older adults, outcome bias, ultimatum game, fairness

Inequity Aversion in Old Age:

An Outcome Bias in Older Adults' Socio-Economic Decisions

Moral judgment depends on a consideration of the agents' intentions as well as the outcomes of their actions (Cushman, 2008; Monroe & Malle, 2017). Evidence suggests that the relative weighting of these two kinds of information is influenced by aging. In comparison to younger adults, older adults (age ≥ 65 years) tend to rely more on outcomes and less on intentions (Margoni et al., 2018, 2019; Moran et al., 2012). Aging has thus been associated with an *intent-to-outcome shift* in third-party moral judgment. Studies have suggested that older adults' cognitive decline in theory of mind abilities is associated with such an intent-to-outcome shift or outcome bias in moral judgment (Margoni et al., 2018, 2019). Here we investigated whether this shift extends to second-party social economic decisions.

Investigating the presence of an outcome bias in social economic decisions in old age is important, as it can have far-reaching implications for older adults' social interactions and financial choices. This, in turn, may influence their psychological and financial well-being. Furthermore, the previously documented age-related outcome bias in third-party moral judgments could be partially explained by age-related differences in motivational factors to engage with the task (Strough et al., 2015). Research has shown that cognitive limitations in older adults have a negative impact on judgment and decision making, especially for tasks of low self-relevance (Bruine de Bruin et al., 2015; Hess & Queen, 2014). Therefore, it is important to examine whether the intent-to-outcome shift extends to social decisions in which participants are personally involved.

The aim of the present study is to investigate the extent to which older adults (75–100 years) rely on others' intentions when deciding whether to accept or reject unfair offers in an Ultimatum Game, as compared to younger adults (19–39 years). In this game, participants

assigned to the role of responder (R) are asked to decide whether to accept or reject an offer received by a proposer (P). For instance, P may propose an equitable division of a sum of money, say 5\$ for P and 5\$ for R . If R accepts, the money is divided as proposed by P . If R rejects, no one is paid. When taking the role of R , people tend to accept fair offers but reject unfair ones, such as 2\$ for R and 8\$ for P , about half the time (Camerer, 2003; Güth & Kocher, 2014; Sanfey, 2007). Thus, the Ultimatum Game can help assess the propensity to engage in acts of costly punishment motivated by aversion to inequity (i.e. R loses 2\$ to punish P ; Fehr & Fishbacher, 2003).

Aging research using the Ultimatum Game has reported that, compared to younger adults, older adults divide money more generously, expect more fair offers and sometimes accept fewer unfair offers (Bailey et al., 2013; Beadle et al., 2012; Harlé & Sanfey, 2012; Roalf et al., 2012; but see Girardi et al., 2018, for a study reporting that older adults accept more unfair offers). However, prior research does not clarify whether older adults' decision to reject unfair offers is based on the outcome of P 's behavior or on P 's intentions.

Here, we address this question by employing a modified Ultimatum Game, which we call *Intent-Ultimatum Game* (see Falk et al., 2003). In this modified version, participants play the role of R and are told that P chose a particular division of resources but could have instead chosen another division. In this way, we varied the information about P 's intention while keeping the outcome constant. Two cases are critical to illustrate this point. If P proposes an unfair offer $8P/2R$ (8\$ for P and 2\$ for R) but could have proposed a fair offer $5P/5R$ (5\$ for each), participants can infer that P 's offer was intended. By contrast, if P proposes an unfair offer ($8P/2R$) but the only other alternative was the same unfair offer ($8P/2R$), participants will likely infer that P 's offer does not signal a bad intention. Consistently, children and adults tend to reject

the intended unfair offer in a ($8P/2R-5P/5R$) trial but tend to accept the unintended unfair offer in a ($8P/2R-8P/2R$) trial (Falk et al., 2003; Jaroslawska et al., 2020; Radke et al., 2012).

To investigate whether older adults engage in acts of costly punishment by relying more on the outcomes of *Ps*' actions compared to younger adults, we examined how younger and older adults respond to intended and unintended unfair offers in the Intent-Ultimatum Game described above. The difference in rejection rates between these offers provides a measure of participants' reliance on intention: the smaller the difference, the greater the tendency to neglect intentions and to rely on the inequity of the outcomes. If older adults rely more on outcome inequity and less on intentions, then the difference in rejection rates between intended and unintended unfair offers will be relatively smaller for them than for younger adults.

We further tested whether a possible age-related difference in responding to unintended unfair offers would be associated with age-related changes in inhibitory control and theory of mind abilities (Cho & Cohen, 2019; Henry et al., 2013). Research on moral judgment has linked age-related differences in the ability to consider intentions with the acquisition and later decline of both theory of mind and inhibitory control (Buon et al., 2016; Margoni & Surian, 2020; Margoni et al., 2018). The capacity to 'read' others' actions in mentalistic terms, as well as the ability to inhibit a prepotent response elicited by the unfairness of the outcome and select a less salient intent-based response, may thus account for age-related differences in the Intent-Ultimatum Game.

Methods

The data and Supplementary Material are available on the [Open Science Framework](#).

Participants

We determined the required sample size by an a-priori power analysis using G*Power (Faul et al., 2007) for a χ^2 test. To detect a large effect size of $w = 0.50$ (based on Margoni et al.,

2018) with α set at .006 (adjusted for 8 comparisons) and a power of .80, a minimum sample size of 52 participants was required. We recruited a larger sample size of 80 participants as a safeguard measure to protect against smaller true underlying effects (Perugini et al., 2014). Specifically, we recruited 40 older adults (30 female, age range: 75–100, $M_{Age} = 86.6$ years, $SD_{Age} = 6.55$) and 40 younger adults (25 female, age range: 19–39, $M_{Age} = 24.4$ years, $SD_{Age} = 5.21$). However, the analyses are based on 78 participants (39 older and 39 younger adults), due to the exclusion of two participants who failed a practice trial (see Results). The demographic characteristics of the two groups are presented in Table 1.

Table 1*Sample Demographic Characteristics by Age Group.*

	Young Adults ($n = 39$)		Old Adults ($n = 39$)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (years)	24.41	5.27	86.60	6.64
Gender (% female)	61.5		76.9	
Education (years)	14.00	1.89	7.08	3.37
MMSE	-	-	27.70	1.76

Note. MMSE = Mini-Mental Status Examination.

Although the sample size calculation was based on χ^2 -tests, below we report the results of mixed-effect logistic regression models, which are better suited to analyze the present data. Please note that the originally planned χ^2 test analyses yield similar results (see Supplementary Results).

As a screening tool for dementia, we employed the Mini-Mental Status Examination (MMSE; Folstein et al., 1975; score range between 0–30). All older participants scored between

24 and 30 (see Table 1), indicating no impairment. MMSE scores were negatively correlated with age, although not significantly, $r(37) = -.26, p = .111$. Older participants were recruited through two local residential communities and younger participants through the University of XXX. The research protocol was approved by the Ethics Committee of the University of XXX.

Materials and Procedure

Intent-Ultimatum Game

Participants were presented with six Intent-Ultimatum Game trials. In each trial, participants played the role of the responder (*R*) and were presented an offer by a proposer (*P*) which consisted in a certain division of 10 lottery tickets for a final prize of 50 euros. If participants accepted the offer, they and *P* received the specified amount of lottery tickets. If participants rejected the offer, both they and *P* received nothing. Critically, participants were told that *P* was constrained to choose one of two offers (see the Supplementary Material for additional procedural details).

Participants received one sheet for each trial with *P*'s chosen offer alongside the alternative offer, and they had to choose whether to accept or reject it (see Table 2 for the chosen and alternative unchosen offer in each trial). Participants received two intended unfair offers, two unintended unfair offers, and two fair or generous offers. Participants were informed that offers were real and each trial involved a different proposer. Trials were presented in a randomized order. After the game, for each trial participants were asked whether they believed *P*'s choice revealed a specific intention, and to guess *P*'s age and gender. Finally, participants indicated whether they believed that the *Ps* were real or fictitious players.

Before the game, to familiarize participants with the task and assess their understanding, we administered two practice trials. In the first practice trial, *P* offered one cake and one

breadstick to both *P* and *R* (fair option), and the alternative offer was two cakes for *P* and two breadsticks for *R* (unfair option). In the second trial, the options were the same but *P* chose the unfair option. Participants had to indicate whether they would have accepted or rejected each offer, and to answer the comprehension probe: “Does anyone receive anything if you reject the offer?”. All participants responded correctly to this comprehension probe.

Table 2

All Six Trials of the Intent-Ultimatum Game.

	Chosen Offer		Unchosen Offer	
	<i>P</i> gets	<i>R</i> gets	<i>P</i> gets	<i>R</i> gets
Intended Unfair Offers	8	2	5	5
	8	2	2	8
Unintended Unfair Offers	8	2	8	2
	8	2	9	1
Intended Fair or Generous Offers	5	5	8	2
	2	8	8	2

Note. *P* indicates the player that proposed the offer, *R* the responder (i.e. the participant). If *R* rejects the offer, both *P* and *R* receive nothing.

Executive Functioning Skills

A shortened version of the Stroop Color Word Test interference (Stroop, 1935) was administered to measure individual differences in executive functioning such as inhibitory control and selective attention abilities (Carruffa et al., 2002). Scores are expressed in terms of time delay due to interference.

Mentalistic Reasoning Skills

Participants were administered the Strange Stories task (Happé, 1994; Lecce et al., 2019). They received four stories which tap their ability to understand situations involving double bluff,

persuasion, misunderstanding and sarcasm (see Supplementary Material). In each story, the character says something that it is not literally true and participants have to indicate why. Following Happé's (1994) original scoring scheme, we rated responses on a three-point scale (0 for an incorrect response, 1 for a response that only partially referred to mental states, and 2 for a response that fully referred to mental states).

Results

Prior to data analyses, we excluded two participants (one older and one younger) because they rejected the clearly *fair and intended* practice trial offer, revealing a lack of understanding of the task (i.e. that if the offer is rejected, both players will receive nothing). Thus, the results presented below are based on the remaining 78 participants (older adults: 75–100 years; younger adults: 19–39; see Table 1).

Preliminary Analyses: Age and Education

On average, older participants had fewer years of school education than younger participants (see Table 1), $U = 966.50$, $p < .001$, $d_{\text{Cohen}} = 0.89$. To assess whether education influenced responses to the critical intended unfair offer in the (8P/2R–5P/5R) trial and the critical unintended unfair offer in the (8P/2R–8P/2R) trial, we conducted four logistic regression analyses, two for each age group, one for the intended unfair and one for the unintended unfair offer. Education did not significantly predict participants' responses to both trials for either group (younger participants: intended unfair offer, $OR = 1.36$, $z = 1.52$, $p = .130$, unintended unfair offer, $OR = 1.28$, $z = 1.31$, $p = .192$; older participants: intended unfair offer, $OR = 0.82$, $z = -1.45$, $p = .146$, unintended unfair offer, $OR = 0.90$, $z = -1.01$, $p = .312$).

Lastly, most participants believed that *Ps* were real players (only 10% of the older participants, and 28% of the younger participants indicated that one or more players were

fictitious). Crucially, the response to this question did not significantly affect participants' rate of rejection of the intended unfair offer in the $(8P/2R-5P/5R)$ trial, $OR = 0.62$, $z = -0.67$, $p = .504$, or the unintended unfair offer in the $(8P/2R-8P/2R)$ trial, $OR = 0.75$, $z = -0.51$, $p = .611$.

Age Differences in the Intent-Ultimatum Game

Frequency of Offer Rejection

Figure 1 displays participants' average rejection rate of the three main types of offer: intended unfair, unintended unfair, intended fair or generous. The intended unfair offers involved the $(8P/2R-5P/5R)$ and $(8P/2R-2P/8R)$ trials. In the former trial, where P proposed a selfish $8P/2R$ split but could have offered instead an equitable $5P/5R$ split, 87% of the older adults rejected the offer, whereas only 59% of the younger adults did so. In the latter trial, where P proposed a $8P/2R$ split but could have instead offered a $2P/8R$ split in R 's favor, 87% of older adults rejected the offer, whereas only 49% of the younger adults did so.

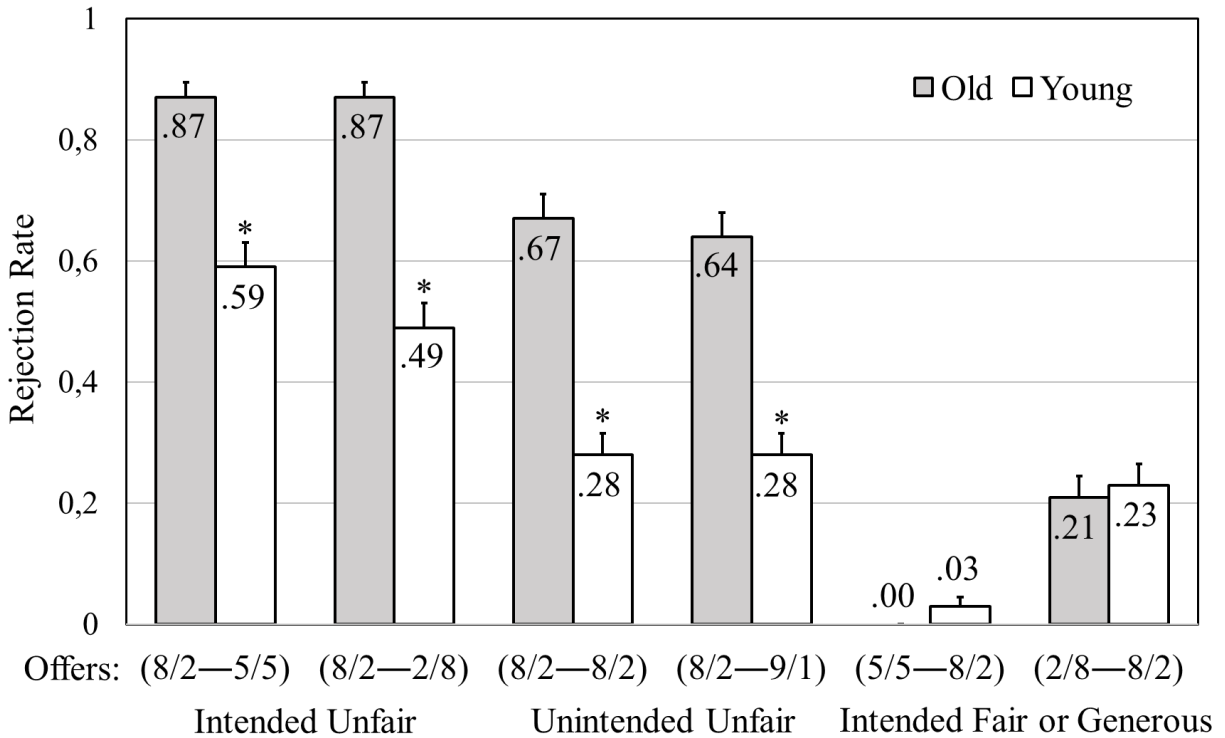
The unintended unfair offers involved the $(8P/2R-8P/2R)$ and $(8P/2R-9P/1R)$ trials. Here, when P was forced to offer $8P/2R$ ($8P/2R-8P/2R$), 67% of the older adults rejected the offer while only 28% of the younger adults did so. When P proposed a $8P/2R$ split instead of a $9P/1R$ split, which would be even more disadvantageous for R , 64% of older adults rejected the offer, whereas only 28% of the younger adults did so.

Lastly, a fair and a generous offer were proposed in the $(5P/5R-8P/2R)$ and $(2P/8R-8P/2R)$ trials, respectively. None of the older participants and only one younger participant rejected the $5P/5R$ fair split, but, unexpectedly, 21% of older participants and 23% of younger participants rejected the generous $2P/8R$ offer. The reason why several participants rejected the generous offer might be due to the counterintuitive nature of the trial; it is the only trial where P

would receive less than R . Participants may have rejected this offer out of kindness, without thinking about the negative consequences of their decision for both R and P .

Figure 1

Rejection Rate as a Function of Age Group and Type of Offer



Note. Error bars show the magnitude of the standard error of the proportion, and an asterisk denotes a significant difference between adjacent columns, $p < .006$.

We analyzed participants’ choices with a mixed-effect logistic regression model using age group (0 = younger, 1 = older) and offer type (1 to 6) as fixed effects accounting for the random intercept of participants. This analysis revealed a significant main effect of offer type, $\chi^2(5) = 50.62, p < .001$, but no main effect of age group, $\chi^2(1) < 1.00, p = .973$. Crucially, there was a significant Age group \times Offer type interaction, $\chi^2(5) = 11.96, p = .035$.

Next, to better qualify the age group differences, we conducted eight post hoc comparisons (p values were adjusted for multiple comparisons using the Bonferroni method). We found a significant difference between younger adults' and older adults' rejection rates in the intended unfair trials ($8P/2R-5P/5R$: $OR = 8.58$, $z = 2.73$, $p = .048$; $8P/2R-2P/8R$: $OR = 15.85$, $z = 3.48$, $p = .004$), and the unintended unfair trials ($8P/2R-8P/2R$: $OR = 10.62$, $z = 3.32$, $p = .007$; $8P/2R-9P/1R$: $OR = 9.01$, $z = 3.11$, $p = .016$). No significant age difference was found for the intended fair offers ($5P/5R-8P/2R$: $p = 1.00$; $2P/8R-8P/2R$: $OR = 0.79$, $z = -0.31$, $p = 1.00$).

Thus, first, older participants showed a greater aversion to inequity compared to younger participants, as revealed by their higher rejection rate of both intended and unintended unfair offers. In the trials where P intentionally offered an unfair offer, about half of the younger adults responded 'rationally', preferring to accept the offer than get nothing. Alternatively, this could be because they reasoned that it is understandable that P wanted to keep the larger share for themselves. By contrast, most older participants made the costly decision to reject the offer, likely because they focused on its unfairness. Second, responses to unintended unfair offers suggest that whereas younger adults appear to have considered that P did not have a valid alternative, older adults continued to rely on outcome inequity. Third, responses to fair and generous offers indicate that participants understood the task. Indeed, we found low rejection rates in both age groups.

Age Differences in Weighing Intentions and Outcomes

To assess whether older adults relied more on outcomes than intentions compared to younger adults, we conducted two additional post hoc comparisons. We focused on the two critical trials of intended and unintended unfair offers: the ($8P/2R-5P/5R$) and ($8P/2R-8P/2R$) trials. We did not focus on the remaining intended unfair trial ($8P/2R-2P/8R$) because the

alternative is not a fair split but a split that favors *R*, therefore some participants may have accepted the offer thinking it was unrealistic to expect a sacrifice from *P* for the benefit of *R*. Furthermore, we did not focus on the remaining unintended unfair trial ($8P/2R-9P/1R$) as the alternative here was even more disadvantageous for *R*: Although the $8P/2R$ offer was unintentionally unfair, it was chosen generously (and, thus, intentionally), as *P* could have chosen an even worse offer for *R*. For these reasons, in order to assess whether age influences the weight given to intentions and outcomes we focused on the ($8P/2R-5P/5R$) and ($8P/2R-8P/2R$) trials. As predicted, for younger participants we found a significant difference between these two trials, $OR = 6.63$, $z = 3.16$, $p = .016$, but for older participants we did not, $OR = 5.36$, $z = 2.41$, $p = .128$. However, we note that the effect is small: for younger adults the difference in percentage units between the two trials is 31 (59% minus 28%), whereas for older adults is 20 (87% minus 67%), resulting in an overall difference of 11 percentage points (31 minus 20).

Explicit Attribution of Intentionality

Whereas the great majority of younger and older participants attributed intentionality to *P*'s behavior in the ($8P/2R-5P/5R$) trial (87% and 92% respectively), only about half of them attributed intentionality to *P*'s behavior in the ($8P/2R-8P/2R$) trial (51% and 61% respectively). We analyzed intentionality attribution by conducting a mixed-effect logistic regression model with age group (0 = younger, 1 = older) and offer type (1 to 6) as fixed factors accounting for the random intercept of participants. We found a significant main effect of offer, $\chi^2(5) = 59.97$, $p < .001$, but no main effect of age $\chi^2(1) = 2.14$, $p = .144$. There was a significant Offer \times Age group interaction, $\chi^2(5) = 13.75$, $p = .017$. In the post-hoc comparisons, we once again focused on the two critical trials ($8P/2R-5P/5R$ and $8P/2R-8P/2R$), but additional results on intentionality attribution can be found in Supplementary Results. First, we did not find any group difference in

the tendency to attribute intentionality in the (8P/2R 5P/5R) or (8P/2R 8P/2R) trial, $OR \leq 1.75$, $z \leq 0.82$, $ps = 1.00$. Second, analyses revealed a significant difference between the (8P/2R 5P/5R) and (8P/2R 8P/2R) trials for both younger participants, $OR = 7.04$, $z = 3.31$, $p = .007$, and older participants, $OR = 8.23$, $z = 3.01$, $p = .021$ (p -values adjusted with the Bonferroni correction). These results suggest that the age differences found in the critical trials in the Intent-Ultimatum game cannot be explained by differences in explicit attributions of intentionality alone, but to a change in the relative weight given to intentions and outcomes.

Correlations Between Age Group, Rejection of the Unintended Unfair Offer, Executive Function, and Theory of Mind

Table 3 shows Spearman’s rank correlations between age group (0 = young, 1 = old), rejection of the unintended unfair (8P/2R–8P/2R) offer, executive functioning skills (standardized z scores) and theory of mind skills (higher scores on each test are associated with better skills). As predicted, age was positively correlated with rejection of the unintended unfair offer, but negatively correlated with executive functioning and theory of mind. Rejection of the unintended unfair offer was negatively correlated with executive functioning and theory of mind.

Table 3
Correlations Between Age Group, Rejection of the Unintended Unfair (8P/2R–8P/2R) Offer, Executive Functioning, and Theory of Mind.

	1	2	3	4
1. Age group	--			
2. Rejection of (8P/2R–8P/2R) offer	.39**	--		
3. Executive functioning	-.86**	-.43**	--	
4. Theory of Mind	-.66**	-.25*	.67**	--

Note. Age group: 0 = young, 1 = old. * $p \leq .050$, ** $p \leq .001$.

Relationship Between Age Group, Rejection of the Unintended Unfair Offer, Executive Function, and Theory of Mind

We assessed whether age group differences in inhibitory control and theory of mind skills contribute to age group differences in the tendency to reject the unintended unfair (8P/2R–8P/2R) offer. We used 10,000 bootstrapping resamples (Preacher & Hayes, 2004). The outcome variable was rejection of the unintended unfair (8P/2R–8P/2R) offer, age group (0 = young, 1 = old) was the independent variable, and executive function and theory of mind were entered as mediators. The unstandardized regression coefficient between age group and executive functioning was significant, $b = -1.17$, $p < .001$, 95% CI [-1.39, -0.96], as was the one between age group and theory of mind, $b = -2.90$, $p < .001$, 95% CI [-3.67, -2.13]. However, the unstandardized regression coefficient between either of these mediators and the rejection of unintended unfair offer was not significant (executive functioning: $b = -0.46$, $p = .449$, 95% CI [-1.65, 0.73]; theory of mind: $b = 0.001$, $p = .996$, 95% CI [-0.31, 0.31]). The bootstrapped unstandardized indirect total effect was $b = 0.54$, 95% CI [-1.27, 3.79] (executive functioning: $b = 0.54$, 95% CI [-1.06, 4.24]; theory of mind: $b = -0.002$, 95% CI [-1.07, 0.95]). The 95 % CIs of the indirect effect coefficient b included 0, indicating no statistically significant mediation.

Discussion

We investigated age-related differences in aversion to inequity. Using the Intent-Based Ultimatum Game, we examined whether younger and older adults differ in their reliance on outcome-inequity and intentions when deciding whether to take a costly action to reduce a proposer's payoff. Overall, compared to younger adults, older adults showed a greater aversion to inequity, and their decisions relied more heavily on outcomes. Indeed, 67% of the older adults rejected unintended unfair offers, whereas only 28% of the younger adults did so. Younger adults

rejected reliably more often intended unfair than unintended unfair offers, whereas intention did not have a significant effect on older adults' rejections. Both younger and older adults attributed greater intentionality to proposers that intentionally offered an unfair division than those that unintentionally offered an unfair division. Further analyses showed that inhibitory control and theory of mind skills negatively correlated with the tendency to rely on outcomes when deciding whether to punish the proposer of an unintended unfair split. However, these skills did not mediate the relationship between age and outcome-based decision.

The current finding that older adults rely less on intentions or more on outcomes when deciding whether to engage in acts of costly punishment extends prior work on the moral evaluation of hypothetical events from a third-party perspective (Margoni et al., 2018, 2019; Moran et al., 2012). The present results add that an intent-to-outcome shift may affect not only older adults' moral judgment but also their daily social interactions and activities, especially complex ones such as those involving social economic decisions (Bonsang & Costa-Font, 2019). Furthermore, the current findings suggest that this shift in judgment and decision making is unlikely to be driven by motivational factors (Hess & Queen, 2014), as participants in our study were personally involved. Unlike previous studies wherein participants judged hypothetical actions that did not directly involve them, here they were asked to make decisions that would directly affect them financially. However, whereas we found clear evidence that older adults rejected more unintended unfair offers, the effect of age on the difference between rejection rates in intended and unintended unfair offer trials was smaller than predicted. Further research is needed to accurately estimate and evaluate the extent of this difference.

Our results on intentionality attribution excludes the possibility that older adults were rejecting unintended unfair offers because they were attributing a negative intention to those who

proposed unfair outcomes. Indeed, we found no age differences in how participants attributed intentionality to the critical unintended unfair and intended unfair offers. We also examined whether other factors, such as theory of mind or executive functioning skills, contribute to explaining the outcome bias in responding to unintended unfair offers. Although we found that old adulthood is associated with a decline in both types of skills, these skills did not mediate the relationship between age group and the tendency to reject the unintended unfair offer in the critical ($8P/2R-8P/2R$) trial. It is possible that when these skills decline with aging beyond a certain threshold, they lead to outcome-based decisions irrespective of the precise magnitude of the decline. Future research could investigate this, as well as whether the present effect has an emotional basis (see McNair et al., 2018). For instance, a possibility is that older adults exhibit more negative affective reactions to outcome-inequity compared to younger adults, which may bias their decision making (Hess et al., 2015).

The current study employed a cross-sectional design rather than a longitudinal one. Therefore, the reported age differences might reflect a cohort effect. It is possible that people born in the '20s and '30s have always been less sensitive to intentions compared to people born in the '80s and '90s. One factor for such an effect might be education. People that have more years of education might also be better in taking others' mental states into consideration as it is more cognitively demanding to consider intentions than to focus on outcomes (see Buon et al., 2013). Although our older participants had fewer years of education, we found that education did not influence their rejection rates of the critical trials. Hence, it seems unlikely that such a factor drives the age group effect. However, research on the intent-to-outcome shift in old age is still in its infancy, and future studies, ideally including longitudinal ones, will be important in settling the issue. Although our study investigated older adults born between 1920 and 1945, our results

potentially have applied significance as 9.3% of the world's population in 2020 (and an estimated 16% in 2050) are aged 65 years or over (United Nations Department of Economic and Social Affairs, 2020), and some of them hold influential positions in the law and political arenas.

In conclusion, we showed that, compared to younger adults, older adults engage more often in acts of costly punishment on the basis of outcome inequity rather than on the basis of the agent's likely intentions which could have been inferred from contextual constraints. These results extend prior work on third-party moral judgment by showing that the intention-to-outcome shift generalizes to social economic decision making.

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