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BRIEF REPORT

Control Preference Persists With Age

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The opportunity to exert control in one's environment is desirable, and individuals are willing to seek out control, even at a financial cost. Additionally, control-related activation of reward regions in the brain and the positive affect associated with the opportunity to exert control suggest that control is rewarding. The present study explores whether there are age-related differences in the preference for control. Older and younger adults chose whether to maintain control and play a guessing game themselves or to cede this control to the computer. Maintaining and ceding control were associated with different amounts of monetary reward that could be banked upon a successful guess. This required participants to weigh the value associated with control compared to monetary rewards. We found that older adults preferred control and traded monetary reward for control, similar to younger adults. The results suggest that the preference for exerting control may be preserved across age.

Public Significance Statement
Humans value being in control of their lives, but it is unclear how aging might influence this preference for control. We found that older and younger adults did not differ in their preference for control, indicating that it is relatively unaffected by healthy aging.

Keywords: perceived control, preference for control, choice, aging, reward

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In day-to-day life, control over decisions is desirable (Leotti et al., 2010). It is pleasurable to have control over which foods you eat, the tunes you jam to on a morning run, or who you vote for in an election (Bown et al., 2003; Leotti et al., 2010). Accordingly, a perceived sense of control increases positive affect and activates reward centers in the brain (Leotti & Delgado, 2011). Additionally, people prefer decisions that allow for control, even to the point of forgoing monetary incentives (Bobadilla-Suarez et al., 2017; Owens et al., 2014; Wang & Delgado, 2019). While there is considerable evidence that control is rewarding for both humans and other animals (Bown et al., 2003; Leotti et al., 2010; Suzuki, 1997, 1999), it is unknown if there are age-related differences in the preference for control. There are some observations that reward processing and decision-making differ between younger and older adults (e.g., Samanez-Larkin & Knutson, 2015), particularly in the context of the valuation of different rewards (Rademacher et al., 2014). Thus, the present study aimed to explore whether there are age-related differences in the reward associated with control.

Exercising control allows an individual to achieve a goal by directly affecting their environment in the way they think best. As the adage goes: "If you want something done right, do it yourself." This ability to control one's environment generates positive affect (Leotti & Delgado, 2011), whereas the lack of perceived control can cause stress (S. M. Miller, 1979) and the development of depressive symptoms (W. R. Miller & Seligman, 1975). However, too much control can be similarly maladaptive (Rotter, 1966), particularly when there is a disparity between how much perceived control a person has and how much they think they can handle (Amoura et al., 2014; Evans et al., 1993). Age-related differences in physical and mental abilities (Park & Schwarz, 1999) may result in a mismatch between the opportunity and preference for control. For example, acquiring new knowledge and skills becomes increasingly difficult

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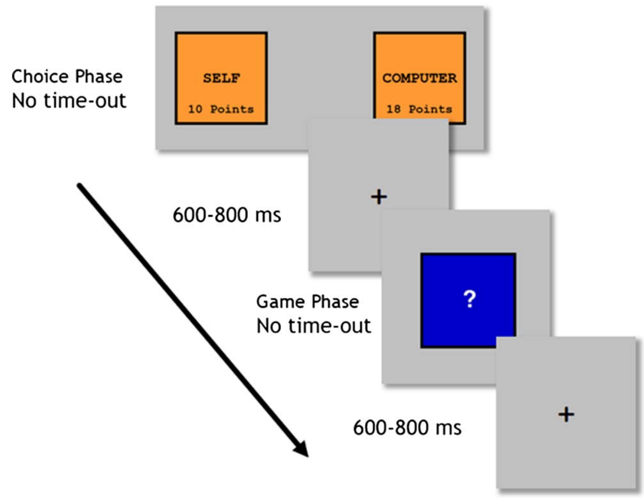
with age (Baltes, 1987; Kliegl et al., 1989; Salthouse, 2004), and older adults may decide to cede control to others when they cannot draw from past experience (e.g., how to stream video on a TV). It is unclear, however, whether ceding control is the result of less preference for control or the lower perceptions of ability. Given that beliefs about the ability to control one's life and environment—or sense of control—begin to decrease around 50 years of age (Mirowsky, 1995; Mirowsky & Ross, 2007; Schieman, 2001), understanding whether there are age-related differences in preference for control is important as a mismatch between the opportunity and the preference for control can be problematic (Evans et al., 1993).

While the *sense* of being in control decreases with age (Mirowsky, 1995; Mirowsky & Ross, 2007; Schieman, 2001; Slagsvold & Sørensen, 2008), it is unclear whether there are age-related differences in the *preference* to be in control. For example, the preference and sense of control may be related if a diminished sense of control resulted in a devaluation of rewards associated with exerting control. Ly et al. (2019) propose that sense of control is driven by reward-related prediction error signals in instrumental learning. This positive feedback loop may be disrupted due to aging, as older adults are less effective at learning action-reward associations (Chowdhury et al., 2013; Eppinger & Kray, 2011; Samanez-Larkin & Knutson, 2014, 2015; Westbrook et al., 2012). Based on Ly et al.'s (2019) model, this may result in less reward feedback associated with exerting control and diminished approach behavior to situations that can be controlled.

In this experiment, we conducted an exploratory investigation of whether the preference for control differs between younger and older adults. To this end, we implemented the Value of Control task or "VoC task" (Wang & Delgado, 2019; Wang et al., 2021) in which participants chose between exerting and relinquishing control via options associated with different levels of monetary reward (Figure 1). Participants could decide to retain control by guessing whether a hidden card was greater or less than five or cede control by having the computer guess. Older adults' trade-off between control and monetary rewards was compared to younger adults, who were willing to forgo monetary reward to retain control in prior iterations of this task (Wang & Delgado, 2019; Wang et al., 2021).

Figure 1

Participants Were Shown Two Orange Boxes During the "Choice Phase" That Had SELF and COMPUTER-Options, Both of Which Contained Point Values Indicating the Magnitude of Potential Reward Payout



Note. Choosing SELF had the participant play a game themselves where they were shown a blue box and were told to indicate if a hidden number, represented as a card, was greater than or less than five by using the up and down arrow keys. Choosing COMPUTER defers the control to the computer, where the computer plays the game instead. The point value representing monetary reward was only banked if the subsequent task's "Game Phase" was answered correctly by them or the computer. See the online article for the color version of this figure.

Method

Transparency and Openness

This research was not preregistered. Deidentified participant data and analytical code conducted using a mixed-effect model are available at Open Science Framework (OSF): https://osf.io/tcjk3/?view_only=efbb30a6b9ad4b4d8022b046e5609ab4.

Participants

This study was reviewed and approved by Michigan State University's institutional review board. In order to observe the effects of age on preference for control, we aimed to recruit younger adults between the ages of 18 and 25, and older adults, 50 years and older, for which previous research has shown declines in perceived sense of control (Mirowsky, 1995; Mirowsky & Ross, 2007; Schieman, 2001). To ensure that we would be able to observe a preference for control in each group, we calculated the sample size needed to achieve an α of .05 and power of .8 using the Cohen's d effect size of control preference (d = .69) in the VoC task (Wang & Delgado, 2019). A sample size of 19 is required to observe a preference for control in a two-tailed t test against a constant (i.e., no preference for control). Thus, we aimed to recruit a minimum sample of 19 participants per group.

Thirty-eight[1] older adults ages 51–77 (M = 63.1) were recruited from the greater Lansing community via flyers, listservs, newspapers, and radio programming. On average, older adults were college-educated with 16.82 years of education and were predominately female (73.7%). To screen for general cognitive deficits, a score of 23 points on the mini-mental state exam (Anthony et al., 1982; Folstein et al., 1975) was required and all older adult participants met this standard. Twenty-eight younger adults were recruited from the undergraduate subject pool at Michigan State University and were predominately female (71.4%). We did not record the racial and ethnic backgrounds of our participants.

Participants were compensated at the rate of $10 an hour with a potential bonus of up to $5 based on their performance in the experiment. Additionally, older adults who traveled to the testing site received a bonus of $3 to pay for gas and time.

[1] We recruited more participants in the older group because we excluded older adult outliers in our original analyses. In response to a reviewer's suggestion, we implemented a mixed-effect model which included all participants.

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Procedure

The VoC task comprised a card-guessing game (Delgado et al., 2000) and was subdivided into two parts, the "choice phase" and the "game phase," which occurred during every trial (Figure 1). In the choice phase, participants decided whether they wanted to retain or defer control over the subsequent trial's game phase. To retain control, participants would need to choose the orange box containing the word SELF while to defer control, participants must choose the box containing the word COMPUTER. Additionally, a point value ranging from 0 to 20 points in increments of 2 was shown below the words of either the COMPUTER- or SELF-option, whereas the other option had a baseline of 10 points for comparison. Participants were informed that the chosen option's points could be banked if they or the computer (if they chose to defer control) answered the subsequent game correctly and told that the more points they banked, the more money they could receive at the end of the experiment (up to $5). Therefore, participants needed to weigh their preference to be in control against the monetary value associated with the two options. Choosing options that had less monetary reward but maintained control would indicate that control was subjectively valuable to the participant.

A trial's game phase consisted of a card-guessing game where one answered if an unknowable number was greater than or less than 5. Participants played the game themselves if they chose the SELF-option or had the computer play for them if they chose the COMPUTER-option in the trial's choice phase. No feedback was given so that participants would be unaware of whether the accuracy was better for themselves or the computer (although note, accuracy should always be around 50%). Participants performed 88 trials and practiced via a block of 20 training trials.

After the VOC task, participants were asked to complete the following surveys: eight questions from Levenson Multidimensional Locus of Control scale (Levenson, 1981), which measures general control beliefs; eight questions from form A of Multidimensional Health Locus of Control (Wallston et al., 1978), which measures specific health-related control beliefs; eight questions from the Computer User Self-Efficacy Scale (CUSE; Cassidy & Eachus, 2002), which measures belief in computer competency; and 12 reward questions from the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia et al., 2001), which measures reward processing. The locus of control scales was divided into Chance, Internality, and Powerful Others.

Finally, older adults were administrated the mini-mental state exam (Anthony et al., 1982; Folstein et al., 1975), which measures impaired thinking in diseased, uneducated, undeveloped, and very old populations. Participants needed to score 23 or higher to be included in the analysis.

General Mixed-Effect Model

We sought to derive the likelihood of choosing the SELF-option as predicted by the difference in expected value between the options (EVdiff). Expected values were calculated by multiplying an option's points by the chance of success (.5). A general mixed-effect model was subsequently constructed using the fixed effect of trial-by-trial EVdiff predicting the binary selection of the SELF-option per participant. Furthermore, group and the interaction of EVdiff by group were included as fixed effect predictors to observe preference for control differences across age groups and assess age differences in the tradeoff between monetary rewards (EVdiff) and preference for control. Age groups were effect coded (sum coded) such that the grand mean was used as the reference variable instead of one group dummy coded to be the reference variable. This allowed for main effects to be interpreted directly (rather than simple effects). Random effects included by-subject random intercepts and slopes for EV-difference predicting SELF-choice in order to account for variance across subjects.

Analysis on pairwise bivariate regressions and *t* tests were conducted through IBM SPSS 27, whereas the mixed-effect models were conducted through R studio 4.1.0 (RStudio Team, 2021) using the lme4 package Version 1.1-27.1 (Bates et al., 2015).

Participants were excluded from data analysis if they failed the mini-mental state exam ($n = 0$), missed the survey catch trial ($n = 1$), chose either the COMPUTER or SELF-option 100% of the time ($n = 2$), or chose a side of the screen 3 *SD*s above the mean ($n = 2$). These criteria resulted in the removal of two younger adults and three older adults, leaving 26 younger and 35 older adults.

For more information on the methods as well as extended results, see Supplemental Materials through our OSF link.

Results

Analyses focused on the Choice Phase of the experiment, in which participants decided to relinquish control (COMPUTER-option) or maintain control (SELF-option). When accounting for all predictors within the general mixed-effect model and setting the grand mean as the reference variable, the intercept was significantly different from the null of 50% ($\beta_0 = 0.905$, $SE = 0.148$, $Z = 6.12$, $p < .001$) obtaining an odds of 2.247. Therefore, the older and younger adult samples were in general 2.247 times more likely (a probability of 71.88%) to choose the SELF-option over the COMPUTER-option. In more simplistic terms, using a one-sample *t* test against chance (50%), both younger, $t(25) = 5.128$, $p < .001$, and older adults, $t(34) = 4.577$, $p < .001$, significantly preferred the control maintaining SELF-option. The likelihood of choosing the SELF-option did not significantly differ between age groups $\beta_2 = -0.868$, $SE = 0.146$, $Z = 0.593$, $p = .553$, indicating that preference for control was similar between age groups (Figure 2). Additionally, a linear regression showed that the age of the older adults did not predict choice preference, $r = -.078$, $F(1, 33) = 0.202$, $p = .656$, further suggesting that preference for control does not differ between age groups.

Accounting for age group, EVdiff predicted SELF-choice likelihood, $\beta_1 = -1.020$, $SE = 0.119$, $Z = -8.57$, $p < .001$, where one unit difference in expected value reduced the odds of choosing the SELF-option by 0.361. The lack of an interaction for EVdiff × age $\beta_3 = 0.086$, $Z = 0.744$, $p = .457$, indicates that older adults responded to the difference in EV similarly to younger adults. Thus, the trade-off between monetary reward and control was equivalent between the two age groups (Figure 2).

Survey Results

No subscale predicted SELF-choice ($r < .125$, $p > .297$) nor did the computer self-efficacy scale, CUSE; $r = -.207$, $F(1, 59) = 2.631$, $p = .110$, or the sensitivity for reward scale, SPSRQ; $r = -.073$, $F(1, 59) = .320$, $p = .574$, predict SELF-choice for either

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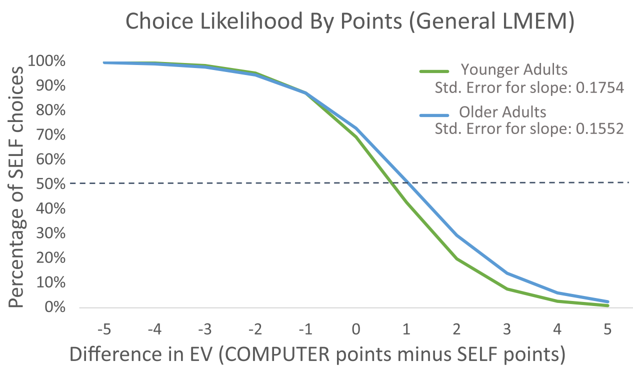
Figure 2

Individual Parameter Estimates Using Dummy Coding for Younger and Older Adults' Predicted Percentage to Choose the SELF-Option as Compared to the COMPUTER-Option at Every Point of Difference in Expected Value (EV)



Note. Analysis conducted using a general linear mixed-effect model (LMEM). The *x*-axis is labeled such that −5 indicates the SELF-option was 10 points greater than the COMPUTER-option, whereas five on the *x*-axis indicates the COMPUTER-option had 10 more points than SELF. See the online article for the color version of this figure.

group. Tech competency (CUSE) was equivalent between groups, $t(59) = 1.755$, $p = .084$.

Discussion

Humans and other animals prefer to have control over their environment (Bown et al., 2003; Leotti et al., 2010; Suzuki, 1997, 1999), but it is unknown how this drive might be influenced by healthy aging. We found that older adults were willing to forego monetary rewards to exert control consistent with the behavior of younger adults (Bobadilla-Suarez et al., 2017; Leotti & Delgado, 2014; Owens et al., 2014; Wang & Delgado, 2019; Wang et al., 2021). Both older and younger adults considered the trade-off between the value of monetary rewards and control similarly when choosing whether to maintain or cede control. These results suggest that control is valuable to older adults and that they are just as willing to cede monetary reward for the prospect of autonomous control as younger adults.

We found no evidence that older adults devalued control. Ly et al. (2019) argued that older adults' deficits in reward learning (Chowdhury et al., 2013; Eppinger & Kray, 2011; Samanez-Larkin & Knutson, 2014, 2015; Westbrook et al., 2012) and anticipation (Dreher et al., 2008; Schott et al., 2007) might diminish the frequency of obtaining rewards associated with exerting control. Over time, this may diminish the approach behavior to situations that offer the opportunity to be in control. The continued preference for control by older adults is consistent with the idea that control is rewarding in itself (Bobadilla-Suarez et al., 2017; Owens et al., 2014; Stolz et al., 2020; Wang & Delgado, 2019) rather than merely being a means to obtain the outcome of control. If so, older adults may still find pleasure in the act of control, even if their efforts are less successful as they age.

Alternatively, we may not have observed a devaluation of control because our task took little skill. Indeed, some models predict that older adults compensate for a lower sense of control by seeking out control over goals that are more achievable (Brandtstädter, 2009; Brandtstädter & Rothermund, 1994; Heckhausen et al., 2019; Schulz & Heckhausen, 1996). Investigating whether older adults might prefer to cede control in a more difficult or novel task would help to understand whether potentially greater failures might reduce the value of control compared to younger adults. Moreover, our older population was relatively high functioning, as evidenced by their perceived technological competency and years of education. As such, their efforts to control their environment may be mostly successful and, consequently, rewarded. It is important to assess preference for control in a more diverse group of older adults.

In sum, we found that control is subjectively valuable to humans regardless of age, with younger and older adults preferring control to the same extent. Thus, our results support the idea that the opportunity to be in control remains rewarding for older adults.

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