Socioeconomic Status Effect on the Performance Difference Between Younger and Older Adults on Incentivized Working Memory Task

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Authors Note

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Abstract

Older adults are often less responsive to monetary incentives for cognitive performance than young adults. However, in most studies, older adults (usually retired members of the community around a university) likely have greater financial resources than younger adults (typically college students), so the money is less important to them. The present study tries to address this confound by testing young and older adults of high and low socioeconomic status (SES). Young and older adult participants recruited from the top or bottom two SES tiers of the Prolific recruitment database completed a Sternberg working memory task under either control (no incentive) or loss incentive (money subtracted for errors) conditions. After the Sternberg task, participants completed the MacArthur Socioeconomic Status questionnaire. Results did not replicate the finding of loss-incentive-induced reductions in working memory performance and motivation (Jang et al., 2022). However, results did replicate a finding from Jang et al. (2022) showing better correct rejection performance after the longer (16 sec) vs shorter (4 sec) retention interval. Working memory performance showed that low SES groups had higher correct rejection rates than high SES groups. Additionally, the high SES participants in the loss group showed a better correct rejection rate than the high SES participants in the control group. NASA-TLX ratings showed that during the task, participant motivation decreased, and cognitive demand increased, which suggests participants got fatigued.

Keywords: Socioeconomic status, incentive, younger adults, older adults, working memory

Introduction

The prospect of gaining money for good performance or losing money for deficient performance is often used to incentivize performance on cognitive tasks. Several studies have suggested that older adults are less responsive to monetary incentives than young adults and that some types of monetary incentives may even reduce the performance of older adults while increasing that of young adults (Cutler et al., 2021; Dhingra, 2020; Jang et al., 2022; Lustig et al., 2019; Mikels, 2009; Samanez-Larkin et al., 2015; Spaniol, 2011; but see Opitz et al., 2022). However, one problem for interpreting these studies is that they typically assess college students – who have limited financial resources – and older adults recruited from the community surrounding the university where the study is conducted, and who are often much more financially secure. This raises the question of whether the monetary incentives might have less subjective value for the older adults, not because of aging per se, but because of their greater financial status. The present study attempts to address that gap by testing young and older adults of high and low socioeconomic status.

Research on age differences in the response to incentive on cognitive tasks is mixed. Some studies using rewards for good performance show similar responsivity to incentives for young and older adults, whereas others show a reduced reward sensitivity in older adults. In some of these studies, performance sensitivity to incentive is similar for young and older adults, but older adults show different patterns of brain activity. For example, Dhingra et al. (2020) showed an age-related effect on the magnitude of monetary reward processing. Older adults had less activation in the reward system in anticipation of a large monetary gain but more activation for a small monetary gain. Opitz et al. (2022) found that older adults showed less modulating of reward related connectivity in brain during a monetarily incentivized task. For loss incentives,

older adults often show less incentive sensitivity than do young adults, both behaviorally and neurally (Culter et al., 2021; Mikels & Reed, 2009; Samanez-Larkin & Knutson, 2015; Spaniol et al., 2011).

In some cases, loss incentives may even improve the performance for young adults while decreasing it for older adults. That was the case in Jang et al. (2022), which laid the groundwork for this study. They used a monetarily incentivized working memory task to study the differences in younger adults and older adults in their sensitivity towards incentives. Participants were assigned the control group or the loss incentive group. During the task, they were shown a set of letters to memorize, then they fixated on a cross. After that, participants were probed with a singular letter and asked to recall if that letter was part of the original set of letters they memorized. The control group lost nothing if a correct or incorrect answer was produced. The loss incentive group of participants lost nothing when they produced a correct answer but lost monetary reward for every incorrect answer produced. It was found that younger adults performed better in the loss incentive condition than in the control condition, and gave higher ratings on a motivation scale, whereas older adults showed the opposite pattern.

Although these studies have advanced our understanding of how incentives may affect cognitive performance, they have an important limitation: they have been conducted using college students and older adults recruited form the surrounding community, and who are themselves often alumni of the university where the study is located. This may limit the degree to which the results generalize to groups of lower socioeconomic status (SES). Even within a study, differences in financial resources for young adult college students versus the wealthy retirees that typically volunteer as older adults may present an important confound: are older

adults less reactive to incentive in general, or do the monetary incentives have less subjective value for them?

There is surprisingly little research on how socioeconomic status may impact the response to incentives for performance on cognitive tasks. Most of the studies that do exist have focused on child samples, rather than comparing young or older adults. For example, Kieffer & Goh (1981) gave elementary children an age-appropriate incentivized IQ test to measure an IQ X socioeconomic status X reward effect. He split children into three reward groups based on what their test was incentivized with: tangible reward, social reward, and control group. Kieffer found that social and tangible rewards increased the IQ scores of children with low socioeconomic status. Additionally, the gap in IQ scores between children of low and middle socioeconomic status decreased due to the rise of IQ scores in low socioeconomic status children.

The present study attempted to close some of the gaps previously mentioned, and test hypotheses from this field of study. This study recruited younger and older adults of high and low socioeconomic status. The rest of our design closely mimicked that of Jang et al. (2022): the main task was the Sternberg Memory test with a monetary incentive associated with the loss group to manipulate participants' motivation to do well on the memory test. In between each run of the working memory task, people answered questions regarding how much effort the task required and how motivated they were to do the task. At the end of the experiment, participants self-reported their socioeconomic status, annual household income and years of education completed. This design aimed to close the age versus socioeconomic status gap on how motivated people are to perform well with a monetary incentive associated with their performance. If the age differences in loss-incentive sensitivity seen in Jang et al. were an artifact of age differences in SES, then in the present study low-SES older adults' incentive

sensitivity should look more like that of the young adults, whereas high-SES young adults should show less incentive sensitivity than low-SES young adults.

Methods

Participants

This study was approved by the University of Michigan Health and Behavioral Sciences IRB (Institutional Review Board; exempt determination).

Participants included 124 young (18-30) and 124 older (60+) adults that were recruited online through Prolific (https://www.prolific.com). The initial sample size contained 248 participants, but 18 participants were not included in the final data analysis due to time restrictions in collecting data. The final sample included 230 participants aged 18-30 & 60+. Participants were asked demographic information including age, racial distribution, education level, employment status, student status, household annual income, and social status. Participant demographics can be found in Table 1. The base rate pay for Prolific participants was $12/hour for everyone, and participants in the incentive loss group were paid whatever amount of money earned from the Sternberg Task in addition to the base rate pay. Participants were also screened for depression, dementia, the correct socioeconomic status (high or low), and the correct age group (18-30 years old or 60+ years old).

Table 1

Participant Demographics

Demographic	Young Control		Old Control		Young Loss		Old Loss	
	High SES (n= 29)	Low SES (n= 30)	High SES (n= 29)	Low SES (n= 30)	High SES (n= 29)	Low SES (n= 30)	High SES (n= 26)	Low SES (n= 27)
Age (years)								
M	24.517	25.033	65.207	64.900	24.172	24.567	68.000	63.852
SD	3.408	2.399	2.664	4.722	3.392	3.674	7.088	3.840
Racial distribution (%)								

Demographic	Young Control		Old Control		Young Loss		Old Loss	
	High SES (*n*= 29)	Low SES (*n*= 30)	High SES (*n*= 29)	Low SES (*n*= 30)	High SES (*n*= 29)	Low SES (*n*= 30)	High SES (*n*= 26)	Low SES (*n*= 27)
White	26%	40%	50%	80%	7%	33%	73%	92%
Black	73%	43%	46%	13%	89%	56%	15%	4%
Asian		6%				3%	4%	4%
Mixed		6%		3%	4%	3%	4%	
Other		3%	3%	3%		3%	4%	
Gender (n)								
Female	15	15	14	17	14	14	15	19
Male	14	15	15	13	15	16	11	8
Education Level (n)								
Low	16	20	9	24	13	19	12	22
Medium	3	5	7	3	12	8	2	2
High	10	5	13	3	4	3	12	3
Employment status (%)								
Full time	66%	16%	43%	20%	80%	16%	19%	11%
Part time	13%	26%	20%	23%	7%	23%	11%	18%
Unemployed	6%	30%	3%	13%	7%	30%	4%	11%
No data	10%	6%	3%			13%	11%	14%
Other	3%	20%	30%	34%	7%	16%	53%	44%
Student status (%)								
Student	66%	60%	6%	3%	75%	53%	4%	4%
Not a student	26%	33%	90%	93%	24%	30%	84%	82%
No data	6%	6%	3%	3%		16%	11%	14%
SES Q1: Income (rating)								
M	7.366	3.247	7.472	2.622	7.109	3.547	8.071	2.636
SD	2.422	1.557	2.024	1.276	1.974	1.406	1.521	1.134
SES Q2: Social Status (rating)								
M	7.534	3.442	6.997	3.546	6.798	4.471	7.709	3.894
SD	1.934	1.744	2.106	1.736	2.461	1.697	1.768	2.093

Note. SES Q1= socioeconomic status question one, SES Q2= socioeconomic status question two, SD= standard deviation, M= mean, n= number of participants

The sample size was determined using G*Power 3.1.9.7 (a priori, repeated measures, between-factors, eight groups, repeated measures = 3, corr. among rep measures .5, effect size f = .2). Low SES participants were those from Prolific's bottom two SES tiers; High SES participants were those from Prolific's top two SES tiers. Participants were screened for health conditions that could affect their performance and given a consent form prior to the study.

We also examined whether groups differed on the SES questions from the MacArthur Socioeconomic Scale (Adler, et al., 2000). In both cases, there was a clear difference between the

high-SES and low-SES groups, both $p < .0001$. For the income question, there was also an Age X SES interaction, $F(1,222) = 24.306$, $p = .004$, $\eta^2_G = .013$, such that older adults in the high-SES group gave slightly higher ratings than high-SES young adults, whereas older adults in the low-SES group gave slightly lower ratings than the low-SES young adults (See Table 1). For the social status question, there was a significant Age X SES X Condition interaction, $F(1,222) = -4.243$, $p = .041$, $\eta^2_G = .010$. This was driven by the high-SES groups: for participants in the control condition, high-SES young adults gave slightly higher ratings than high-SES older adults, whereas the opposite was true for participants in the loss condition. Low-SES young and older adults in the control condition gave similar ratings, and there were only slightly higher ratings by low-SES young adults in the loss condition. However, overall, these age and incentive-condition differences were quite small (less than 1 point) compared to the differences between the SES groups (3 points or more) and seem unlikely to have a major impact on our results.

Working Memory Task

The main task in this study was the Sternberg working memory task adapted from Jang et al. (2022). Trials began with a three-second presentation of the memory set; the memory set included four, six, or eight letters presented on the screen (the number varied between trials). Then the letters disappeared, and a cross point appeared on the screen for participants to fixate at for four or sixteen seconds (the time interval varied between trials). After that, participants had to press the letter key “f” or “j” to indicate if the letter was originally shown in the memory set. Participants had three and a half seconds to respond and if no response was made by three and a half seconds, the response was considered incorrect. The task was repeated for 30 trials, for five rounds for a total of 150 trials. The control group in this study had no money involved and the loss incentive group started with $15 and lost $0.30 for every incorrect response. At the end of

the experiment, subjects knew what they got right or wrong, and how much money they obtained based on their performance.

The Sternberg working memory task was counterbalanced in a couple of ways. Firstly, the response keys of "f" and "j" were counterbalanced with "yes this letter was in the original set" and "no this letter was not in the original set". This created "f yes, j no" and "f no, j yes" versions of the memory task. Secondly, the stimuli were counterbalanced. Starting with stimuli A and going through to stimuli E (ABCDE) was the first version of the task. Other versions shifted the starting stimulus letter (BCDEA, CDEAB, DEABC, EABCD). This counter balancing created five versions of the working memory task. All the counterbalancing considered, there were ten versions of the Sternberg working memory task for the control and loss incentive groups.

Post-Task Socioeconomic Status Questionnaire

Participants completed the MacArthur socioeconomic status scale which allowed them to self-report their socioeconomic status (Adler, et al., 2000). There were two questions this questionnaire asked participants to answer. The first asked participants to define their current socioeconomic status within the country they currently resided in, with the top of the scale representing "the most money, best education, and most respected jobs" and the bottom of the scale indicating the opposite. The second question asked participants to define their current position within a community. Participants were able to use their own definition of what community was and thought in terms of high or low standing within that community. The ladder had ten rungs and therefore ten levels participants could choose to place themselves on.

Participants answered by placing themselves on a rung on the ladder. The lowest rung was scored as a one and the highest rung was scored as a ten.

NASA In-between Runs

The NASA Task Load Index (NASA-TLX) was administered in-between rounds of the working memory task. This allowed participants to self-report workload during the Sternberg task. After each run of 30 working memory trials, participants were asked questions about mental demand, physical demand, temporal demand, performance, effort, and frustration. Our lab has added two questions, one asking about distraction and one asking about motivation level (Jang et al., 2022). The NASA-TLX along with these two additional questions was administered after each working memory run, for a total of five times.

Procedure

This experiment was done online using Pavlovia and Prolific. Before starting the experiment, participants went through the informed consent process. During this process, participants were given explanations of what they should expect during the task and confidentiality of their data. Participants were also given the option to share their de-identified data with other scientists in the community to help with research efforts. Opting out of data-sharing still allowed participants to complete the study.

After passing the informed consent process, participants were given explanations about the working memory task. They first completed ten practice trials and had to score 80% or better on those practice trials to proceed to the main experiment. This allowed participants to practice and ensure that they were able to do the task before moving on to the real experiment. After successfully completing the practice trials, participants moved on to the main task with the

NASA self-reporting in-between rounds. After the main task, participants were asked to complete the MacArthur Socioeconomic Status questionnaire. Finally, participants were compensated for their time.

Statistical Analysis

ANOVA analysis using JASP software was used to perform the statistical analysis of the results from this experiment. There were three between subject independent variables in this experiment: age, socioeconomic status, and incentive. Groups in the age variable were young or old; groups in the socioeconomic status variable were high status or low status; groups in the incentive variable were control or loss. For the Sternberg working memory task there were also two within-subject variables. The first within-subject variable was the letter sequence set size (4, 6 or 8 letters). The second within-subject variable was retention rate with "long" being 16 seconds and "short" being four seconds. There were two dependent variables for the working memory task: accuracy (hits and correct rejections) and response time.

The design of the different variables that went into the ANOVA for the working memory task was 2 (Age: young vs old) x2 (Socioeconomic status: high status vs low status) x2 (Incentive: control vs loss) x3 (Set size: 4, 6, 8) x2 (Intervals: 4, 16). For the ratings task, we used the same between-subjects variables but also examined the within-subjects variable Run (1-5).

Overall, our analyses focus on the between-subjects variables. The main hypothesis predicts an age X SES X incentive interaction. Young and older adults in the high SES group were predicted to reproduce the age X incentive interaction seen in Jang et al., with young adults showing an improvement in incentive in response to the incentive, whereas older adults were

predicted to have decreased performance in the incentive condition. In the low SES group, we expected that both young and older adults would show higher performance in the incentive condition.

Participant demographic information was collected and analyzed as well. Participants were asked their age, annual household income, gender, race & ethnicity, student status, employment status, and years of education. The primary analyses from the experiment task were crossed with participant demographics to see if any trends exist.

As secondary analyses, the replication of the retention interval effect seen in Jang (et al, 2022) was checked (better performance for correct rejections after the longer retention interval). Other exploratory analyses examined age, SES, and incentive effects on questionnaire measures and ratings (ex. motivation).

Results

The complex nature of the design leads to many main effects and interactions. Full ANOVA and means tables are presented in the Appendices. For clarity and to reduce concerns about alpha inflation due to multiple comparisons, I focus the presentation here on the between-subjects effects most relevant to the hypotheses laid out in the introduction.

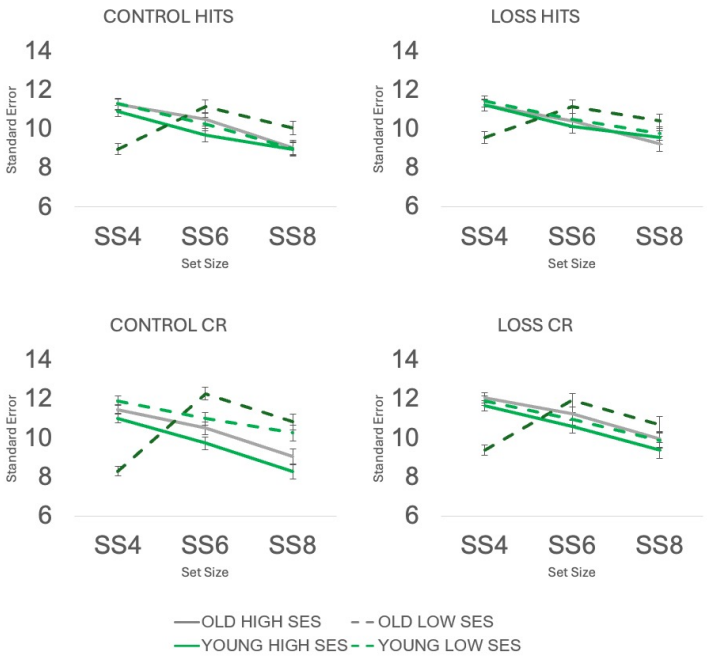
First, it is important to note that even the high-SES group did not replicate the Jang et al. (2022) finding of loss-incentive-induced reductions in working memory performance and motivation. I therefore turn to a more exploratory consideration of the effects related to age group, SES, and incentive condition.

Working memory performance

Please refer to Appendix A for all working memory performance mean tables. I analyzed the data separately for hits (correctly responding "yes" to studied probes) and correct rejections (correctly responding "no" to unstudied probes). For hits, none of the between-subjects effects approached statistical significance for their performance, all $p > .15$, all $\eta^2_G < .006$. For correct rejections, there was a significant Incentive Condition X SES interaction $F(1, 222) = 4.173$, $p = .042$, $\eta^2_G = .012$. As seen in Figure 1, both young and older adult high-SES participants in the control condition had lower correct rejection rates than those in the loss condition, whereas low-SES young and older adults had relatively high correct rejection rates regardless of incentive condition. The main effect of SES was also statistically significant, $F(1,222) = 6.820$, $p = .010$, $\eta^2_G = .019$, reflecting the overall higher correct rejection rate by the low-SES group.

Figure 1

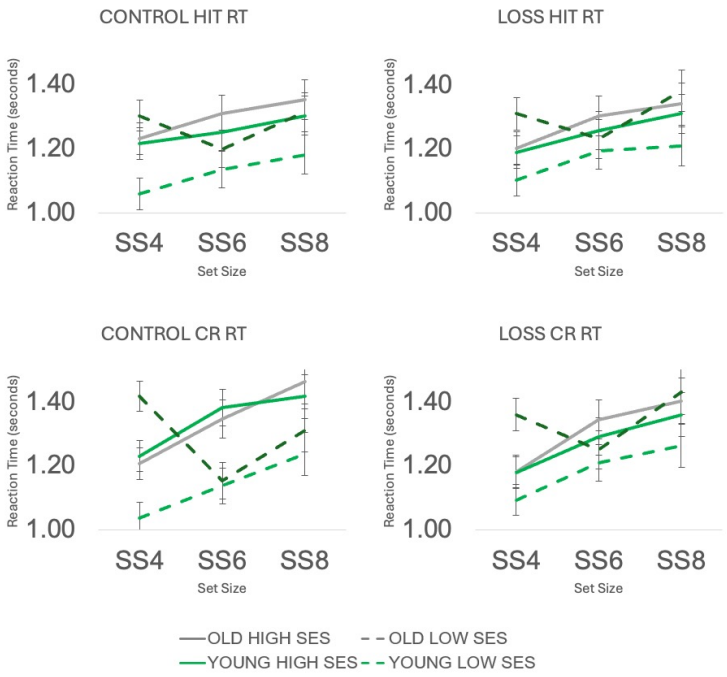
Control vs. Loss Incentive Group Hits vs Correct Rejection Accuracy



I next examined median response times, again separately for hits and correct rejections. For hits, older adults were slower than young adults, as is typically the case, $F(1, 222) = 6.707$, $p = .010$, $\eta^2_G = .024$. Figure 2 suggests that the age difference may have been slightly larger for the low-SES group, but this did not reach statistical significance, $F(1,222) = 2.817$, $p = .095$, $\eta^2_G = .010$. Interestingly, this trend seems to occur because the low-SES young adults were numerically faster than the high-SES young adults, rather than the low-SES older adults being lower than the high-SES older adults. The results for correct rejection RTs showed a similar pattern: older adults were slower than young adults overall, $F(1,222) = 4.966$, $p = .027$, $\eta^2_G = .015$, and the numerical pattern of a greater age difference for the low-SES groups did not reach statistical significance, $F(1,222) = 3.522$, $p = .062$, $\eta^2_G = .011$.

Figure 2

Control vs. Loss Incentive Group Hits vs Correct Rejection Reaction Times



Ratings

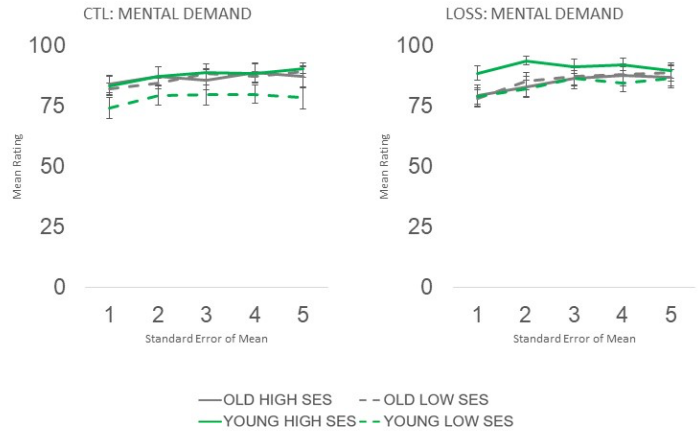
Figures in each section show the results for each NASA-TLX rating. Full ANOVA tables are in Appendix B. For the original NASA-TLX items, higher ratings indicate higher subjective load or demand. In general, these items showed an increase in ratings across runs, reflecting fatigue as the task went on. Distraction likewise increased across runs, whereas motivation decreased. Below we describe significant between-subjects effects for each item.

Mental demand

Although the Age X SES interaction did not reach statistical significance, $F(1, 222) = 3.584$, $p = .060$, $\eta^2_G = .012$, numerically the pattern of higher demand ratings by the high-SES group appeared to be restricted to young adults. We did not find an age difference, which differs from Jang et al. (2022) where older adults reported higher demand levels.

Figure 3

Control and Loss Group NASA-TLX Rating: Mental Demand

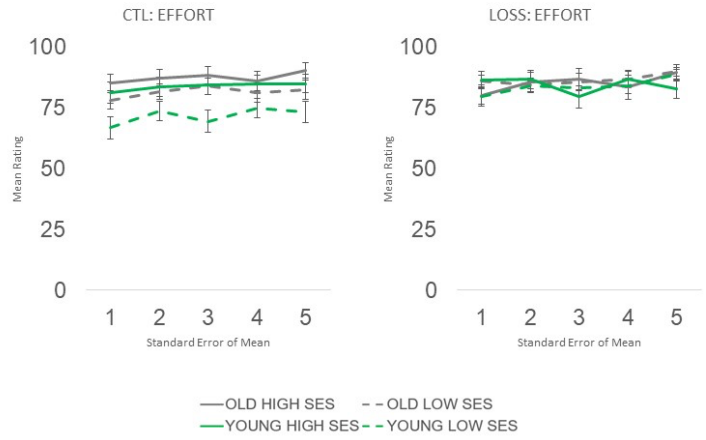


Effort

The Condition X SES interaction was statistically significant, $F(1,222) = 4.648$, $p = .023$, $\eta^2_G = .032$. In the control condition, low-SES young and older adults gave lower ratings for effort required to maintain their performance than did their high-SES peers, whereas all the age and SES groups had similar results in the loss condition. Older adults numerically reported higher effort levels than did young adults, although this did not reach standard levels for statistical significance ($p = .058$).

Figure 4

Control and Loss Group NASA-TLX Rating: Effort

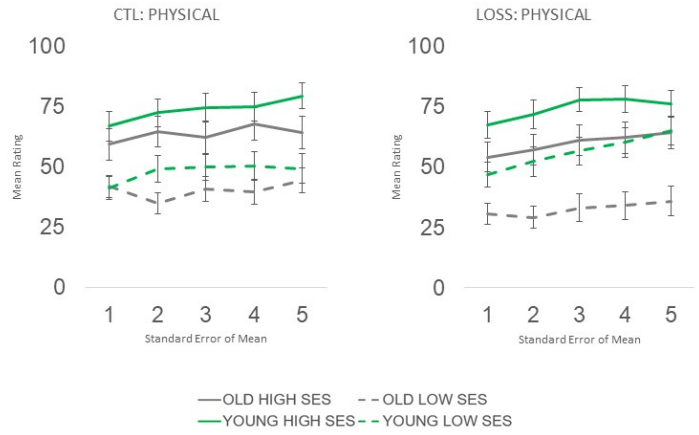


Physical

Surprisingly, young adults reported higher levels of physical demand than did older adults, $F(1,222) = 13.876$, $p < .001$, $\eta^2_G = .043$. High SES participants also reported higher levels of physical demand than did low SES participants, SES $F(1,222) = 39.476$, $p < .001$, $\eta^2_G = .122$.

Figure 5

Control and Loss Group NASA-TLX Rating: Physical

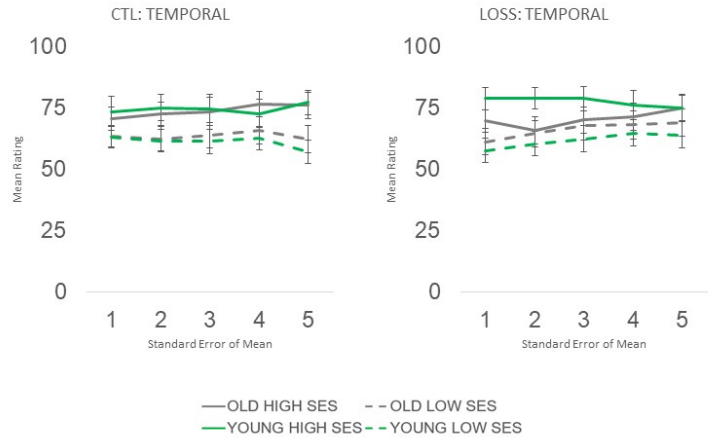


Temporal

Higher SES participants overall reported higher temporal demand than lower SES participants, $F(1,222) = 10.51$, $p = .001$, $\eta^2_G = .037$.

Figure 6

Control and Loss Group NASA-TLX Rating: Temporal

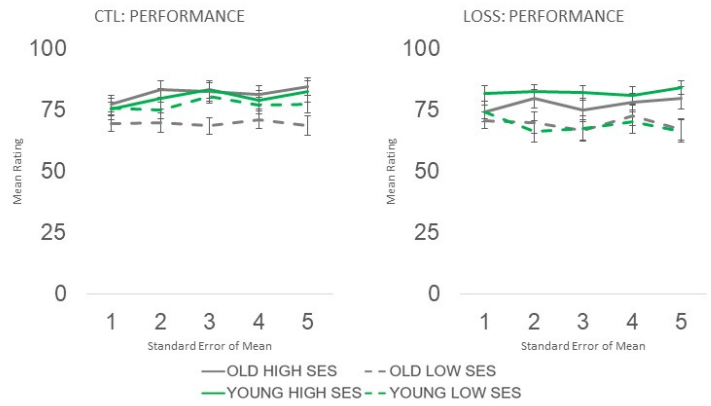


Performance

It should be noted that the Performance measure is a bit counterintuitive as the highest score represents 'failure', i.e., high ratings indicate that subjective performance is poor. Only SES was significant, with higher ratings (poorer subjective performance) by high-SES participants, $F(1,222) = 18.602$, $p < .001$, $\eta^2_G = .050$.

Figure 7

Control and Loss Group NASA-TLX Rating: Performance



Frustration

There was a significant Age X SES X Run interaction, $F(4, 888) = 3.062$, $p = .016$, $\eta 2G = .003$. For older adults, the low-SES group had a higher initial rate of frustration that stayed flat across the runs, whereas the high-SES group started with the lowest frustration levels of any group in the first two runs and then increased to similar levels of frustration as the low-SES group (see Figure 8). For young adults, both SES groups showed an increase across the runs, although this pattern was slightly noisier for the high-SES group.

Figure 8

Control and Loss Group NASA-TLX Rating: Frustration

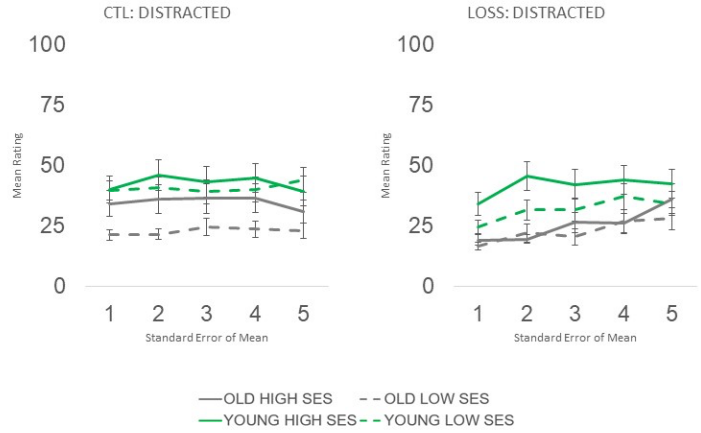


Distraction

Older adults reported being less distracted than young adults, $F(1,222) = 19.358$, $p < .001$, $\eta^2_G = .056$. This pattern replicates that seen by Jang et al. (2022).

Figure 9

Control and Loss Group NASA-TLX Rating: Distraction

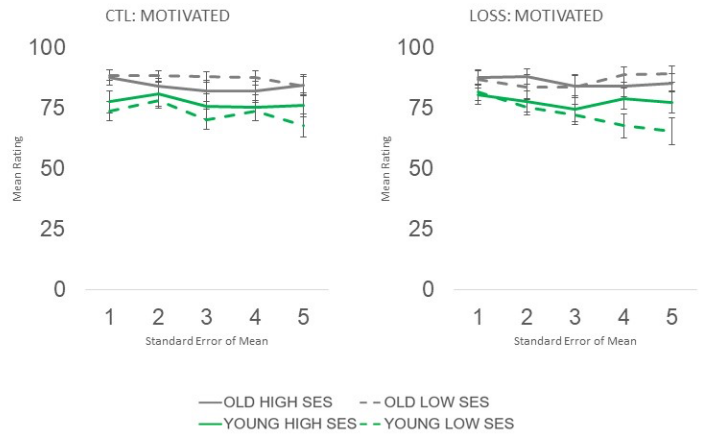


Motivation

Older adults overall reported higher motivation than did young adults, $F(1,222) = 20.300$, $p < .001$, $\eta^2_G = .058$. However, unlike Jang et al. (2022), in the present dataset the age effect did not interact with incentive condition, $F < 1$.

Figure 10

Control and Loss Group NASA-TLX Rating: Motivation



Secondary question: Retention interval effects

As noted in the introduction, a secondary purpose of this experiment unrelated to the incentive and SES questions was whether the working memory task results would replicate Jang et al's unexpected finding of better correct rejection performance after the longer (16 sec) vs shorter (4 sec) retention interval. This was indeed the case. Hits showed the typical pattern of reduced accuracy in the longer retention interval condition, $F(1, 222) = 84.415$, $p < .001$, $\eta^2_G = .032$ In contrast, correct rejections were higher in the longer retention interval than in the shorter one, $F(1,222) = 476.158$, $p < .001$, $\eta^2_G = .098$. For both response types, response times were faster in the long retention interval condition, both $p < .001$ $\eta^2_G > .01$.

Discussion

The original question that inspired this experiment was whether age differences in sensitivity to monetary incentives for cognitive performance seen in some previous studies (Culter et al., 2021; Lustig et al., 2019; Dhingra, 2020; Samanez-Larkin et al., 2015; Jang et al., 2022; Mikels, 2009; Spaniol, 2011; but see Opitz et al., 2022) might be an artifact of age differences in financial resources (Kieffer & Goh, 1981). However, even our high-SES groups did not replicate previous findings of either reduced incentive responses in older adults or a paradoxical reduction in performance by older adults in response to a loss incentive (Jang et al., 2022). Instead, both high SES young and older adults in the loss-incentive condition had higher correct rejection rates than did their peers in the control condition, whereas low-SES young and older adults were less responsive to the incentive.

The procedures in this study closely followed those of Jang et al. (2022). In that study, the young adults were University of Michigan college students, and the older adults were members of the Ann Arbor community. Although Jang et al. (2022) did not ask participants about SES, the college students overall likely had fewer financial resources than the older adults, many of whom are alumni. However, while that study found that loss incentive increased the performance of young adults and decreased it for older adults, we did not find that here. Instead, both high-SES age groups improved performance in the loss condition, specifically for correct rejections. What might underlie the different patterns across studies?

One possibility is that Jang et al. (2022) was a chance finding. It cannot be ruled out but seems less likely given that several other studies in our lab have found detrimental effects of the loss incentive for older adults (Jang, Lin, & Lustig, 2020; Lin, Berry, & Lustig, in prep.) and that this pattern has also been observed other studies (Barber et al., 2015). A different possibility

could exist: the use of the online study format and Prolific participants. In person trials (Jang et al. and other studies) for the loss incentive had money placed in the participant's view, and they were able to physically see the reduction in money at the end of each run. Thus, in those studies the loss incentive is very salient and hard to ignore whereas in online testing it is much less salient and easier to ignore.

Additionally, there could be differences in participant motivation. Although Ann Arbor older adults are very motivated, Prolific older adults may be even more so. Prolific participants are also motivated to perform well across the studies: if they have too many entries rejected for deficient performance they may be screened out of many studies or even removed from the participant pool. Older adults in the present study gave higher motivation ratings overall (M 85.68, 95% CI 82.32 89.05) than those in Jang et al. (M 79.83, 95% CI 75.18 84.47), whereas for young adults the ratings were slightly higher but more similar (M = 74.81, 95% CI 71.45 78.17 vs 71.53, 95% CI 66.637 76.424). Furthermore, we did not replicate the loss incentive induced reduction in motivation seen in the Jang et al. (2022) older adults.

Likewise, where Jang et al. (2022) found that older adults reported higher Mental Demand overall than did young adults, and that this was especially true in the loss condition, the present study found a more complex pattern. Although the interaction did not reach statistical significance ($p = .06$), numerically high-SES young adults reported higher Mental Demand than high SES older adults, and indeed than any other group. The low SES group showed the more typical pattern of higher Mental Demand ratings by older adults. In general, the high SES participants had higher ratings on the NASA-TLX, and this was especially true for young adults. This is rather surprising, as one might have expected that high-SES young adults would have the greatest cognitive abilities of all the groups due to their youth and the advantages in education,

nutrition, and other brain-health promoting factors that come with higher SES, and that they would have therefore found the task the easiest.

This paradoxical finding of higher subjective load for high SES participants might reflect differences in the demands that these different groups face in everyday life, and how difficult the working memory task was in comparison. That is, the jobs and everyday experiences of low-SES groups are often more challenging than those of high-SES groups. Thus, for low-SES participants, pressing a button for a working memory task might seem like an easy task when compared to the demands of their everyday lives, whereas high-SES participants might find it more onerous than their everyday activities. Alternatively, there may be a selection bias for the low-SES group. Prolific may be well-known in the community of cognitive and behavioral researchers, whereas it is less well known outside of scientific and academic settings, including those involved in the education of high SES individuals. Thus, even though we tried to increase generalizability by recruiting both high and low SES groups, we may have ended up with a selection bias that was especially strong in the low SES group. For example, the low SES young adults could be individuals who are from a low SES background but who are in the beginning stages of a college scholarship and thus are a particularly capable and motivated subset of low SES young adults. Likewise, older adults who are aware of Prolific, technically savvy enough to access it and set up an account, and who are motivated to do so may be a select group in general, and this may be especially true for those of low SES backgrounds.

A different perceptive to consider is the economy where participants currently reside. The racial and geographic distribution of participants is not evenly distributed across our different quasi-experimental groups. The racial distribution of young high SES participants was majority black adults and for old high SES participants the distribution was majority white. Participants in

the young low SES group were primarily black and the participants in the old low SES group were primarily white. In the US, we typically see people of color and other minorities in the low SES population while white people are found in the high SES population. This is not the case for some of the countries where our black participants reside in, such as Kenya, Nigeria, and South Africa. Moreover, the economy strength of the US and African countries is different-- $15 USD may have a different practical impact for those residing in the US versus other locations. This could potentially offer a partial explanation of why high SES participants were sensitive to incentives. Future research should consider the strength of the economy of where participants reside in.

Why was the better performance in the loss condition by high-SES participants restricted to correct rejections? This is not entirely clear, but it may be because correct rejections are the more difficult decision and may require more cognitive control. Hits are items that serve as a cue for itself whereas correct rejections need to search an entire memory set, which may require greater inhibition. The need to search an entire memory set to correctly reject a probe rather than searching for the probe itself increases difficulty of a task and therefore increases reaction times (Sternberg, 1969; Klabes et al., 2021).

This study looked at age differences in sensitivity to monetary incentives and whether it was a product of age differences in financial resources. The failure to replicate the original finding from Jang et al. (2022) in our high SES groups made it difficult to assess the original hypotheses in the way planned at the outset of the experiment. However, the results found are interesting and point to new research questions. These include further exploration of why correct rejection performance might be especially sensitive to incentives and motivation, and potential differences between in-person and online samples. Furthermore, this study also shows how

different age groups and socioeconomic status participants feel mentally, emotionally, and physically as they complete an incentivized working memory task. Future research should attempt to directly compare in-person participant testing to online testing and explore the reasons why some aspects of working memory performance may be more sensitive to SES and incentive effects.

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Appendix A
Means Tables for Working Memory Performance

Table A1

Mean Number of HITS Across Conditions by Retention Rate, Set Size, Age Group, and SES

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
RI4, SS4	Old	Control	11.86, 1.620, 29	11.40, 1.329, 30
	Young	Control	11.45, 1.938, 29	11.93, 1.230, 30
	Old	Loss	11.50, 2.404, 26	11.74, 1.745, 27
	Young	Loss	11.86, 1.529, 29	11.90, 1.517, 30
RI4, SS6	Old	Control	10.69, 1.713, 29	10.53, 2.389, 30
	Young	Control	9.69, 3.025, 29	10.90, 1.971, 30
	Old	Loss	10.85, 2.493, 26	10.67, 2.353, 27
	Young	Loss	10.48, 2.132, 29	10.90, 1.936, 30
RI4, SS8	Old	Control	9.14, 1.941, 29	8.93, 1.701, 30
	Young	Control	9.24, 2.668, 29	9.27, 1.874, 30
	Old	Loss	9.58, 2.501, 26	9.96, 2.653, 27
	Young	Loss	9.76, 1.939, 29	10.17, 2.183, 30
RI16, SS4	Old	Control	10.69, 1.312, 29	10.93, 1.363, 30
	Young	Control	10.45, 2.046, 29	10.70, 1.622, 30
	Old	Loss	11.00, 1.549, 26	10.59, 2.515, 27
	Young	Loss	10.62, 1.916, 29	10.97, 1.326, 30
RI16, SS6	Old	Control	10.34, 1.173, 29	9.63, 1.771, 30
	Young	Control	9.69, 2.123, 29	9.67, 1.863, 30
	Old	Loss	10.04, 2.271, 26	10.19, 1.798, 27
	Young	Loss	9.83, 2.054, 29	10.10, 2.006, 30
RI16, SS8	Old	Control	9.00, 1.832, 29	8.93, 1.982, 30
	Young	Control	8.72, 2.282, 29	8.80, 1.827, 30
	Old	Loss	8.92, 2.465, 26	8.59, 2.206, 27
	Young	Loss	9.41, 2.338, 29	9.43, 2.285, 30

Table A2

Mean Number of Correct Rejections Across Conditions by Retention Rate, Set Size, Age Group, and SES

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
RI4, SS4	Old	Control	10.79, 2.210, 29	11.73, 0.521, 30
	Young	Control	10.55, 2.131, 29	11.43, 0.728, 30
	Old	Loss	11.69, 0.679, 26	11.33, 1.301, 27
	Young	Loss	11.14, 1.302, 29	11.50, 1.383, 30

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
RI4, SS6	Old	Control	9.55, 2.487, 29	9.87, 1.634, 30
	Young	Control	8.93, 2.672, 29	10.17, 1.621, 30
	Old	Loss	10.62, 1.267, 26	9.93, 1.838, 27
	Young	Loss	9.83, 2.172, 29	10.43, 1.794, 30
RI4, SS8	Old	Control	8.14, 2.997, 29	8.77, 2.029, 30
	Young	Control	7.31, 2.537, 29	9.93, 1.893, 30
	Old	Loss	8.77, 2.372, 26	9.52, 2.137, 27
	Young	Loss	8.41, 2.196, 29	8.93, 1.999, 30
RI16, SS4	Old	Control	12.17, 2.253, 29	12.83, 0.379, 30
	Young	Control	11.52, 2.293, 29	12.43, 0.817, 30
	Old	Loss	12.46, 1.029, 26	12.56, 0.974, 27
	Young	Loss	12.21, 1.320, 29	12.37, 1.273, 30
RI16, SS6	Old	Control	11.48, 2.530, 29	11.80, 1.424, 30
	Young	Control	10.55, 2.599, 29	11.83, 1.315, 30
	Old	Loss	11.92, 1.695, 26	11.48, 1.968, 27
	Young	Loss	11.38, 1.971, 29	11.53, 1.995, 30
RI16, SS8	Old	Control	9.97, 3.065, 29	10.43, 1.977, 30
	Young	Control	9.28, 2.433, 29	10.60, 2.372, 30
	Old	Loss	11.12, 1.946, 26	10.89, 2.547, 27
	Young	Loss	10.34, 2.525, 29	10.83, 2.437, 30

Table A3

Mean Response Times (RT) for HITS Across Conditions by Retention Rate, Set Size, Age Group, and SES

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
RI4, SS4	Old	Control	1.2810, 0.29826, 29	1.2123, 0.28241, 30
	Young	Control	1.2490, 0.31284, 29	1.0980, 0.31880, 30
	Old	Loss	1.1931, 0.26780, 26	1.2437, 0.25456, 27
	Young	Loss	1.2166, 0.29774, 29	1.1153, 0.22964, 30
RI4, SS6	Old	Control	1.4076, 0.31864, 29	1.3297, 0.32698, 30
	Young	Control	1.2928, 0.42387, 29	1.1800, 0.32672, 30
	Old	Loss	1.3831, 0.32779, 26	1.4270, 0.36323, 27
	Young	Loss	1.3041, 0.36587, 29	1.2083, 0.29144, 30
RI4, SS8	Old	Control	1.4483, 0.36409, 29	1.4133, 0.35076, 30
	Young	Control	1.4141, 0.45634, 29	1.2270, 0.30779, 30
	Old	Loss	1.4177, 0.31560, 26	1.4759, 0.33785, 27
	Young	Loss	1.3603, 0.47240, 29	1.2097, 0.30317, 30
RI16, SS4	Old	Control	1.1831, 0.27145, 29	1.1873, 0.26097, 30
	Young	Control	1.1828, 0.37348, 29	1.0200, 0.24663, 30

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
	Old	Loss	1.2119, 0.28844, 26	1.2174, 0.27341, 27
	Young	Loss	1.1634, 0.30513, 29	1.0887, 0.21133, 30
RI16, SS6	Old	Control	1.2117, 0.29399, 29	1.3010, 0.34594, 30
	Young	Control	1.2121, 0.40896, 29	1.0920, 0.25205, 30
	Old	Loss	1.2227, 0.29037, 26	1.3370, 0.31484, 27
	Young	Loss	1.2121, 0.37874, 29	1.1810, 0.31696, 30
RI16, SS8	Old	Control	1.2586, 0.31456, 29	1.2647, 0.32807, 30
	Young	Control	1.1931, 0.37314, 29	1.1353, 0.29518, 30
	Old	Loss	1.2650, 0.33158, 26	1.3367, 0.32161, 27
	Young	Loss	1.2603, 0.44732, 29	1.2093, 0.32490, 30

Table A4

Mean Response Times (RT) for Correct Rejections Across Conditions by Retention Rate, Set Size, Age Group, and SES

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
RI4, SS4	Old	Control	1.232, 0.278, 28	1.147, 0.264, 30
	Young	Control	1.258, 0.366, 29	1.057, 0.275, 30
	Old	Loss	1.175, 0.276, 26	1.235, 0.261, 27
	Young	Loss	1.214, 0.345, 29	1.088, 0.211, 30
RI4, SS6	Old	Control	1.445, 0.350, 28	1.379, 0.368, 30
	Young	Control	1.529, 0.443, 29	1.209, 0.304, 30
	Old	Loss	1.436, 0.353, 26	1.481, 0.296, 27
	Young	Loss	1.358, 0.428, 29	1.257, 0.287, 30
RI4, SS8	Old	Control	1.597, 0.360, 28	1.418, 0.404, 30
	Young	Control	1.555, 0.518, 29	1.332, 0.342, 30
	Old	Loss	1.522, 0.444, 26	1.487, 0.377, 27
	Young	Loss	1.454, 0.526, 29	1.348, 0.406, 30
RI16, SS4	Old	Control	1.182, 0.274, 28	1.159, 0.285, 30
	Young	Control	1.204, 0.325, 29	1.018, 0.226, 30
	Old	Loss	1.189, 0.297, 26	1.267, 0.246, 27
	Young	Loss	1.146, 0.299, 29	1.098, 0.252, 30
RI16, SS6	Old	Control	1.249, 0.297, 28	1.245, 0.332, 30
	Young	Control	1.237, 0.306, 29	1.065, 0.255, 30
	Old	Loss	1.255, 0.336, 26	1.382, 0.318, 27
	Young	Loss	1.226, 0.367, 29	1.163, 0.273, 30
RI16, SS8	Old	Control	1.333, 0.321, 28	1.287, 0.340, 30
	Young	Control	1.281, 0.367, 29	1.142, 0.318, 30
	Old	Loss	1.283, 0.339, 26	1.422, 0.346, 27

Retention Rate, Set Size	Age Group	Condition	High SES (M, SD, N)	Low SES (M, SD, N)
	Young	Loss	1.267, 0.479, 29	1.180, 0.308, 30

Appendix B
ANOVA Analyses of NASA-TLX Ratings

Table B1

ANOVA Analysis of NASA-TLX: Mental Demand Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	6131.074 [a]	4[a]	1532.769[a]	17.503[a]	< .001[a]	0.015
Run ∗ CONDITION	116.262 [a]	4[a]	29.066[a]	0.332[a]	0.857[a]	2.861×10^{-4}
Run ∗ SESCondPRO	337.218 [a]	4[a]	84.305[a]	0.963[a]	0.427[a]	8.295×10^{-4}
Run ∗ AgeGroup	279.875 [a]	4[a]	69.969[a]	0.799[a]	0.526[a]	6.885×10^{-4}
Run ∗ CONDITION ∗ SESCondPRO	140.281 [a]	4[a]	35.070[a]	0.400[a]	0.808[a]	3.452×10^{-4}
Run ∗ CONDITION ∗ AgeGroup	285.904 [a]	4[a]	71.476[a]	0.816[a]	0.515[a]	7.033×10^{-4}
Run ∗ SESCondPRO ∗ AgeGroup	56.754 [a]	4[a]	14.189[a]	0.162[a]	0.958[a]	1.397×10^{-4}
Run ∗ CONDITION ∗ SESCondPRO ∗ AgeGroup	720.362 [a]	4[a]	180.090[a]	2.057[a]	0.085[a]	0.002
Residuals	77761.571	888	87.569			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B2

ANOVA Analysis of NASA-TLX: Mental Demand Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	696.113	1	696.113	0.470	0.493	0.002
SESCondPRO	4909.167	1	4909.167	3.318	0.070	0.012
AgeGroup	73.183	1	73.183	0.049	0.824	1.801×10^{-4}
CONDITION ∗ SESCondPRO	206.525	1	206.525	0.140	0.709	5.082×10^{-4}
CONDITION ∗ AgeGroup	2419.359	1	2419.359	1.635	0.202	0.006
SESCondPRO ∗ AgeGroup	5303.141	1	5303.141	3.584	0.060	0.013
CONDITION ∗ SESCondPRO ∗ AgeGroup	13.954	1	13.954	0.009	0.923	3.435×10^{-5}
Residuals	328456.542	222	1479.534			

Note. Type III Sum of Squares

Table B3

ANOVA Analysis of NASA-TLX: Effort Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	2783.945[a]	4[a]	695.986[a]	5.063[a]	< .001[a]	0.006
Run ✻ CONDITION	325.529[a]	4[a]	81.382[a]	0.592[a]	0.668[a]	7.511×10^{-4}
Run ✻ SESCondPRO	222.217[a]	4[a]	55.554[a]	0.404[a]	0.806[a]	5.128×10^{-4}
Run ✻ AgeGroup	1003.550[a]	4[a]	250.888[a]	1.825[a]	0.122[a]	0.002
Run ✻ CONDITION ✻ SESCondPRO	489.241[a]	4[a]	122.310[a]	0.890[a]	0.469[a]	0.001
Run ✻ CONDITION ✻ AgeGroup	179.613[a]	4[a]	44.903[a]	0.327[a]	0.860[a]	4.146×10^{-4}
Run ✻ SESCondPRO ✻ AgeGroup	911.791[a]	4[a]	227.948[a]	1.658[a]	0.158[a]	0.002
Run ✻ CONDITION ✻ SESCondPRO ✻ AgeGroup	990.865[a]	4[a]	247.716[a]	1.802[a]	0.126[a]	0.002
Residuals	122069.922	888	137.466			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B4

ANOVA Analysis of NASA-TLX: Effort Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	4282.221	1	4282.221	3.057	0.082	0.010
SESCondPRO	5264.739	1	5264.739	3.758	0.054	0.012
AgeGroup	5092.535	1	5092.535	3.635	0.058	0.012
CONDITION ✻ SESCondPRO	6512.392	1	6512.392	4.648	0.032	0.015
CONDITION ✻ AgeGroup	1883.169	1	1883.169	1.344	0.248	0.004
SESCondPRO ✻ AgeGroup	1196.895	1	1196.895	0.854	0.356	0.003
CONDITION ✻ SESCondPRO ✻ AgeGroup	312.317	1	312.317	0.223	0.637	7.206×10^{-4}
Residuals	311019.894	222	1400.991			

Note. Type III Sum of Squares

Table B5

ANOVA Analysis of NASA-TLX: Physical Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	11590.310[a]	4[a]	2897.577[a]	15.708[a]	< .001[a]	0.011
Run ✻ CONDITION	735.583[a]	4[a]	183.896[a]	0.997[a]	0.408[a]	6.932×10^{-4}
Run ✻ SESCondPRO	478.991[a]	4[a]	119.748[a]	0.649[a]	0.628[a]	4.515×10^{-4}
Run ✻ AgeGroup	1735.058[a]	4[a]	433.764[a]	2.352[a]	0.053[a]	0.002

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run ∗ CONDITION ∗ SESCondPRO	463.800[a]	4[a]	115.950[a]	0.629[a]	0.642[a]	4.372×10^{-4}
Run ∗ CONDITION ∗ AgeGroup	165.090[a]	4[a]	41.273[a]	0.224[a]	0.925[a]	1.557×10^{-4}
Run ∗ SESCondPRO ∗ AgeGroup	1013.561[a]	4[a]	253.390[a]	1.374[a]	0.241[a]	9.549×10^{-4}
Run ∗ CONDITION ∗ SESCondPRO ∗ AgeGroup	1355.345[a]	4[a]	338.836[a]	1.837[a]	0.120[a]	0.001
Residuals	163801.301	888	184.461			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B6

ANOVA Analysis of NASA-TLX: Physical Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	123.812	1	123.812	0.031	0.861	1.167×10^{-4}
SESCondPRO	159439.883	1	159439.883	39.476	< .001	0.131
AgeGroup	56043.812	1	56043.812	13.876	< .001	0.050
CONDITION ∗ SESCondPRO	262.714	1	262.714	0.065	0.799	2.477×10^{-4}
CONDITION ∗ AgeGroup	7415.051	1	7415.051	1.836	0.177	0.007
SESCondPRO ∗ AgeGroup	847.630	1	847.630	0.210	0.647	7.987×10^{-4}
CONDITION ∗ SESCondPRO ∗ AgeGroup	2352.901	1	2352.901	0.583	0.446	0.002
Residuals	896647.119	222	4038.951			

Note. Type III Sum of Squares

Table B7

ANOVA Analysis of NASA-TLX: Temporal Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	1115.653[a]	4[a]	278.913[a]	1.695[a]	0.149[a]	0.001
Run ∗ CONDITION	461.190[a]	4[a]	115.297[a]	0.701[a]	0.592[a]	5.294×10^{-4}
Run ∗ SESCondPRO	479.212[a]	4[a]	119.803[a]	0.728[a]	0.573[a]	5.501×10^{-4}
Run ∗ AgeGroup	1018.466[a]	4[a]	254.616[a]	1.547[a]	0.186[a]	0.001
Run ∗ CONDITION ∗ SESCondPRO	1548.190[a]	4[a]	387.047[a]	2.352[a]	0.053[a]	0.002
Run ∗ CONDITION ∗ AgeGroup	184.552[a]	4[a]	46.138[a]	0.280[a]	0.891[a]	2.119×10^{-4}
Run ∗ SESCondPRO ∗ AgeGroup	386.199[a]	4[a]	96.550[a]	0.587[a]	0.672[a]	4.434×10^{-4}

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run ∗ CONDITION ∗ SESCondPRO ∗ AgeGroup	464.939[a]	4[a]	116.235[a]	0.706[a]	0.588[a]	5.337×10^{-4}
Residuals	146131.482	888	164.562			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B8

ANOVA Analysis of NASA-TLX: Temporal Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	112.030	1	112.030	0.034	0.853	1.287×10^{-4}
SESCondPRO	34302.670	1	34302.670	10.510	0.001	0.038
AgeGroup	36.054	1	36.054	0.011	0.916	4.141×10^{-5}
CONDITION ∗ SESCondPRO	273.731	1	273.731	0.084	0.772	3.143×10^{-4}
CONDITION ∗ AgeGroup	364.231	1	364.231	0.112	0.739	4.182×10^{-4}
SESCondPRO ∗ AgeGroup	3840.212	1	3840.212	1.177	0.279	0.004
CONDITION ∗ SESCondPRO ∗ AgeGroup	1245.776	1	1245.776	0.382	0.537	0.001
Residuals	724549.007	222	3263.734			

Note. Type III Sum of Squares

Table B9

ANOVA Analysis of NASA-TLX: Performance Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	312.882	4	78.221	0.412	0.800	6.898×10^{-4}
Run ∗ CONDITION	1392.171	4	348.043	1.832	0.121	0.003
Run ∗ SESCondPRO	2386.516	4	596.629	3.140	0.014	0.005
Run ∗ AgeGroup	960.094	4	240.023	1.263	0.283	0.002
Run ∗ CONDITION ∗ SESCondPRO	97.870	4	24.468	0.129	0.972	2.159×10^{-4}
Run ∗ CONDITION ∗ AgeGroup	303.080	4	75.770	0.399	0.810	6.682×10^{-4}
Run ∗ SESCondPRO ∗ AgeGroup	32.725	4	8.181	0.043	0.996	7.220×10^{-5}
Run ∗ CONDITION ∗ SESCondPRO ∗ AgeGroup	56.296	4	14.074	0.074	0.990	1.242×10^{-4}
Residuals	168716.854	888	189.996			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B10

ANOVA Analysis of NASA-TLX: Performance Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	1950.016	1	1950.016	1.521	0.219	0.004
SESCondPRO	23841.549	1	23841.549	18.602	< .001	0.050
AgeGroup	1884.745	1	1884.745	1.471	0.227	0.004
CONDITION ✻ SESCondPRO	664.503	1	664.503	0.518	0.472	0.001
CONDITION ✻ AgeGroup	25.459	1	25.459	0.020	0.888	5.617×10^{-5}
SESCondPRO ✻ AgeGroup	300.051	1	300.051	0.234	0.629	6.616×10^{-4}
CONDITION ✻ SESCondPRO ✻ AgeGroup	3889.742	1	3889.742	3.035	0.083	0.009
Residuals	284530.369	222	1281.668			

Note. Type III Sum of Squares

Table B11

ANOVA Analysis of NASA-TLX: Frustration Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	2470.856[a]	4[a]	617.714[a]	2.390[a]	0.049[a]	0.002
Run ✻ CONDITION	2194.316[a]	4[a]	548.579[a]	2.123[a]	0.076[a]	0.002
Run ✻ SESCondPRO	361.256[a]	4[a]	90.314[a]	0.349[a]	0.845[a]	3.498×10^{-4}
Run ✻ AgeGroup	2856.217[a]	4[a]	714.054[a]	2.763[a]	0.027[a]	0.003
Run ✻ CONDITION ✻ SESCondPRO	1513.134[a]	4[a]	378.283[a]	1.464[a]	0.211[a]	0.001
Run ✻ CONDITION ✻ AgeGroup	1075.478[a]	4[a]	268.869[a]	1.040[a]	0.385[a]	0.001
Run ✻ SESCondPRO ✻ AgeGroup	3165.059[a]	4[a]	791.265[a]	3.062[a]	0.016[a]	0.003
Run ✻ CONDITION ✻ SESCondPRO ✻ AgeGroup	711.889[a]	4[a]	177.972[a]	0.689[a]	0.600[a]	6.890×10^{-4}
Residuals	229506.903	888	258.454			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B12

ANOVA Analysis of NASA-TLX: Frustration Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	49.638	1	49.638	0.014	0.907	4.807×10^{-5}
SESCondPRO	3558.518	1	3558.518	0.984	0.322	0.003

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
AgeGroup	1995.056	1	1995.056	0.552	0.458	0.002
CONDITION ✻ SESCondPRO	5859.386	1	5859.386	1.620	0.204	0.006
CONDITION ✻ AgeGroup	3601.343	1	3601.343	0.996	0.319	0.003
SESCondPRO ✻ AgeGroup	3738.553	1	3738.553	1.034	0.310	0.004
CONDITION ✻ SESCondPRO ✻ AgeGroup	129.631	1	129.631	0.036	0.850	1.255×10^{-4}
Residuals	802986.353	222	3617.056			

Note. Type III Sum of Squares

Table B13

ANOVA Analysis of NASA-TLX: Distraction Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	5751.856[a]	4[a]	1437.964[a]	6.212[a]	< .001[a]	0.008
Run ✻ CONDITION	3847.932[a]	4[a]	961.983[a]	4.156[a]	0.002[a]	0.005
Run ✻ SESCondPRO	414.470[a]	4[a]	103.617[a]	0.448[a]	0.774[a]	5.594×10^{-4}
Run ✻ AgeGroup	1084.790[a]	4[a]	271.197[a]	1.172[a]	0.322[a]	0.001
Run ✻ CONDITION ✻ SESCondPRO	1304.034[a]	4[a]	326.009[a]	1.408[a]	0.229[a]	0.002
Run ✻ CONDITION ✻ AgeGroup	1334.427[a]	4[a]	333.607[a]	1.441[a]	0.218[a]	0.002
Run ✻ SESCondPRO ✻ AgeGroup	762.252[a]	4[a]	190.563[a]	0.823[a]	0.510[a]	0.001
Run ✻ CONDITION ✻ SESCondPRO ✻ AgeGroup	449.024[a]	4[a]	112.256[a]	0.485[a]	0.747[a]	6.060×10^{-4}
Residuals	205545.431	888	231.470			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B14

ANOVA Analysis of NASA-TLX: Distraction Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	6604.205	1	6604.205	2.740	0.099	0.009
SESCondPRO	12485.276	1	12485.276	5.181	0.024	0.017
AgeGroup	46649.597	1	46649.597	19.358	< .001	0.059
CONDITION ✻ SESCondPRO	44.636	1	44.636	0.019	0.892	6.027×10^{-5}
CONDITION ✻ AgeGroup	4.278	1	4.278	0.002	0.966	5.777×10^{-6}
SESCondPRO ✻ AgeGroup	142.146	1	142.146	0.059	0.808	1.919×10^{-4}
CONDITION ✻ SESCondPRO ✻ AgeGroup	5302.097	1	5302.097	2.200	0.139	0.007

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Residuals	534993.536	222	2409.881			

Note. Type III Sum of Squares

Table B15

ANOVA Analysis of NASA-TLX: Motivation Within Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
Run	3436.140[a]	4[a]	859.035[a]	4.724[a]	< .001[a]	0.006
Run ∗ CONDITION	469.000[a]	4[a]	117.250[a]	0.645[a]	0.631[a]	8.803×10^{-4}
Run ∗ SESCondPRO	613.716[a]	4[a]	153.429[a]	0.844[a]	0.498[a]	0.001
Run ∗ AgeGroup	1259.894[a]	4[a]	314.973[a]	1.732[a]	0.141[a]	0.002
Run ∗ CONDITION ∗ SESCondPRO	492.229[a]	4[a]	123.057[a]	0.677[a]	0.608[a]	9.238×10^{-4}
Run ∗ CONDITION ∗ AgeGroup	960.256[a]	4[a]	240.064[a]	1.320[a]	0.261[a]	0.002
Run ∗ SESCondPRO ∗ AgeGroup	1307.501[a]	4[a]	326.875[a]	1.798[a]	0.127[a]	0.002
Run ∗ CONDITION ∗ SESCondPRO ∗ AgeGroup	1166.358[a]	4[a]	291.590[a]	1.603[a]	0.171[a]	0.002
Residuals	161479.610	888	181.846			

Note. Type III Sum of Squares, [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$).

Table B16

ANOVA Analysis of NASA-TLX: Motivation Between Subjects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_G
CONDITION	40.260	1	40.260	0.024	0.877	7.563×10^{-5}
SESCondPRO	623.935	1	623.935	0.374	0.542	0.001
AgeGroup	33910.123	1	33910.123	20.300	< .001	0.060
CONDITION ∗ SESCondPRO	226.374	1	226.374	0.136	0.713	4.251×10^{-4}
CONDITION ∗ AgeGroup	5.787	1	5.787	0.003	0.953	1.087×10^{-5}
SESCondPRO ∗ AgeGroup	3386.535	1	3386.535	2.027	0.156	0.006
CONDITION ∗ SESCondPRO ∗ AgeGroup	44.029	1	44.029	0.026	0.871	8.271×10^{-5}
Residuals	370835.566	222	1670.430			

Note. Type III Sum of Squares