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Age Differences in Prosocial Behavior Depend on Effort Costs

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Abstract

Objectives: This study examined age differences in willingness to engage in effortful and effortless prosocial behavior for a fully anonymous recipient.

Method: Participants were recruited through the Prolific online recruitment platform. In Experiment 1, older (N=46) and younger (N=65) adults completed the 'Pay-It-Forward' effortful decision-making task with fixed effort demands and a version of the Dictator Game, an effortless prosocial decision-making task. In Experiment 2, older (N=38) and younger (N=42) adults completed the Dictator Game and a modified Pay-It-Forward decision-making task in which effort demands were calibrated to one's ability.

Results: In both Experiments 1 and 2, older adults were more prosocial than younger adults on the effortless Dictator Game. In Experiment 1, older adults were less prosocial across all trials of the effortful Pay-It-Forward task. However, when the task was more achievable in Experiment 2, older adults were only less prosocial when the probability of a reward was low.

Discussion: In everyday life, many prosocial contexts depend on effort expenditure. When prosocial activities are effortful, older adults are less willing to engage in prosocial behavior, particularly when reward likelihood is low, and instead focus on resource conservation. In the absence of such effort costs, older adults are more prosocial than younger adults. This work suggests that older adults may prefer to engage in prosocial behavior more than younger adults, but physical resource constraints may limit their ability to engage in such effortful prosocial activities.

Keywords: Aging; Prosocial behavior; Altruism; Effort; Decision-making

"Those who are happiest are those who do the most for others." ― Booker T. Washington

Research shows that there are numerous benefits to helping others, including promoting a sense of belonging, well-being, and fulfillment (Klein, 2017). These 'prosocial acts' are critical for maintaining harmonious social dynamics, economic success, and enhancing the well-being of society as a whole (Kosse & Tincani, 2020; Fehr & Fischbacher, 2003). Despite these benefits, there are substantial individual and situational differences in willingness to help others. Prosocial behavior can be defined as voluntarily performing actions that are meant to benefit people other than oneself (Batson & Powell, 2003). One individual difference factor that has been suggested to influence prosocial behavior is age. Older adults tend to engage in prosocial behavior and show increased concern for others more than younger adults (Cutler, Nitschke, Lamm, & Lockwood, 2021; Sparrow et al., 2021; Mayr & Freund, 2020). However, not all studies report a positive association between age and prosocial behavior (Rieger & Mata, 2015; Roalf et al., 2011). Mixed findings could be due to several factors including the nature of the beneficiary, and whether they are perceived as a close or distant other (Cutler et al., 2021). Another crucial factor is the type of costs incurred. Many prosocial acts are effortful, yet most studies of prosocial behavior manipulate financial costs (Mayr & Freund, 2020). Given that older adults in general have higher wealth than younger adults, prosociality could be confounded with wealth (Mayr & Freund, 2020). Thus, there is a pressing need to investigate how effortful prosocial decisions change across the lifespan and to compare them with costs that are purely financial. The present study compares older and younger adults' effortful and effortless prosocial decisions and behavior for an anonymous beneficiary.

Age-related changes in motivational orientation, physical resources, and cognitive reserve may contribute to a heightened concern for others across the lifespan (Mayr & Freund, 2020). Socioemotional selectivity theory proposes that people value socioemotional goals over

goals that emphasize knowledge and material acquisition with age (Carstensen, Fung, & Charles, 2003; Carstensen, Isaacowitz, & Charles, 1999). This goal shift is due to changes in time perception salience: older adults perceive the time they have as more limited compared to younger adults (Carstensen et al., 1999). As one's time horizon shrinks, emotionally meaningful activities increase in perceived value (Carstensen, 2006).

Converging evidence from various economic and moral decision-making paradigms, self-report data, and charitable giving reports have demonstrated that altruistic prosocial behavior increases with advancing age (e.g., Cutler et al., 2021; Engel, 2011; Matsumoto et al., 2016; Mayr & Freund, 2020; Midlarsky & Hannah, 1989; Sparrow et al., 2021; Sze et al., 2012). However, some studies do not find such age differences (Bailey et al., 2020; Best & Freund, 2021; Rieger & Mata, 2015; Roalf et al., 2011). More specifically, older adults donate more to charity in both laboratory (Sze et al., 2012) and naturalistic settings (Midlarsky & Hannah, 1989) and dedicate more time to volunteering activities of their choice (Chi et al., 2021). Age differences in economic decision-making tasks have primarily focused on the Dictator Game (Bailey, Ruffman, & Rendell, 2013; Beadle et al., 2015; Rosi, Nola, Lecce, & Cavallini, 2019) and altruistic delay discounting tasks (Sparrow & Spaniol, 2018). In these financial decision-making tasks, older adults allocate more money to beneficiaries—charities and strangers—than younger adults. However, some experimental studies have not observed such age differences in helping behavior that requires donating their time to help others (Bailey et al., 2020; Best & Freund, 2021). It is possible that older adults may not feel any more motivated to engage in non-monetary prosocial behavior than younger adults; alternatively, older adults may choose to engage in non-monetary prosociality when they feel strongly connected to the cause. Indeed, engaging in prosocial behavior may be more emotionally fulfilling to older than younger adults

because they fulfill socioemotional goals (Bjalkebring et al., 2016). When the prosocial task does not support one's socioemotional goals, older adults may not be particularly inclined to engage in it. This evidence derives from prosocial behavior data in which the costs to oneself are primarily financial, time, or moral costs, rather than effort-based costs. However, many prosocial contexts depend on willingness to expend effort for the sole benefit of another, such as giving up one's seat on the subway, walking a lost stranger to their desired location, or helping a stranger change a flat tire. Despite the prevalence of these prosocial contexts, few studies have empirically assessed age-related changes in effortful prosocial behavior. Moreover, not all studies find a positive association between age and prosocial behavior (Rieger & Mata, 2015; Roalf et al., 2011).

While prosocial behavior may increase across the lifespan, willingness to engage in effortful behavior for rewards declines with age (Byrne & Ghaiumy Anaraky, 2020; Hess & Ennis, 2012). The Selection, Optimization, and Compensation (SOC) model of lifespan development explains that this age-related change may be due to a decline in physical and cognitive resources (Baltes, 1997; Baltes & Baltes, 1990). These resource limitations lead to a motivational reorientation away from growth and acquiring new resources towards a focus on maintaining or preventing the loss of one's available resources (Carpentieri et al., 2017; Ebner, Freund, & Baltes, 2006; Freund & Ebner, 2005). . The perceived benefits of an action must be worth the cost, and the type of costs (financial versus effort) and benefits (financial versus socioemotional) may be valued differently across the lifespan. It is therefore possible that age-related decreases in effort expenditure may be localized to benefits for oneself instead of another person (Soutschek, Bahaini, Hare, & Tobler, 2022).

To our knowledge, only one study has empirically examined age-related differences in prosocial behavior that involved effort costs (Lockwood et al., 2021). This prior study compared older and younger adults' willingness to exert physical effort for rewards that either benefitted oneself or another future participant. Physical effort was operationalized as percentage of one's maximum hand grip force, and the reward magnitude and probability of receiving a reward for oneself or another person varied on each trial. The study showed that older adults were more willing to exert physical effort for another person compared to younger adults (Lockwood et al., 2021). Consistent with these results, other work has shown that older adults are more willing to engage in incentivized exercise than younger adults when the incentive benefitted charity (Raposo et al., 2021).

A second crucial factor is the perception of the beneficiary. Older adults are more prosocial but perhaps only to those they perceive to be similar to themselves, rather than those they perceive to be different or far away. For example, older adults give away more money when the beneficiary is described as having positive psychological or physical features (Rosi et al., 2019). Furthermore, older adults tend to donate more money to local charities than international charities, suggesting that older adults' prosocial behavior are strongly influenced by in-group preferences (Cutler et al., 2021). Knowing that the beneficiary has positive qualities, is disadvantaged, or is perceived to 'one of their own' may increase sense of connectedness and meaning.

It is therefore possible that age-related differences in effortful prosocial behavior may depend on whether the beneficiary or qualities about them is known or not. Older adults may be willing to expend effort for others when the socioemotional relevance is clear, but not when the beneficiary is fully anonymous. When the context is relevant to older adults' socioemotional

goals, they are more willing to engage in effortful prosocial behavior than younger adults. However, we propose that in contexts in which the socioemotional relevance of the prosocial effort cost is ambiguous, such as in the case of a fully anonymous beneficiary, older adults may be less willing to expend effort. Consistent with the SOC model, in such contexts, older adults may instead focus on conserving their resources.

The objective of the present study is to examine age-related differences in effortful and effortless prosocial behavior towards a fully anonymous beneficiary. To assess effortful prosocial behavior, we employed the 'pay-it-forward' effortful decision-making task in which participants repeatedly choose between a low-effort, low-reward option and high-effort, high-reward option (Fang et al., 2017). On each trial of the task, the rewards either benefit the participant themselves or an anonymous future participant; no other information is given about the beneficiary. Because of potential physical resource limitations, we predicted that older adults may be less willing to engage in effortful prosocial behavior than younger adults. To examine whether this hypothesis was specific to effortful contexts only, we further examined age differences in prosocial behavior in effortless conditions using a version of the Dictator Game. Additionally, both the effortful and effortless tasks vary in reward value and probability. This design allows for exploring whether such motivational factors moderate the influence of age on prosocial behavior. Based on past research examining age differences in prosocial behavior (Sparrow et al., 2021), we expected that older adults may be more prosocial to a fully anonymous stranger in the absence of effort costs.

Experiment 1

Method

Participants

The study was approved by the university Institutional Review Board before procedures were implemented. Forty-six older adults (M_{age} = 69.57; range = 65 – 77; 56.5% female) and 65 younger adults (M_{age} = 27.43; range = 20 – 34; 55.4% female) completed the study on Prolific, an online participant pool. Table 1 in the Supplementary Materials shows additional demographic information.

Measures

Demographics. Self-report demographics information included age, gender, race, and income level.

"Pay-It-Forward" Effortful Decision-Making Task. The "pay-it-forward" effort-based decision-making (Fang et al., 2017) was modeled after the Effort Expenditure for Rewards Task (EEfRT; Treadway et al., 2009), a physical effort task that entails choosing between a high-effort, high-reward option and a low-effort, low-reward option. To assess prosocial behavior, the "pay-it-forward" version of the EEfRT includes decisions to exert effort for rewards for oneself compared to another future participant in the study ("pay-it-forward"). On each trial, participants choose between completing an easy, low-effort task or hard, high-effort task to try to earn a reward (Figure 1A). On the pay-it-forward trials, participants needed to decide whether to exert a low-effort (easy task) or high-effort (hard task) when there is no benefit for oneself, and only a potential benefit for another unknown future participant.

At the beginning of the task, participants were informed that they were among the first people to complete the task as the study was newly launched. Participants were told in advance that one of the trials for themselves would be randomly selected at the end of the task, and they would receive that amount as a bonus. Similarly, a trial for the benefit of another future participant would be randomly selected and given to another future participant on the subsequent day.

The task entailed 40 total trials. Half of the trials involved decisions in which the potential reward was for the participant's own benefit ("Self" trials), and the other half of the trials entailed decisions about potential rewards for unknown future participant ("Pay-it-forward" trials). Self and Pay-it-forward trials were pseudo-randomly presented to participants. The easy option entails pressing the spacebar 30 times in 7 seconds, and the hard option involves pressing the arrow keys 100 times in 20 seconds (the 50 first presses required the left arrow key, and the second 50 presses required the right arrow key). Easy trials had a 10-second delay before the onset of the subsequent trial to equate the time to complete easy and hard tasks. The easy task always offered a potential reward of $1. The hard task offered potential for a larger amount, ranging from $1.25 - $5.50 on each trial. For both easy and hard tasks, if the task was successfully completed, participants had a 12%, 50%, or 88% chance of earning the reward on that trial. The task took between 18–24 minutes.

Upon completion of the task, one of the participants' successful trials was randomly selected, and participants received that amount as a monetary bonus. Effortful prosocial behavior was operationalized as selection of the hard task over the easy task on each trial, regardless of whether those tasks were successfully completed or not.

Prosocial Effortless Decision-Making Task. The effortless decision-making task was a modified dictator game. Here, rather than exerting effort to obtain rewards, participants simply had to report the proportion of a monetary reward (ranging from $1 - $6) that they would like to keep for themselves versus the proportion that they would like to give to an unknown future participant. For consistency with the 'pay-it-forward' task, the probability of receiving the reward was also manipulated so that it varied between 12%, 50%, and 88% on each trial, and the real monetary bonus given to the participants at the end of the study in addition to their

compensation was randomly selected from one of the participant's trials (Figure 1B). The task took approximately 5 – 7 minutes to complete. Prosocial behavior was operationalized as the amount of monetary reward given to another person divided by the total amount to be allocated on each trial. Higher values indicate a greater prosocial behavior when effort is not required. Values ranging from 0 – 0.49 reflect selfish behavior, a value of 0.50 indicates equal allocation to oneself and the other participant, and values from 0.51 - 1 reflect prosocial behavior (a higher allocation given to the other future participant compared to oneself).

Procedure

After providing digital informed consent, participants completed demographic questionnaires. Then, participants completed the Pay-It-Forward effortful decision-making task or the prosocial effortless decision-making task in a counterbalanced order. Participants were told the estimated time that each task would take in advance but were not told exactly how many trials of each task they would complete. Upon completion of the study, participants were compensated $7 for completing the study and an additional $1–$10 in monetary bonuses based on their performance on both tasks.

Data Analysis

At an alpha-level of .05 and sample size of 111 participants, a post hoc sensitivity power analysis indicated that the study had .80 power to detect a medium effect size *(d*=0.54), based on Cohen's effect size guidelines (Cohen, 1988). To analyze both the pay-it-forward effortful decision-making task and prosocial effortless decision-making task, we conducted a mixed-effect logistic regression model with random intercept (Participant ID) to account for repeated measures and random slope (Trial Number) for participants' fatigue. We first studied the model

with 4-way interactions and compared it against the model with all the 3-way interactions. All the analysis was carried out in R.

Results

People allocate more rewards to themself and are effort averse when effort

A paired samples t-test was performed to assess the proportion of hard task selections for 'self' compared to 'pay-it-forward' trials across the whole sample. Results showed that, on average, participants chose the hard task approximately 10% more on trials in which the potential reward was for oneself (M=0.514, SD=0.297) compared to an unknown future participant (M=0.407, SD=0.306), $t(110)$=-4.574, p<0.001). Moreover, successful task completion rates differed by age; younger adults successfully completed more tasks (M=97.0%, SD=17.6%) than older adults (M=82.0%, SD=38.4%), $t(110)$=16.817, p<0.001.

The average ratio of self-to-other allocations on the effortless prosocial decision-making task was 0.254 (SD=0.228). This result suggests that, on average, participants allocated a greater proportion of money to oneself compared to the other future participant.

Older adults are less willing to exert effort for others benefit than younger adults

We first created a saturated model with all the independent variables of win probability, reward magnitude, reward recipient, age group, and their interaction terms. Then we excluded the 4-way interaction term from the model and compared the two models. These models were not significantly different ($\chi 2(2)$=0.924, p=0.629) suggesting the four-way interaction was not significant. Therefore, we proceeded with the three-way interactions (syntax in the Supplementary Material). We then reduced the model to remove the non-significant three-way interactions and reported the reduced final model in Table 1.

Results revealed a significant Age X Reward Recipient interaction (β=-1.963, p=0.004) such that older adults (M =0.264, SD=0.270) were less likely to choose the hard task than

younger adults (M=0.507, SD=0.292) when the benefit of the potential reward was for another future participant (d=.86).

Results also showed a significant three-way interaction effect between Reward Magnitude X Reward Recipient X Age (β=-0.492, p=0.018, Supplemental Figure 1), suggesting that the effect of reward magnitude on older adults' decisions was stronger on trials that benefitted oneself compared to pay-it-forward trials that benefited another future participant.

In addition, we found a significant additive interaction effect between Probability X Reward Recipient X Age Group such that older adults were more willing to invest effort if they were reward recipient themselves (i.e., Self trials), and the possibility of earning the reward was high (i.e., 88%, see Figure 2A).

Furthermore, probabilities higher than 12% led to an overall higher level of effort expenditure (for 50% and 88%, βs=1.651, 2.724, ps<0.001). However, the two-way interaction between Probability X Age Group suggests that the effect of probability on effort expenditure was weaker for the older adults (for 50% and 88%, βs=-1.101, -1.233, ps<0.001).

In addition, a higher reward magnitude could increase the likelihood of spending more effort (β=1.029, p<0.001). However, the two-way interaction between the Reward Magnitude X Age Group suggests that the predictive effect of Reward Magnitude on effort expenditure was weaker for the older adults (β=-0.688, p<0.004). Lastly, individuals were more likely to expend effort on Self trials than Pay-it-forward trials (β=0.990, p=.024).

Older adults are more willing to choose to allocate effortless rewards to benefit others than younger adults

We first compared the model with Age Group, Reward Magnitude, Probability, and Expected Value to a baseline model with random intercepts. Model comparison results showed that the model with fixed factors and interactions fit the data significantly better than the baseline

model ($\chi^2(7)=105.95$, $p<0.001$). However, the generalized linear mixed effects regression results showed no significant effects of Reward Magnitude ($p=0.136$), Probability ($p=0.369$), or Expected Value ($p=0.563$) or interactions with Age Group ($ps>0.50$). Therefore, we conducted a reduced model with the task motivation factors removed; this reduced model also fit better than the baseline model ($\chi^2(1)=105.81$, $p<0.001$). Age Group significantly predicted effortless prosocial behavior ($\beta=0.194$, $p=0.033$). Older adults ($M=0.299$, $SD=0.185$) had a higher allocation ratio of giving to another future participant compared to younger adults ($M=0.223$, $SD=0.189$), suggesting that older adults were more willing to engage in prosocial behavior than younger adults when effort is not required ($d=.41$, Figure 2B).

Discussion

Experiment 1 showed that older adults were more prosocial than younger adults when the prosocial activity did *not* involve physical effort expenditure. However, when the task did involve effort costs, the opposite finding was true: older adults engaged in *less* prosocial behavior when effort was required. However, some key limitations to the experimental design constrain the conclusions that can be drawn from this experiment. First, due to recruitment difficulties, the older and younger adult sample sizes were unequal. Second, deception was used in the allocation to future participants such that participants did not receive money from prior participants. In online platforms, participants may be particularly suspect of suggestions that other anonymous participants are involved in studies, which may have influenced participants' prosocial decisions.

Additionally, like the original EEfRT (Treadway et al., 2009) and Pay-It-Forward prosocial version of the EEfRT (Fang et al., 2017), all participants were given the same effort levels. However, both of these prior studies relied on a young adult sample. Given that physical capabilities tend to decline with age, it is possible that the tasks were more physically effortful

for older than younger adults. Indeed, successful task completion rates were lower for older than younger adults. Thus, some participants may not have accepted offers as they were perceived to be risky that they would reach the required effort, in addition to the varying probabilities. A post-task survey addressing perceived effort was not included in the experimental design, and thus it is unclear whether age differences in perceived effort may have impacted the findings. Experiment 2 sought to address these points in experimental design by using a calibration procedure for effort expenditure.

Experiment 2

Method

Participants

Sample size estimation for Experiment 2 was based on the effect size from the Age X Reward Recipient interaction from the 'Pay-It-Forward' task in Experiment 1 (d=.86). A priori power analysis results indicated that 45 participants would be needed to have 80% power to detect an effect with an alpha-level = .05. Thus, we sought to recruit at least 45 participants, and set a target of 45 participants in each group to have a sample size comparable to Experiment 1.

Ninety total participants (45 older adults and 45 younger adults) took part in the study through Prolific. Ten were excluded for either not completing all parts of the experiment or failing to respond on any trials of the Pay-It-Forward task. Thus, thirty-eight older adults (M_{age} = 69.71; range = 65 – 82; 71.1% female) and 42 younger adults (M_{age} = 25.07; range = 19 – 30; 52.4% female) fully completed the study. Further demographics are presented in Table 1 in the Supplementary Materials.

Measures

Experiment 2 utilized the same measures as Experiment 1 with the addition of the NASA Task Load Index (NASA-TLX; Hart & Staveland, 1988).

Perceived Workload. The NASA-TLX was used to assess perceived workload of the Pay-It-Forward effortful decision-making task. This six-item questionnaire measures perceived workload using the following domains: physical demand, mental demand, effort, frustration level, performance, and temporal demand (e.g., 'How hurried or rushed did you feel during the task?'). Participants respond using a 1 (*Very Low*) to 7 (*Very High)* scale. Participants indicated their response to the easy and hard task separately; thus, participants responded to 12 total items. Prior research has used the NASA-TLX with older adult samples (e.g., Devos et al., 2020; Hess, Neupert, & Lothary, 2022). Preliminary evidence suggests that the NASA-TLX has strong test-retest reliability within older adults, and convergent validity has also been demonstrated using ERPs as an index of cognitive load (Devos et al., 2020).

Procedure and Data Analysis

Like Experiment 1, in this experiment, participants provided digital informed consent, completed demographics information, and then began the Pay-It-Forward effortful prosocial decision-making task or effortless decision-making task in a counterbalanced fashion. There were four key modifications in Experiment 2. First, before beginning both the Pay-It-Forward and effortless decision-making task, participants were given a $0.50 - $2 bonus; participants were informed that this amount was allocated from a previous participant who had already completed the study. These amounts were based on average allocations from Experiment 1. Second, participants completed two calibration trials each for the easy and hard task (four total calibration trials). For the first calibrations (the easy task), participants were told to press the spacebar as many times as they could in 7 seconds and that their goal was to try to fill up an

empty box on the screen. Unbeknownst to participants, the box required 300 spacebar presses to fill, an exceptionally difficult feat. For the second calibrations (the hard task), participants were asked to try their best to fill the empty box in 21 seconds. Third, instead of all participants completing a fixed number of presses, participants' target number of presses was 80% of their maximum effort on the easy and hard calibration trials. Fourth, all participants completed the NASA-TLX workload survey immediately after completion of the Pay-It-Forward effortful decision-making task. Then, like Experiment 1, participants were compensated $7 for completing the study, plus the amount from their previous participant and an additional $1–$10 in monetary bonuses based on their performance on both tasks.

Data analysis was identical to Experiment 1 with the addition of examining NASA-TLX data using a 2 (Age Group: Younger Adults vs. Older Adults) X 2 (Task: Easy vs. Hard) mixed ANOVA to examine differences in perceived workload.

Results

People have high task completion success rates, allocate more rewards to themselves, and are effort averse when effort is calibrated

Rates of successful task completion did not differ between older and younger adults, (94% vs. 93%, respectively, $t(78)=1.129$, $p=.259$). In the calibration phase, younger adults' maximum response was 49.78 average presses for the easy task ($SD=8.73$, range = 29 - 74) and 135.43 average presses for the hard task ($SD=17.91$, range = 103 - 192). Older adults pressed the spacebar an average of 36.26 times on the easy task ($SD=6.49$, range = 18 – 48) and 111.87 times for the hard task ($SD=12.89$, range = 89 – 146).

Results comparing proportion of hard task selections for 'self' compared to 'pay-it-forward' trials across all participants showed that participants chose the hard task approximately 10% more on trials that benefitted oneself ($M=0.510$, $SD=0.500$) rather than an unknown future

participant (M=0.410, SD=0.491), $t(78)$=-5.71, p<0.001). Similar to Experiment 1, the average ratio of self-to-other allocations on the effortless prosocial decision-making task was 0.275 (SD=0.221), which indicates that participants allocated more money to themselves than the other future participant.

When effort is calibrated, age differences in effortful prosocial behavior depend on reward likelihood

Similar to Experiment 1, an interaction between Probability X Reward Recipient X Age Group was observed (12% vs. 50%: β=-1.018, p=0.049; 12% vs. 88%: β=-1.793, p=0.001). However, while Experiment 1 showed that older adults were more willing to exert effort for themselves at high probabilities, in this Experiment 2, the opposite pattern was found: younger adults were more willing to invest effort when they were the reward recipients and the possibility of earning the reward was *high* (i.e., 50% and 88%). In contrast, older adults were more willing to choose the hard tasks to benefit themselves compared to benefitting a future participant when the probability of rewards was *low* (i.e., 12%, see Figure 3A). This finding suggests that older adults are less willing to exert effort for others' benefit than younger adults when the likelihood of a potential reward is low, but younger adults are less willing to exert effort for others when the likelihood of reward is high. Thus, older adults are motivated to act selfishly when the benefit is unlikely, but young adults are more motivated to act selfishly when the benefit is highly likely.

Results also showed a significant two-way interaction effect between Reward Magnitude X Age (β=-0.477, p=0.004), suggesting that the effect of reward magnitude was associated with increased likelihood of choosing the hard task in older adults compared to younger adults. Main effects of Probability Level (12 vs. 50%: β=1.651, p<0.001; 12% vs. 88%, β=2.772, p<0.001) and Reward Magnitude (β=0.677, p<0.001) were also observed; probabilities greater than 12% and higher potential rewards led to greater effort expenditure. In contrast to Experiment 1, the

two-way Reward Recipient X Age interaction was non-significant in this Experiment (p=0.207). Regression results are reported in Table 2.

Perceived workload is greater for the hard task and greater among young adults

Results from the NASA-TLX survey revealed that participants perceived the hard task as more mentally demanding (p<0.001), physically demanding (p<0.001), more frustrating (p<0.001), requiring more effort (p<0.001), and felt more rushed (p<0.001) than the easy task. Older adults found the tasks overall less mentally demanding (p=0.028), physically demanding (p=0.001), frustrating (p<0.001), and effortful (p=.006) and felt less rushed (p=0.033) than younger adults. There were no differences in feelings of successfully accomplishing the easy versus hard task (p=0.965) or between older and younger adults (p=0.249). Results are shown in Supplemental Table 2.

Older adults are more willing to choose to allocate effortless rewards to benefit others than younger adults

Replicating Experiment 1, the generalized linear mixed effects regression results indicated that a significant main effect of Age (12% vs. 50%: β=0.124, p=0.015). Older adults (M=0.340, SD=0.191) had a higher allocation ratio of giving to another future participant compared to younger adults (M=0.216, SD=0.229), and were therefore more willing to engage in prosocial behavior than younger adults in the effortless task (Figure 3B). Results also showed significant effects of Probability (12% vs. 50%: β=0.133, p<0.001; 12% vs. 88%: β=0.085, p=0.050) and Expected Value (12% vs. 50%: β=-0.034, p=0.002).

Discussion

Experiment 2 results replicated findings for the effortless task: older adults acted more prosocially than younger adults by allocating more money to another future participant. In the effort-calibrated version of the Pay-It-Forward Task, effortful decisions were dependent on the

likelihood of receiving a reward. When effort was calibrated based on one's ability, thereby making the tasks more achievable, older adults were indeed more prosocial at the 50% and 88% probability levels. Therefore, when a reward was likely, older adults increased their effortful prosocial behavior relative to younger adults, but when a reward was unlikely, older adults act less prosocially than younger adults. Because older adults tend to have greater physical resource limitations than younger adults, older adults may be wise to be more selective in their effort investments. Results of this experiment suggest that older adults may only endeavor to undertake effort cost for others' benefit when that cost is highly likely to lead to a reward. When the benefits are less likely, older adults may be less willing to take the risk of an effort cost for others' benefit compared to their own.

General Discussion

This study examined age differences in willingness to engage in effortful and effortless prosocial behavior for a fully anonymous recipient. In the absence of physical effort expenditure, findings from both Experiments 1 and 2 demonstrated that older adults engaged in more prosocial behavior than younger adults. When the task did involve effort costs, older adults' prosocial behavior differed depending on the effort demands of the task and likelihood reward. In Experiment 1, effort requirements were the same for all participants, and older adults were less successful at completing the tasks; as such, the tasks may have required more effort for older adults than younger adults to achieve the same level of performance. Findings from Experiment 1 suggest when effort costs were disproportionately high for older adults, they are less willing to exert effort for others compared to younger adults. When effort was calibrated to one's ability in Experiment 2, older adults only engaged in less effortful prosocial behavior when the likelihood of reward was low. Collectively, this work suggests that older adults are more prosocial than

younger adults in the absence of effort costs but are more selective in their prosociality in high-effort contexts.

Previous studies have suggested that older adults may be more prosocial than younger adults (Mayr & Freund, 2020) in contexts including economic games (Engel, 2011; Matsumoto et al., 2016; Sparrow et al., 2021), learning about rewards for others (Cutler et al., 2021), charitable donations (Bekkers & Wiepking, 2011; Freund & Blachard-Fields, 2014; Raposo et al., 2021), and effortful actions (Lockwood et al., 2021). However, not all studies find a positive association (Bailey et al., 2020; Best & Freund, 2021; Rieger & Mata, 2013; Roalf et al., 2011). Compared to previous studies specifically examining physical effort, the current study suggests that in some high effortful contexts older adults are not always more prosocial. There are several reasons this may be the case.

First, older adults may have a *preference* to be more prosocial but not always have the ability to do so. In previous work (Lockwood et al., 2021), the effort levels were thresholded to each participants own ability and were a maximum of 70% of their top threshold, meaning they were always achievable. In Experiment 1, we show that when the same task demands are applied for prosocial acts for young and older adults, and thus older adults' effort costs may be disproportionately high, older adults are less willing to exert effort. When effort costs are more equitable, as in Experiment 2, older adults exert less effort when a reward for others' benefit is unlikely. Older adults appear more selective in allocating effort for others' benefit, weighing the costs and likelihood that such costs will be worth the effort more carefully than younger adults. Critically, this finding aligns with the Selective Engagement of Cognitive Resources framework of aging, which proposes that older adults are more selective in how they allocate their cognitive resources (Hess et al., 2014). Because of increasing age-related effort costs, they are less

intrinsically motivated to engage in effortful tasks and are more attuned to the potential benefits of such effort expenditure. This is an important result because it suggests how in the real world, faced with the same effortful activity, older adults may want to exert more effort to help but may not have the physical ability to carry through because such a task may have higher effort costs for older than younger adults. Future research dissociating propensity from ability is critical to document the patterns of changing in prosocial motivation across the lifespan (Contreras-Huerta et al., 2020).

Second, previous work has examined a range of different beneficiaries and shown that when older adults perceive the beneficiary as not similar or close to them geographically, they may be less willing to be prosocial than younger adults (Cutler et al., 2021). In the current study, the beneficiary was fully anonymous, and the study was conducted online. Thus, the participant that benefitted from one's effort may have been perceived as closer in past research (Lockwood et al., 2021) as they were present in the lab compared to the current study in which the recipient was fully anonymous. The difference in perception of the beneficiary could have affected the socioemotional relevance of the prosocial effort. However, we believe this second interpretation is less likely given that when older adults were given a task without effort costs, they were more prosocial than younger adults. Consistent with prior research using the Dictator Game (Matsumoto et al., 2016), we found that older adults had a higher allocation ratio of giving to another future participant compared to younger adults. This shows evidence of increased prosocial behavior when effort costs are removed in the same participants.

The current study suffers from certain limitations. Due to the length of the experiment, it was not possible to manipulate the nature of the beneficiary. To understand whether older adults would behave differently if deciding to benefit a close-other rather than a completely anonymous

recipient, further studies could manipulate this factor directly. However, many of our prosocial decisions in everyday life do involve such anonymous recipients. Examples include anonymous donations, sharing code, and recycling waste. Therefore, although we were unable to assess the impact of different beneficiaries, our findings have important implications for adults' effortful and effortless prosocial decisions for common anonymous beneficiaries.

In conclusion, we show that older adults' prosocial behavior differs when faced with effortless versus effortful decisions to benefit an anonymous other person. Older adults are more willing to engage in effortless prosocial behaviors than younger adults, regardless of reward likelihood. In contrast, they may be less willing to engage in effortful behaviors to benefit others than younger adults when the effort costs are disproportionately high and the likelihood of reward is low. These findings could have crucial implications for understanding the effects of globally aging populations and contribute to age-specific strategies that can increase prosocial behaviors across the lifespan.

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Data Availability Statement

Data for this study can be found on the Open Science Framework:

https://osf.io/26u9v/?view_only=b19d2ae0064d45399214e0c8c849b20e

This study was not pre-registered.

Author Contributions

K.B. conceptualized the study and performed some of the statistical analyses. K.B. and P.L. wrote the manuscript. R.G.A. and Y.L. performed statistical analyses and contributed to editing the manuscript.

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Table 1

Experiment 1 Results of the Mixed Effects Logistic Regression Predicting Effort Decision

Variable	Levels	Estimate	SE	P-value
(Intercept)		-3.952	0.409	<.001 ***
Probability (vs. 12%)	50	1.651	0.201	<.001 ***
	88	2.724	0.218	<.001 ***
Reward Magnitude		1.029	0.101	<.001 ***
Reward Recipient (vs. Other Future Participant)		0.990	0.44	.024 *
Age Group (vs. Younger Adults)		0.780	0.623	.211
Reward Magnitude*Reward Recipient		-0.178	0.138	.197
Reward Magnitude*Age Group		-0.688	0.15	<.001 ***
Reward Recipient * Age Group		-1.963	0.68	.004 **
Probability*Reward Recipient	50	0.441	0.276	.109
	88	0.396	0.293	.177
Probability*Age Group	50	-1.101	0.322	<.001 ***
	88	-1.233	0.326	<.001 ***
Probability*Reward Recipient *Age Group	50	0.486	0.445	.274
	88	0.932	0.45	.039 *
Reward Magnitude* Reward Recipient*Age Group		0.492	0.208	.018 *

Note. Age Group was dichotomized as young adults (coded as 0) and older adults (coded as 1). Reward Recipient was dichotomized as reward for another future participant (coded as 0) and reward for oneself (coded as 1). The 'Effort Decision' outcome variable was dichotomized as Easy Task (coded as 0) and Hard Task (coded as 1).

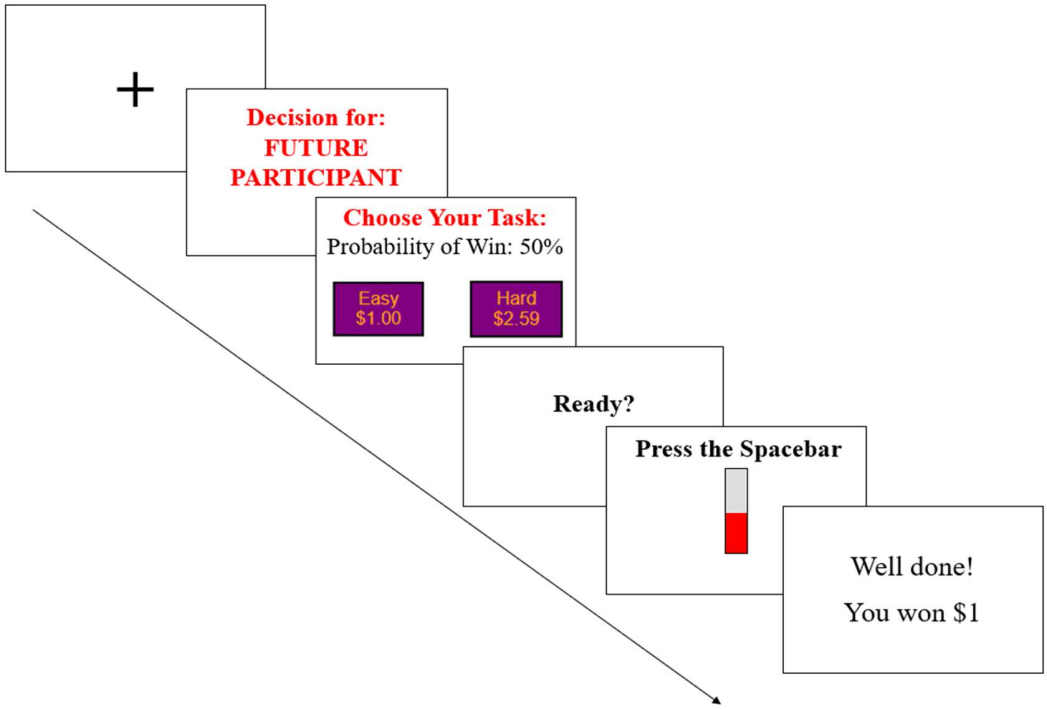
Table 2

Experiment 2 Results of the Mixed Effects Logistic Regression Predicting Effort Decision

Variable	Levels	Estimate	SE	P-value
(Intercept)		-3.845	0.481	<0.001 ***
Probability (vs. 12%)	50	1.809	0.258	<0.001 ***
	88	2.772	0.265	<0.001 ***
Reward Magnitude		0.677	0.113	<0.001 ***
Reward Recipient (vs. Other Future Participant)		-0.409	0.547	0.455
Age Group (vs. Younger Adults)		0.295	0.711	0.678
Reward Magnitude*Reward Recipient		0.368	0.163	0.024 **
Reward Magnitude*Age Group		-0.477	0.168	0.004 **
Reward Recipient * Age Group		0.996	0.790	0.207
Probability*Reward Recipient	50	0.350	0.347	0.313
	88	0.941	0.373	0.012 **
Probability*Age Group	50	0.478	0.397	0.228
	88	1.298	0.409	0.002 **
Probability*Reward Recipient *Age Group	50	-1.018	0.518	0.049 **
	88	-1.793	0.539	0.001 **
Reward Magnitude* Reward Recipient*Age Group		-0.184	0.233	0.430

Note. Age Group was dichotomized as young adults (coded as 0) and older adults (coded as 1). Reward Recipient was dichotomized as reward for another future participant (coded as 0) and reward for oneself (coded as 1). The 'Effort Decision' outcome variable was dichotomized as Easy Task (coded as 0) and Hard Task (coded as 1).

A



B

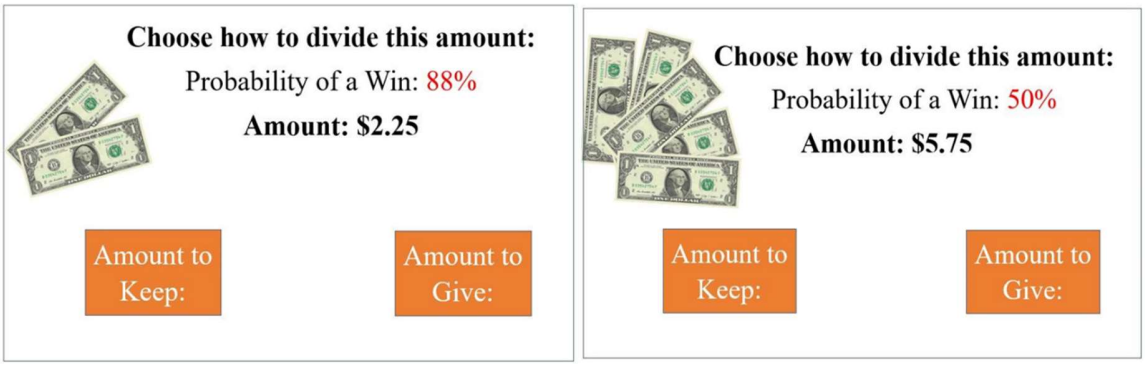
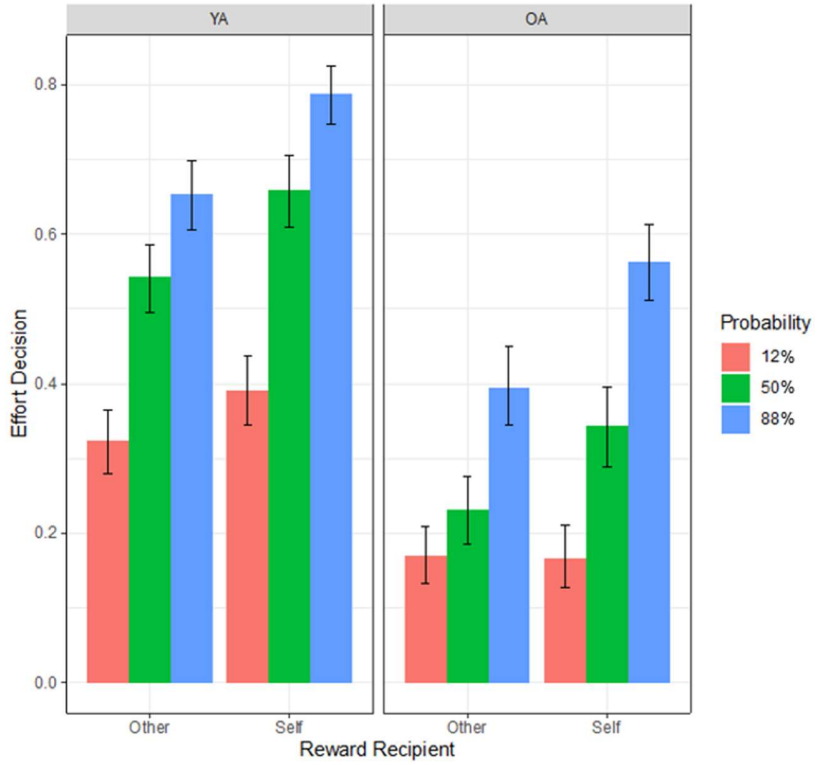


Figure 1. (A) Sample trial of the prosocial effort-based decision-making task on a trial for another's benefit ("pay-it-forward" trial). All participants received trials that were both for another's benefit and for oneself in this within-subjects study design. (B) Two sample trials of the prosocial effortless decision-making task.

A



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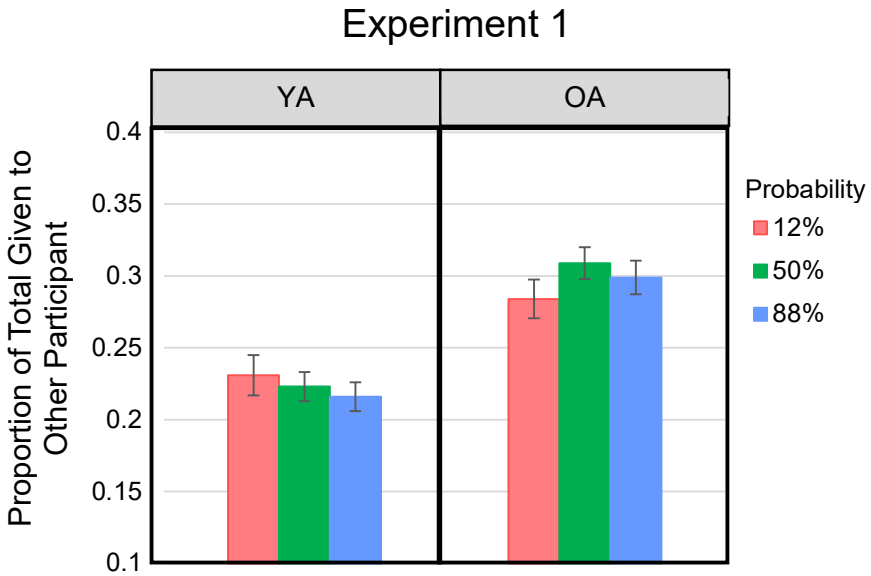
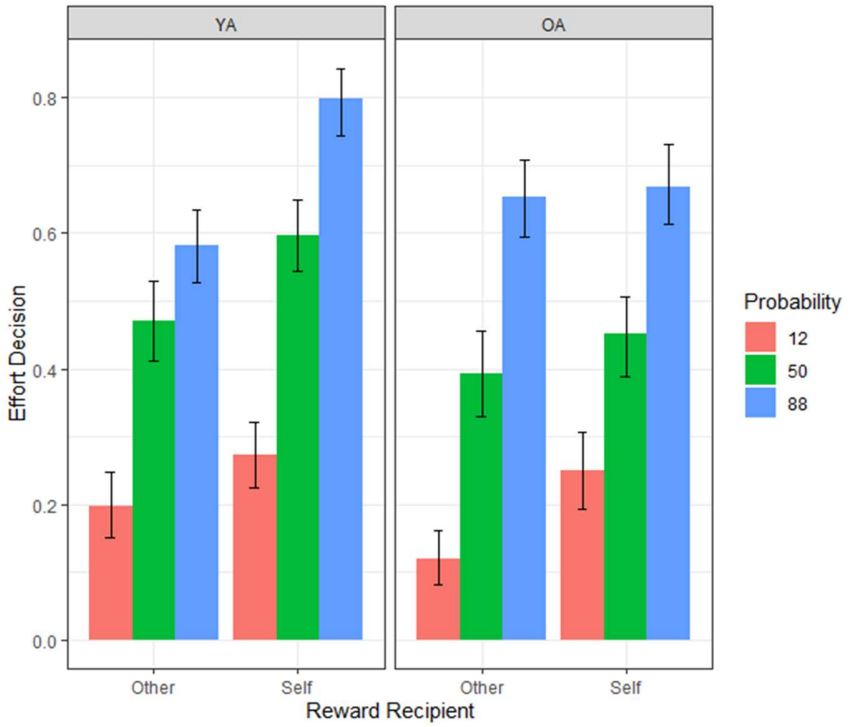


Figure 2. (A) Effort decision (Easy versus Hard task selections, with higher values reflecting a greater proportion of hard, effortful decisions) in Experiment 1 predicted by Age Group, Probability, and the Reward Recipient (Self vs. Other Future Participant). YA = young adult. OA = older adult. (B) Proportion of the total amount given to an anonymous future participant on the prosocial effortless decision-making task in Experiment 1 in older adults compared to younger adults by probability level. Error bars represent standard error.

A



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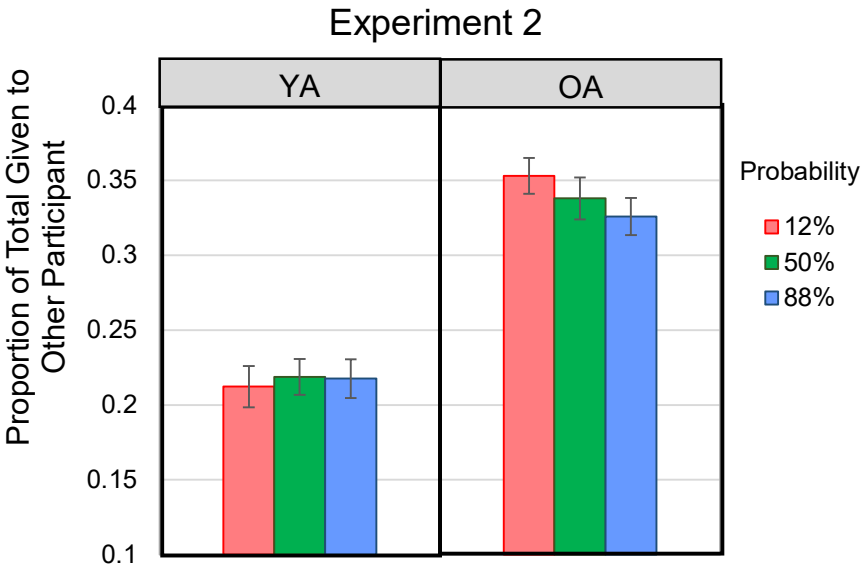

Figure 3. (A) Effort decision (Easy versus Hard task selections, with higher values reflecting a greater proportion of hard, effortful decisions) in Experiment 2 predicted by Age Group, Probability, and the Reward Recipient (Self vs. Other Future Participant). YA = young adult. OA = older adult. (B) Proportion of the total amount given to an anonymous future participant on the prosocial effortless decision-making task in Experiment 2 in older adults compared to younger adults by probability level. Error bars represent standard error.