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Long-Term Effects of a Real-World Multi-Skill Intervention on Older Adults' Growth Mindset

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Abstract

Although there have been interventions to increase growth mindset, little is known about their effectiveness over a longer period, especially for older adults. This study with older adults investigated the long-term effects of a learning intervention that included growth mindset lectures and discussions on growth mindset. In Study 1 ($n = 27$), participants were tracked for one year after a 12-week intervention. We found that an increased growth mindset did not last beyond the intervention. In Study 2 ($n = 71$), the COVID-19 pandemic interrupted the intervention after only two months. Participants were followed up for two years, and their growth mindset at one year was greater than at the pretest (Week 0) but declined from the 1- to 2-year follow-up. Taken together, interventions incorporating growth mindset messages can increase growth mindset in the short term but may require booster sessions to retain effects, especially during disruptive life events.

Keywords

growth mindset, older adults, cognitive intervention, motivation, COVID-19

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Negative stereotypes in older adulthood often focus on cognitive abilities, such as learning new skills (Barber, 2017). Such age-based stereotype threats may temporarily lower older adults' performance on cognitive tasks (e.g., Lamont et al., 2015), making it seem as if they are experiencing cognitive decline. One protective factor that may combat these stereotypes is growth mindset (i.e., the belief that abilities, especially intelligence, are malleable; Dweck, 2000). Espousing growth mindset has been associated with academic adjustment (e.g., persistence; Dweck, 2000) in younger learners, namely adolescents and young adults. Growth mindset has the potential to contribute to the improvement of cognitive abilities and successful aging later in life (e.g., Heslin et al., 2021) and may be particularly helpful in debunking age-related negative stereotypes and improving older adults' cognitive performance (Barber, 2017). However, scant research has tested these ideas.

One potential way to increase growth mindset is via interventions that convey positive messages, such as neuroplasticity in late life (Aronson et al., 2002; Sarrasin et al., 2018). Recent research found that a learning intervention can cultivate older adults' growth mindset (Sheffler et al., 2023). In this three-month intervention, older adults engaged in learning multiple real-world skills (e.g., how to use an iPad) and attended weekly motivational lectures and discussions that addressed the concepts of growth mindset and neuroplasticity. Results indicated an increase in participants' growth mindset over the course of the intervention, and interestingly, growth mindset at baseline predicted increased cognitive abilities at the end of the intervention. However, questions remain regarding the sustainability of such effects, given that maintenance of intervention effects is one of the key criteria for evaluating cognitive training (Kelly et al., 2014).

Across two studies, we investigated whether a real-world multi-skill learning intervention yields long-term effects on older adults' growth mindset beyond the intervention period. There was no passive control group included in both studies. However, in Study 1, we included the baseline assessments four-week prior to the intervention serving as a baseline control, and different dosages of intervention classes in Study 2 (i.e., the lowest dosage served as a control group). Following Sheffler et al. (2023), where older adults' initial levels of growth mindset predicted cognitive gains, we also explored if growth mindset levels influence cognitive gains over time. Study 1 followed up the sample from Sheffler et al. (2023) until one year after the end of the intervention. Study 2 investigated the same questions with a larger sample and with a variety of intervention dosages.

An important consideration for the present studies is that Study 1 finished before the COVID-19 pandemic, and Study 2 took place before and during the pandemic. The effects of interventions targeting changes in one's growth mindset may be dependent on contextual factors or environmental contexts (Hecht et al., 2021). Besides potential physical and mental health concerns, the pandemic may have led to additional challenges and opportunities related to learning new skills for older adults (e.g., Brooke

& Jackson, 2020; Hecht et al., 2021). Therefore, Study 2 was uniquely positioned to shed light on how growth mindset may change in the midst of highly disruptive life events.

Study 1

Method

Participants and Procedures

Participants were recruited via various channels including word of mouth and local community programs. A power analysis indicated that 30 participants are needed to detect medium to large effect sizes with 80% power. All participants ($n = 27$) took part in a 12-week learning intervention where they learned multiple real-world skills (Ferguson et al., 2023; Leanos et al., 2023; Sheffler et al., 2023). Data were collected at seven timepoints: baseline (four weeks before the intervention), pretest (Week 0), midpoint (Week 6), posttest (Week 12, end of the intervention), and at 3-month, 6-month, and 1-year follow-ups after the intervention concluded. Sheffler et al. (2023) reported the growth mindset results from baseline to posttest. For each assessment, participants received $40 as compensation. All procedures in Studies 1 and 2 were reviewed and approved by the Institutional Review Board at the University of California, Riverside.

During the 12-week intervention, participants learned at least three new skills simultaneously (i.e., Spanish, photography, music composition, drawing, and how to use an iPad). For each skill, participants took a 2-hour class on a weekly basis during the intervention period. In addition to these three skill-learning classes, there was a 1-h weekly discussion session, where the senior author lectured on motivational topics and led group discussions. By discussing topics including growth mindset and the brain's malleability across the lifespan and providing learning resources, it was anticipated that this intervention would cultivate growth mindset beliefs while supporting learning opportunities (see Leanos et al., 2023 for more details of the procedures and measures). Data are available from the corresponding author upon request.

Measures

In addition to their sociodemographic information (see Table 1), participants reported on their growth mindset, and experimenters assessed their cognitive function. The growth mindset measure was a subscale of the Broad Learning Adult Questionnaire (Leanos et al., 2019), which adapted Dweck's (2000) Implicit Theories of Intelligence Questionnaire. Five items (e.g., "Regardless of whether I am of high or low intelligence, I can still learn new skills") on a 6-point Likert-type scale (1 = *strongly disagree* to 6 = *strongly agree*) were utilized. An average was taken to form the composite, with higher scores representing a greater endorsement of growth mindset.

Participants' cognitive function was assessed using the standardized NIH EXAMINER battery (Kramer et al., 2014), which measures working memory (1-back and dot-counting) and cognitive control (Flanker and set-shifting). This assessment was administered on a

Table 1. Sociodemographic Characteristics of Participants in Studies 1 and 2.

Variable	Study 1 ($n = 27$)	Study 2 ($n = 71$)
Sex		
Female	18 (67%)	14 (20%)
Male	9 (33%)	57 (80%)
Age, $M \pm SD$ (range)	69.44 ± 7.12 (58 – 86)	70.49 ± 6.30 (60 – 87)
Race[a]		
White	18 (67%)	45 (63%)
Black or African American	4 (15%)	14 (20%)
Asian	1 (4%)	3 (4%)
Multiracial or other	4 (15%)	8 (11%)
Prefer not to answer	–	1 (1%)
Years of education, $M \pm SD$ (range)	15.56 ± 2.90 (12 – 20)	16.05 ± 2.67 (10 – 24)
Work status		
Retired	22 (81%)	62 (87%)
Not retired	5 (19%)	7 (10%)
Prefer not to answer	–	2 (3%)
Marital status		
Married or have a partner	19 (70%)	36 (51%)
Not in a relationship	8 (30%)	35 (49%)
Living arrangements		
Living alone	5 (19%)	22 (31%)
Living with someone else	22 (81%)	47 (66%)
Prefer not to answer	–	2 (3%)
Family income[b]		
< $30,000	4 (15%)	7 (10%)
$30,000–$49,999	2 (7%)	12 (17%)
$50,000–$99,999	11 (41%)	25 (35%)
$100,000 and over	5 (18%)	20 (28%)
Prefer not to answer	5 (18%)	7 (10%)

[a]In the main analyses, race was recoded into 0 = White, 1 = Non-White.
[b]In the main analyses, income was recoded into 0 = below $50,000; 1 = $50,000 to $99,999; 2 = $100,000 and over. However, as it was not associated with the outcome variables in any of the models, income was not included in the subsequent analyses.

desktop computer, and participants' performance was recorded on PsychoPy, a software supporting data collection. Following Kramer and colleagues (2014), a composite cognitive function score was computed based on reaction time and accuracy scores on the four tasks.

Table 2. Descriptive Statistics for Growth Mindset and Cognitive Function Scores in Study 1.

Variable	Baseline	Pretest	Midpoint	Posttest	3-month	6-month	1-year
Growth mindset *M* (*SD*)	5.22 (0.58)	5.29 (0.49)	5.32 (0.43)	5.44 (0.67)	5.13 (0.53)	5.27 (0.65)	5.27 (0.61)
Cognitive function *M* (*SD*)	0.61 (0.75)	0.80 (0.62)	1.06 (0.57)	0.90 (0.56)	0.97 (0.64)	1.15 (0.62)	1.33 (0.50)

Note. Growth mindset scores' possible range was from 1 to 6, and cognitive function scores ranged from −1.79 to 2.32 in this sample.

Results

Table 2 shows descriptive statistics for participants' growth mindset and cognitive function. To address our primary research question (i.e., whether growth mindset scores change over time), a linear mixed-effects model was employed. This approach includes both fixed effects (i.e., population level) and random effects (i.e., subject level), taking into account the dependence among repeated measurements within the subject. In our analyses, time was included as a categorical variable, and sociodemographic factors (e.g., sex) were included as covariates. Initial models included the highest level of interaction among all predictors including covariates. Predictors were then systematically removed to find the optimal model using Bayesian Information Criterion (BIC) and performing likelihood ratio tests. The normality assumption (i.e., the residuals following a normal distribution) for the linear mixed-effects model was satisfied.

The final model showed that growth mindset measured at midpoint and posttest significantly differed from baseline (see Figure 1). As reported by Sheffler et al. (2023), compared to baseline, participants' growth mindset increased by 0.15 ($p = .014$) at midpoint and by 0.29 ($p = .028$) at posttest. A Wald test was performed to compare the levels of growth mindset across all combinations of timepoints including follow-up timepoints, but there were no significant differences. Among the covariates, age emerged as a significant predictor of growth mindset, such that getting one year older was associated with a decrease of 0.03 in growth mindset scores ($p = .004$).

To explore the effects of growth mindset at baseline on the changes in cognitive function at 1-year, a linear regression model with covariates (e.g., sex) was used. For this analysis, data from 11 participants who had measurements both at baseline and 1-year were analyzed. The final model was selected based on the same criteria used in the linear mixed-effects models described previously. We did not find any expected effects of growth mindset, although some unexpected effects of sociodemographic factors emerged (see Supplemental Table S1). Lastly, using the same regression model procedure, we tested the effects of the change in growth mindset (from baseline to 1-year) on the change in cognitive function (from baseline to 1-year). Findings

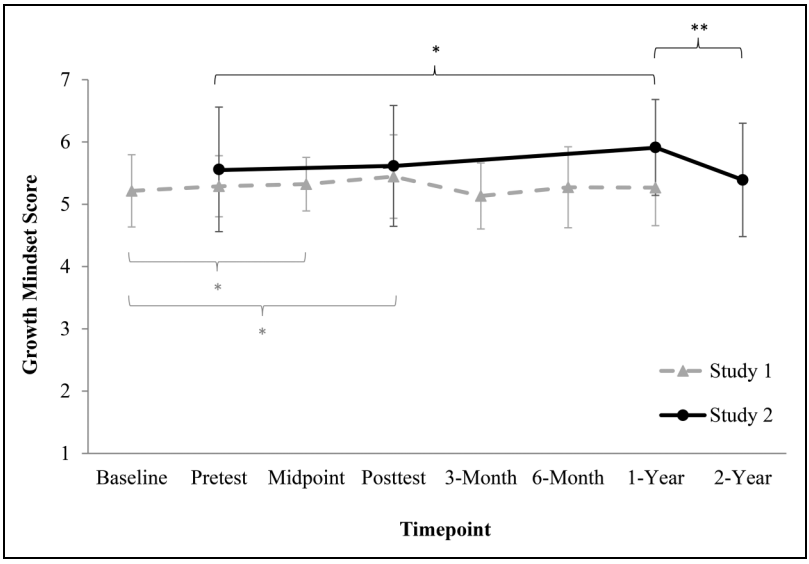

Figure 1. Mean levels of growth mindset at each timepoint. *Note.* Average growth mindset scores of participants in Study 1 and Study 2. Error bars represent ± 1 standard deviation. In all analyses, time was included as a categorical variable, allowing the change in the outcome variables to be different between timepoints. Sociodemographic factors (i.e., sex, retirement status, race, marital status, living arrangements, Mini-Mental State Examination score, age, total hours spent on homework, and years of education) were included as covariates. *$p < .05$. **$p < .01$.

suggested that the change in growth mindset did not have a significant effect on the change in cognitive function ($p = .153$; see Supplemental Table S2).

Study 2

Method

Participants and Procedures

Participants in Study 2 ($N = 71$) were recruited by the same strategies used in Study 1, and participants also received $40 for each assessment. Similar intervention procedures were used as in Study 1, except participants received different dosages of the intervention (frequency: 2 h vs. 6 h of classes; variety: one class vs. three classes a week). In addition, the COVID-19 pandemic interrupted the intervention at Week 8 (two-thirds of the way through the planned 12 weeks). As such, data were collected at five timepoints: baseline (six weeks before the start of the intervention), pretest (start of the intervention), posttest (four weeks after the premature end of the intervention), and 1-year and 2-year follow-ups. Table 1 shows the sociodemographic information of the participants.

Measures

Participants' growth mindset scores were assessed at all timepoints except at baseline, while their cognitive function was measured at baseline, pretest, and 2-year follow-up since these assessments were in person. Growth mindset was assessed using items from Dweck (2000). Among 20 items in the original questionnaire, three items measuring growth mindset (e.g., "You can always substantially change how intelligent you are"), and three items measuring fixed mindset (e.g., "You can learn new things, but you can't really change how intelligent you are") were selected. Unlike Study 1, which used a Likert-type scale, participants responded on a sliding scale by moving the slide marker to the desired point on the scale (from 1 = *strongly disagree* to 7 = *strongly agree*) for each statement. Items assessing fixed mindsets were reverse-coded, and an average was taken across the six items to form the composite score. Higher scores represented a greater endorsement of growth mindset. Cronbach's alphas were .80 at the pretest, .82 at the posttest, .80 at one-year, and .79 at two-year. As in Study 1, participants' cognitive function was measured by the NIH EXAMINER battery (Kramer et al., 2014).

Results

Table 3 shows descriptive statistics for growth mindset and cognitive function. The same statistical approaches from Study 1 were used, and the normality assumption for linear mixed-effects models was satisfied. In the final model, participants' growth mindset scores at the 1-year follow-up were estimated to be 0.26 larger ($p = .026$) than at pretest. Additional comparisons using the Wald test showed that at 1-year, growth mindset scores were 0.36 larger than at 2-year ($p = .003$). For covariates, there was an interaction between race and years of education ($p = .024$), although this interaction effect was not anticipated and needs to be replicated with a larger sample. There also were no effects of intervention dosage.

We also used a linear regression model to test the effects of growth mindset at pretest on the changes in cognitive function at the 2-year follow-up (see Supplemental Table S3). Results showed that growth mindset at pretest was not related to change in cognitive function between pretest and 2-year ($p = .802$). Similarly, changes in growth mindset from

Table 3. Descriptive Statistics for Growth Mindset and Cognitive Function in Study 2.

Variable	Baseline	Pretest	Posttest	1-year	2-year
Growth mindset *M* (*SD*)	–	5.56 (1.00)	5.62 (0.97)	5.91 (0.77)	5.39 (0.91)
Cognitive function *M* (*SD*)	0.50 (0.51)	0.87 (0.49)	–	–	0.69 (0.45)

Note. Growth mindset scores' possible range was from 1 to 7, and cognitive function scores ranged from −0.65 to 1.92 in this sample.

pretest to the 2-year follow-up did not have a significant effect on the change in cognitive function ($p = .536$; see Supplemental Table S4).

Discussion

The present study examined the long-term effects of a real-world multi-skill learning intervention with growth mindset lectures and discussions on older adults' growth mindset. Building upon prior work (Sheffler et al., 2023), the present two studies provide inroads to research on older adults' learning motivation and the retention effects of interventions targeting it. Our results showed an increase in growth mindset during the intervention period, but these effects were not maintained beyond the intervention period (Study 1) or beyond one year (Study 2). It may be the case that in order to prolong the enhanced growth mindset of older adults, booster sessions are needed. It is intriguing that, compared with participants in Study 1, those in Study 2 assessed throughout the COVID-19 pandemic showed longer-lasting intervention effects on growth mindset. While caution is warranted due to the small sample size for Study 1, it is possible that the additional challenges from the pandemic may have provided learning contexts. For example, participants may have had opportunities to practice and act upon what they had learned in the intervention by adopting new skills (e.g., using new technology), with these learning experiences further solidifying their growth mindset beliefs. Unlike Sheffler et al. (2023), we did not find evidence that the initial levels or changes in growth mindset confer beneficial effects on older adults' cognitive function in Study 2. Future research should investigate other motivational factors that may impact older adults' cognitive gains, especially in the context of a learning intervention. Based on prior research on younger learners (e.g., Parada & Verlhiac, 2022), it is conceivable that other motivational factors (e.g., coping strategies) may mediate the link between growth mindset and older adults' cognitive function, especially in the face of highly disruptive life changes. Finally, it is worth noting that dosage of learning activity during the intervention did not interact with growth mindset. This finding suggests that perhaps mere lectures and discussions on growth mindset and successful aging, in addition to even a small amount of learning activity, may yield important effects.

Future studies would benefit from investigating the interplay between older adults' actual learning experiences and growth mindset. For example, would failure or error in learning shape older adults' growth mindset over time? Moreover, would providing older adults only growth mindset lectures and discussions (but no organized learning opportunities) yield cognitive improvements? As our intervention included both skill learning and growth mindset messages, it is not possible to disentangle the effects of these two components. Researchers argue that providing growth mindset messages without necessary learning resources may not produce meaningful benefits, or may even be harmful (Dweck & Yeager, 2019; Walton & Yeager, 2020). To clarify this issue, future work may compare different experimental conditions. Lastly, it is possible that growth mindset is associated with other learning-related factors (e.g., reduced age-related stereotypes) during older adulthood. These intriguing possibilities

highlight the potential benefit of growth mindset interventions for older adults' cognitive abilities, but perhaps more importantly, willingness to learn and adjust in a dynamic environment (Nguyen et al., 2020; Wu & Strickland-Hughes, 2019).

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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