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Creativity and Aging: Positive Consequences of Distraction

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Diminished inhibitory control in cognitive functioning renders people vulnerable to the effects of distracting information. Older adults' decreased ability to ignore information makes them especially susceptible to the disruptive effects of distraction. We show that in the domain of creativity, distraction can have beneficial consequences. In the first study, both younger and older adults generated more creative recipes when presented with distracting information that was congruent with target information, compared to no distracting information, in a subsequent creativity task. This increase in creativity with congruent distraction was preserved, and even slightly enhanced, among older relative to younger adults. In the second study, we sought to replicate and extend our findings to a new task. We found that following exposure to distracting information, older adults generated more creative solutions than younger adults on a subsequent unusual uses for a brick task. Present findings suggest ways that distraction can boost creativity among older adults.

Keywords: aging, creativity, distraction, inhibition

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Creativity is a fundamental skill that fosters success across many life domains, ranging from how we solve problems in work settings to the way we decorate our homes. Creativity also frequently plays out in seemingly mundane settings, such as at the grocery store, when a person is deciding which food items to choose for future meals. In everyday life, people employ their creativity to make choices about products and services in complex and busy decision environments that are full of distractions. How might people navigate these distracting contexts in order to make decisions that involve creativity?

An influential theory of cognitive aging suggests that as people age, they can become increasingly vulnerable to the effects of distracting information due to normal age-related declines in inhibitory control (Hasher & Zacks, 1988; Hasher, Zacks, & May, 1999). These inhibitory control decrements are thought to occur gradually over the life course and to contribute to declines in task performance involving a variety of cognitive processes, including working memory, selective attention, speed of processing, and reasoning (Healey, Ngo, & Hasher, 2014; Lustig, Hasher, & Tonev, 2006).

While a decline in inhibitory control is typically described as a negative consequence of normal cognitive aging, recent evidence suggests that older adults' cognitive functioning can be spared in some situations. For instance, greater susceptibility to distraction can facilitate older adults' performance on a secondary or concurrent task when the distraction is relevant to or congruent with that task. Research has demonstrated this facilitation using the Remote Associates Task (RAT), in which participants view a triad of words (e.g., falling, actor, dust) and are asked to find a new word that can be paired with each word in the triad (e.g., star). Better performance on the RAT is associated with cognitive flexibility (i.e., the ability to adapt cognitive processing strategies to suit the problem or situation; cf. Canas, Fajardo, & Salmeron, 2006) and experience-based convergent thinking. Distracting information has been shown to prime older adults with concepts that improve their performance on the RAT (Kim, Hasher, & Zacks, 2007).

Similarly, when distraction is congruent (vs. incongruent) with the required response or is compared to no distraction, older adults show improved task performance in the form of faster response times (Spieler, Balota, & Faust, 1996; Yang & Hasher, 2007), improved reading comprehension (Griffin & Wright, 2009), greater implicit memory (May, 1999), and reduced forgetting (Biss, Ngo, Hasher, Campbell, & Rowe, 2013). Thus, evidence is mounting that with cognitive aging, the effects of distraction can be either beneficial or detrimental depending on what outcome is measured (for reviews, see Healey, Campbell, & Hasher, 2008;

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Data from Study 1 were presented in talks or posters at the following conferences: Society for Personality and Social Psychology, Society for Judgment and Decision Making, Association for Consumer Research, and Society for Consumer Psychology. They were also presented at the 2017 Symposium in Honour of Lynn Hasher held at the University of Toronto. No results from this research have been published outside of this article. The data and materials used in this research will be made available upon publication on the APA data repository: https://osf.io/view/apa/. Study methods and the initial analysis plan were preregistered on the open science framework website prior to the collection of data (https://osf.io/cd6w5).

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Weeks & Hasher, 2014). Extending previous research, the focus of the present investigation is on the outcome of creativity (Kasof, 1995, 1997).

In the present article, we examine how the availability of distracting information may serve to enhance older adults' creativity on a subsequent task. We hypothesize that when distracting information is not successfully suppressed, this information is accessible during subsequent processing to enhance creative task performance when the distracting information is relevant to the task. Indeed, attention to distracting (and often seemingly irrelevant) information has been associated with enhanced creativity in situations where the goal is complex, such as with an artistic goal (Kasof, 1995, 1997; Runco & Okuda, 1988). Despite the generally positive impact of distracting information on creativity, we hypothesize that the extent to which distracting information enhances creativity may differ between younger and older adults. Specifically, given older adults' diminished ability to inhibit information, we hypothesize that distracting information will be more accessible to older adults and facilitate subsequent creativity. We first tested these hypotheses using a task involving recipe generation—a domain in which most people have some experience and also where divergent and convergent thinking are inherent to the success of the creative process. In Study 1, we directly compared the creativity of recipes generated by younger and older adults following a task that required participants to ignore distracting information. In Study 2, we tested the same hypotheses as in Study 1 with a more widely used creativity task involving the generation of unusual uses for a brick following exposure to distracting information. In both studies, we tested the hypothesis that older adults in the distraction condition would generate recipes (Study 1) or uses for a brick (Study 2) with higher creativity scores than younger adults and that there would be no age difference between the control (nondistraction) conditions.

Study 1: Distraction Effects on a Creative Recipes Task

We sought to compare younger and older adults' performance on a creativity task following exposure to a distraction that was congruent with the required task response. We selected an established distraction paradigm used in prior research supporting the notion that greater vulnerability to distraction is a direct result of impaired inhibitory processes (e.g., Kim et al., 2007). We hypothesized that participants in the distraction condition would have enhanced performance on a subsequent creativity task, as compared to participants in the control condition without distraction. Distraction was manipulated by asking participants to actively ignore distracting information (i.e., food-related words) embedded in a brief vignette. We predicted that older participants in the distraction condition would demonstrate preserved, and perhaps even enhanced, creativity relative to younger participants. We reasoned that older adults' decrements in inhibitory control, relative to younger adults, would result in greater accessibility of information that facilitates more creativity on the subsequent recipe generation task. We used a planned comparison to test our hypothesis that distracting information would lead older adults to generate recipes with higher creativity scores than younger adults and that creativity scores would not differ between older and younger adults in the control condition.

Method

Participants. Eighty-five undergraduates were recruited from a subject pool at a large university in the Midwest (mean age = 20.82, 56 females). In addition, 53 community-dwelling older adults were recruited from an existing database (n = 25) and from senior centers (n = 28) in cities located in the Midwest and Eastern United States (mean age = 72.87, range = 60–90, mean education = 4.73, SD = 1.52, where 4 = 2-year college degree/professional degree and 5 = 4-year college degree, 33 females). All participants were told that the study was about reading comprehension. Younger adults received partial course credit for their participation, and older adults received $25 for participation and $2 for transportation costs. The data were removed for one younger participant for failure to complete the recipe generation creativity task and for five older participants who were unable to complete the study due to technical problems with the computer system. This left a total of 132 participants for analysis (younger adults: ignore = 40 [29 females] and control = 44 [27 females]; older adults: ignore = 25 [18 females] and control = 23 [15 females]). Sample sizes and stopping rules in this study were determined by subject pool allotment (younger adults) and the available older research volunteers in our database (older adults), and they are comparable to sample sizes in extant creativity research (cf. Cheng, Sanchez-Burks, & Lee, 2008). The research described in this (and the second) study was approved by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board.

Procedure and materials. Participants completed all tasks individually on a laboratory computer. Each participant was randomly assigned to an "ignore" distraction condition or to a control condition and completed a reading task that was closely adapted from a preexisting distraction paradigm (Kim et al., 2007). All participants read a mundane passage about a person going on a regular trip to the grocery store. Participants in the distraction condition read the passage in italicized font, and their task was to ignore distracting food-related words that each appeared 13 or 14 times (i.e., avocado [14], chicken [14], fresh basil [14], orange juice [13]) and were periodically embedded in an upright, nonitalicized font. Participants in the control condition read the passage in an italicized font without any distracting information; XXXXs replaced the embedded words from the distraction condition in order to keep the number of characters the same between conditions.

Immediately following the reading task, participants answered a few short comprehension questions and then completed an ostensibly unrelated creativity task. In the creativity task, they were given three specific ingredients—corn, carrots, and tomatoes—and were instructed that they had 5 min to generate and type out as many food recipes as possible. They were also told that in each recipe, they had to include at least one of the three ingredients. This task has been used to assess creativity in previously published studies within psychology, management, and computer engineering (e.g., Cheng et al., 2008; Cho, Tadmor, & Morris, 2018; Chua, 2013; Pinel & Varshney, 2014). Following the recipe generation task, participants completed questions about their demographic characteristics and were debriefed and dismissed.

Older adults were also asked to complete the Shipley Vocabulary Test (Shipley, 1946) and a question about health status[1] before being debriefed and dismissed. For the health question, participants were asked to rate their physical health compared to other people their age on a 5-point scale, from 1 (*much worse than average*) to 5 (*much better than average*). On average, the participants' scores on the vocabulary test ($M = 36.24$, $SD = 2.91$) were equivalent to the ranges of scores for healthy, community-dwelling older adults typically reported in published studies of cognitive aging (e.g., Light & Singh, 1987; Verhaeghen, 2003). Participants also reported better than average physical health ratings ($M = 3.46$, $SD = .83$). There were no differences between distraction conditions for either the vocabulary scores, $F(1, 23) = .96$, $p = .34$, or the health ratings, $F(1, 22) = 1.01$, $p = .33$.

In a procedure adapted from Cheng et al. (2008) and Cho et al. (2018), recipes were scored by two judges who self-identified as "cooking connoisseurs" and were blind to the hypotheses and conditions. Judges received written instructions on how to rate the dishes, and approximately one third of the recipes generated by both younger adults and older adults were coded during an initial training session. This training session allowed for greater interrater calibration on the recipe ratings across both younger and older adult recipes. In accordance with the coding scheme used in prior studies (cf. Cheng et al., 2008), each recipe was judged on three items—dish creativity, deliciousness, and potential popularity—on a 5-point scale ranging from 1 (*not at all*) to 5 (*very high*). "Dish creativity" is a measure of recipe uniqueness, while "deliciousness" and "potential popularity" correspond more closely to recipe acceptability that may come from knowledge and experience (cf. Cheng et al., 2008). Discrepancies between the two judges were resolved by a third rater who was also blind to hypotheses and conditions. These resolved ratings were used in all analyses. Consistent with how prior research assessed creativity (Cheng et al., 2008; Cho et al., 2018), we averaged the three items to create an "originality composite" score ($\alpha = .85$), which comprised the main dependent variable of creativity.[2] Using the same interrater reliability statistic as in Cheng et al. (2008), the interrater reliability between the two coders was satisfactory, $r = .75$, $p < .001$.

Results and Discussion

A 2 (age group: younger, older) × 2 (distraction: ignore, control) analysis of variance (ANOVA) revealed a significant main effect of distraction on the originality composite score, whereby participants in the ignore condition ($M = 3.34$, $SD = .50$) had significantly higher recipe originality scores than those in the control (no distraction) condition ($M = 2.99$, $SD = .55$), $F(1, 128) = 15.53$, $p < .001$, $\eta_p^2 = .11$ (see Figure 1). Results also revealed a marginal main effect of age group, with older adults ($M = 3.29$, $SD = .67$) having marginally higher recipe originality scores than younger adults ($M = 3.09$, $SD = .46$), $F(1, 128) = 3.69$, $p = .057$, $\eta_p^2 = .03$. This age difference is shown in Figure 1. A planned comparison revealed that in the ignore condition, older adults had significantly higher recipe originality scores ($M = 3.50$, $SD = .59$) than younger adults ($M = 3.24$, $SD = .41$), $F(1, 128) = 3.96$, $p = .049$, $\eta_p^2 = .03$. In the control condition, older ($M = 3.05$, $SD = .68$) and younger ($M = 2.95$, $SD = .47$) adults did not differ in their recipe originality scores, $F(1, 128) = .53$, $p = .47$ (see online supplemental Table S1). The Age Group × Distraction Condition interaction also did not approach significance, $F(1, 128) = .78$, $p = .38$.

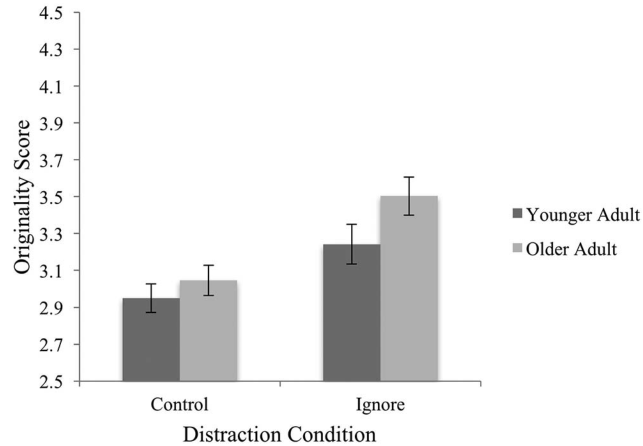

Figure 1. Recipe originality score for age group (younger, older) by distraction condition (control, ignore), Study 1. Error bars represent ± 1 standard error from the mean.

Although not part of our original conceptualization, some research on creativity interprets the number of ideas generated as one component of creativity (e.g., Carson, Peterson, & Higgins, 2003). We thus examined the number of recipes generated across distraction conditions to explore whether a vulnerability to distracting information may also result in the creation of a greater quantity of recipes. Younger adults ($M = 5.95$, $SD = 3.08$) generated a greater number of recipes than older adults ($M = 4.17$, $SD = 3.88$), $F(1, 128) = 8.59$, $p = .004$, $\eta_p^2 = .06$, and distraction condition did not influence the number of recipes generated, $F(1, 128) = .70$, $p = .41$. The Age Group × Distraction Condition interaction was also not significant, $F(1, 128) = .59$, $p = .45$. The finding that younger adults generated more recipes than older adults likely occurred because recipes were generated on a computer and younger adults tend to be more fluent (e.g., have faster typing speeds) in the use of computer-based technologies than older adults.

We next created a different creativity score by using a simpler binary coding scheme of 0 (not creative) and 1 (creative) for each recipe and calculating the proportion of recipes (e.g., 3/10 = .3) that were creative for each participant. We then tested our prediction that older adults in the ignore condition would have a higher creativity score than younger adults. Two coders who were blind to hypotheses and conditions were instructed to code each recipe as 1 (creative, something that you would not easily think of) or 0 (not creative, something you would easily think of). The interrater reliability for this binary coding procedure was high (Cohen's $\kappa = .88$). A third coder, also blind to hypotheses, then resolved any

[1] Note that the Shipley vocabulary and the health status measures were only collected for the second half of the older adult sample. The first half of the sample was recruited from a preexisting database of older adults screened for good health and high cognitive functioning. The second half of the sample was recruited from local senior centers.

[2] The originality composite score is used as a creativity measure because creative outcomes in the present task should be unique and also satisfy their intended purpose (i.e., a unique recipe that is appealing to consume).

discrepancies. Results of a 2 (age group: younger, older) × 2 (distraction: ignore, control) analysis of variance revealed a significant main effect on the creativity score (see online supplemental Table S1). Participants in the ignore condition (M = .49, SD = .29) had a significantly higher creativity score than those in the control (no distraction) condition (M = .35, SD = .28), $F(1, 128) = 10.50$, $p = .002$, $\eta_p^2 = .02$. The creativity score did not differ between older (M = .46, SD = .37) and younger (M = .39, SD = .23) adults, $F(1, 128) = 1.69$, $p = .20$. The Age Group × Distraction Condition interaction was marginal, $F(1, 128) = 3.43$, $p = .066$, $\eta_p^2 = .03$. A planned comparison revealed that older adults (M = .59, SD = .38) in the ignore condition generated significantly more creative scores than younger adults (M = .43, SD = .21), $F(1, 128) = 5.01$, $p = .027$, $\eta_p^2 = .04$. In the control condition, older (M = .33, SD = .32) and younger (M = .36, SD = .25) adults did not differ in their creativity scores, $F(1, 128) = .15$, $p = .70$. In other words, when participants had to ignore distraction, older adults generated a greater proportion of creative recipes than younger adults.

Results of Study 1 indicated that both younger and older adults produced higher originality scores and creativity scores in the ignore condition than the control condition. This suggests that distracting information increases creativity in recipe generation tasks for both younger and older adults. Data also revealed that older adults in the ignore condition generated recipes with both higher originality scores and creativity scores than did younger adults. These results indicate that the decreases in inhibitory control that render older adults more vulnerable to distracting information than younger adults may facilitate older adults' performance on tasks involving creativity.

One limitation of the current work is that the older adult sample in Study 1 is smaller than the younger adult sample. This sampling difference reflects recruitment and testing difficulties that were encountered when bringing older participants into the laboratory to complete a computerized study. It is possible that we did not obtain a significant interaction effect of age and distraction in Study 1 partly due to the small sample size. For this reason, we next sought to replicate and extend our findings using a different creativity task widely used in prior creativity research: the generation of unusual uses for a brick.

Study 2: Distraction Effects on a Creative Uses for a Brick Task

The purpose of Study 2 was to use a different measure of creativity to test the generalizability of our results from Study 1 suggesting that the creativity of older adults, compared to younger adults, benefits more from distracting information. In doing so, we addressed a potential concern that our findings may be limited to the particular creativity task involving recipe generation. We thus utilized a brick task that has been commonly used in the creativity literature (cf. Carson et al., 2003; Guilford, Christensen, Merrifield, & Wilson, 1978; Roskes, De Dreu, & Nijstad, 2012; Torrance, 1968) and conducted planned comparisons to test our hypothesis that older adults exposed to distracting information would have higher creativity scores for uses of a brick than younger adults and that creativity scores would not differ between age groups in the control condition. We then applied the same planned comparison approach to examine each aspect of creativity separately. A variety of different coding schemes can be used for the unusual uses for a brick task, and we chose the one that we adapted from Carson et al. (2003).

Method

Participants. We recruited 98 (67 females) younger participants aged 18–24 (mean age = 22.60, mean education = 3.79, SD = 1.06, where 3 = some college and 4 = 2-year college/professional degree) and 123 (79 females) older participants aged 60–77 (mean age = 65.33, mean education = 4.39, SD = 1.42, where 5 = 4-year college degree) on Amazon Mechanical Turk. Participants received $1.00 as compensation. Prior to data collection, we conducted a power analysis based on Study 1, which suggested we would need a minimum of 65 participants to test the main effect of distraction at .80 power and a maximum of 285 participants to test the main effect of age group at .80 power. Based on these calculations, we set our initial stopping rule to be at least 200 participants (i.e., at least 50 participants per cell). We opted to conduct the study online by recruiting participants on Mechanical Turk rather than in the lab because doing so enabled us to collect a much larger sample of older adult participants than would have been feasible in person. Additionally, all tasks required participants to type on a computer, which could be readily accomplished at home. At the end of the study, we asked participants a question about how distracting their environment was so that we could control for this in our analyses. All participants were residing in the United States at the time of their participation. The data from one younger participant and two older participants, who indicated that their health was extremely poor, were removed from the analysis due to potential differences in cognitive and language functioning (Leon, Altmann, Abrams, Rothi, & Heilman, 2014). This left a final sample of 218 participants for analysis (younger adults: ignore = 49 [38 females] and control = 48 [29 females]; older adults: ignore = 57 [34 females] and control = 64 [45 females]). Study methods and the initial analysis plan were preregistered on the open science framework website prior to the collection of data (https://osf.io/cd6w5).

Procedure and materials. All tasks were programmed into Qualtrics survey software, and participants completed the survey individually on a computer. Participants were randomly assigned to either a distraction (i.e., ignore) or a control condition. All participants read a mundane passage about a person going on a city architecture tour. We designed the new scenario to be about an architecture tour so that it would have a congruent relationship (i.e., building material) to our subsequent creativity task (unusual uses for a brick). To select the distractor words, 80 pretest participants (32 females) on Mechanical Turk (mean age 38.63, range = 19–72) were asked to generate words that represent nonbrick materials but that have similar uses to a brick.

We selected the top words generated that also had a similar structure to the food distractor words in the recipe study. The words we selected (and the number of times each word was generated) included *paper weight* (14), *wood* (14), *stone* (14), and *door stop* (13). Participants who participated in the pretest were excluded from participating in the main study. In the main study, participants in the ignore condition read the italicized passage with distracting words related to building materials (e.g., wood, stone) periodically embedded in upright, nonitalicized font. Their task was to read only the italicized words and ignore all of the upright words (cf. Kim et al., 2007). Participants in the control condition read the passage in italicized font without any distracting information; XXXXs replaced the embedded words from the ignore condition.

Immediately following the reading task, participants answered a few short comprehension questions and then completed an ostensibly unrelated task involving an alternate uses test (Guilford et al., 1978; Torrance, 1968). Participants were told that they had 2 min to generate as many alternate or unusual uses for a brick as possible. At the end of this 2-min period, the survey automatically advanced to the next screen. Participants then completed questions about their demographic characteristics, perceived physical health compared to others in their age group, and were debriefed. Younger ($M = 3.14$, $SD = .78$) and older ($M = 3.37$, $SD = .92$) adults in this sample reported generally above-average health. A 2 (age group: younger, older) × 2 (distraction: ignore, control) ANOVA assessing perceived physical health status revealed no effect of distraction condition on health, $F(1, 214) = .12$, $p = .73$, or interaction between age group and distraction condition, $F(1, 214) = .52$, $p = .47$. The Shipley Vocabulary Test was not administered in this study due to the need to limit the length of the study for Mechanical Turk respondents.

In a procedure adapted from Carson et al. (2003), three aspects of creativity were assessed: fluency (number of uses generated), flexibility (number of different categories of generated uses), and originality (proportion of low-frequency responses). To address the possibility of subjectivity biases in measures of flexibility, two independent coders who were blind to study hypotheses and conditions categorized a subset of uses generated by 42 participants (19% of the sample). Coders used the same category system they developed together based on the complete list of creative uses of a brick that all participants generated. Thus, the same set of categories was used to code the flexibility score between the two age groups. Examples of categories included "art tool," "garden tool," "press," and "weapon." The interrater reliability was deemed satisfactory using the same metric as in Study 1, $r = .71$, $p < .001$. The originality score was calculated based on the statistical infrequency of each use within the sample. Specifically, we used a coding procedure established in prior research (Radel, Davranche, Fournier, & Dietrich, 2015) to score originality. Responses that were given by fewer than 5% of participants were coded as 1, and responses that were given by fewer than 1% of participants were coded as 2; otherwise, the responses were coded as 0. As in Carson et al. (2003) and aligned with our preregistered dependent variable, fluency, originality, and flexibility scores were *z*-scored and summed to produce a creativity score for each participant. We computed *z* scores because the flexibility, fluency, and originality scores all have different raw score ranges, and standardizing these scores is consistent with practices established in previous research (Carson et al., 2003). We also preregistered this *z*-scored analysis prior to the collection of data. As in Study 1, we predicted that older, compared to younger, adults who are exposed to distracting words would receive higher creativity scores in their generation of uses for a brick.

Results and Discussion

Following our preregistered data analysis plan, a 2 (age group: younger, older) × 2 (distraction: ignore, control) ANOVA revealed a significant interaction of age and distraction on creativity, $F(1, 214) = 4.43$, $p = .036$, $\eta_p^2 = .02$ (see Figure 2). Specifically, a planned comparison revealed that in the ignore condition, older adults ($M = .35$, $SD = 1.82$) had marginally higher creativity scores than younger adults ($M = -.37$, $SD = 2.22$), $F(1, 214) = 3.18$, $p = .076$, $\eta_p^2 = .02$. In the control condition, younger ($M = .25$, $SD = 2.15$) and older ($M = -.22$, $SD = 2.05$) adults did not differ in their creativity scores, $F(1, 214) = 1.41$, $p = .24$. This pattern of results is consistent with the recipe originality outcomes observed between older and younger adults in Study 1.

Given that the study was conducted with a Mechanical Turk sample, one could argue that our results were driven by different levels of distraction in the participants' environment at the time of their participation. Thus, we ran an analysis of covariance (ANCOVA) to control for distractions in the environment and obtained consistent results; the interaction of age and distraction

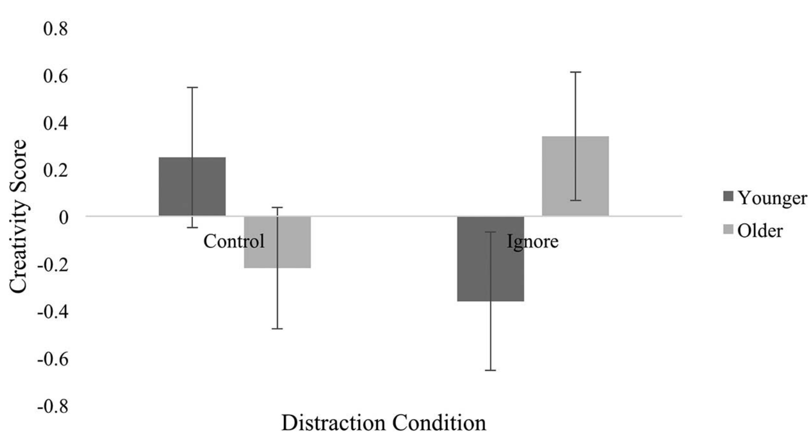

Figure 2. Creativity score for alternate uses of a brick by age group (younger, older) and distraction condition (control, ignore), Study 2. A creativity score of 0 indicates an average score for the sample. A negative creativity score indicates below average, and a positive creativity score indicates above average. Error bars represent ± 1 standard error from the mean.

condition on creativity scores remained significant, $F(1, 213) = 4.41$, $p = .037$, $\eta_p^2 = .02$. Only in the ignore condition did older adults ($M = .35$, $SE = .27$) receive marginally higher creativity scores than did younger adults ($M = -.37$, $SE = .30$), $F(1, 213) = 3.13$, $p = .078$, $\eta_p^2 = .01$.

Next, we explored the effects of age and distraction on each aspect of creativity separately in order to check the robustness of results. Specifically, we conducted ANOVA and ANCOVA (controlling for distraction in the environment) analyses on the raw scores of fluency, flexibility, and originality to further examine interactive patterns of age and distraction on creativity. No differences were found between analysis models, and so we only report the results of the ANOVA analyses (see online supplemental Table S2 for detailed results). First, on fluency (i.e., the number of brick uses generated), we did not obtain significant effects of age, $F(1, 214) = .10$, $p = .75$, or distraction condition, $F(1, 214) = .57$, $p = .45$. As in Study 1, age and distraction also did not have an interactive impact on the number of creative uses participants generated for a brick, $F(1, 214) = .05$, $p = .82$. On average, participants generated seven creative uses for a brick. As discussed in Study 1, our lack of a significant interaction for fluency may be an artifact of participants completing the creativity task on a computer and older adults being somewhat less fluent with the use of computer-based technology than younger adults.

Second, on flexibility (i.e., number of different categories of generated uses), the interaction of age and distraction was significant, $F(1, 214) = 4.59$, $p = .033$, $\eta_p^2 = .02$. Planned comparisons revealed that in the ignore condition, older adults generated a significantly greater number of categories ($M = 3.21$, $SD = .98$) than younger adults ($M = 2.71$, $SD = .98$) on uses for a brick, $F(1, 214) = 6.48$, $p = .012$, $\eta_p^2 = .03$. In the control condition, younger ($M = 2.92$, $SD = 1.05$) and older ($M = 2.83$, $SD = 1.00$) adults did not differ in the number of categories generated from their list of uses for a brick, $F(1, 214) = .22$, $p = .64$. While distraction did not influence younger adults' generation of categories for brick use, $F(1, 214) = .99$, $p = .32$, distraction enhanced older adults' ability to generate a greater number of categories for brick use, $F(1, 214) = 4.40$, $p = .037$, $\eta_p^2 = .02$.

Third, on the originality score (i.e., proportion of low frequency responses), the interaction of age and distraction was significant, $F(1, 214) = 6.06$, $p = .015$, $\eta_p^2 = .03$. Planned comparisons revealed that the difference in the proportion of low-frequency responses generated by older ($M = 1.0$, $SD = 1.10$) and younger ($M = .63$, $SD = .95$) adults in the ignore condition trended in the predicted direction, although it did not reach significance, $F(1, 124) = 2.38$, $p = .12$. In the control condition, older adults generated fewer low-frequency responses ($M = .86$, $SD = 1.30$) than younger adults ($M = 1.31$, $SD = 1.48$), $F(1, 214) = 3.77$, $p = .053$, $\eta_p^2 = .02$. This reduction in the proportion of low-frequency responses among older adults, relative to younger adults, in the absence of distraction was not predicted.

As in Study 1, we also coded the unusual uses for a brick task using the simpler binary coding scheme for each use of a brick to derive a creativity score based on the proportion of creative uses for a brick that participants generated (see online supplemental Table S2 for results). The same two coders from Study 1 were instructed to code each brick use as 1 (creative, something that you would not easily think of) or 0 (not creative, something you would easily think of). The interrater reliability for this binary coding procedure was satisfactory (Cohen's $\kappa = .60$). A third coder, also blind to hypotheses and conditions, resolved discrepancies. A 2 (age group: younger, older) × 2 (distraction: ignore, control) ANOVA revealed no significant main effect of distraction between ignore ($M = .18$, $SD = .17$) or control ($M = .18$, $SD = .17$) condition on the creativity score, $F(1, 214) = .29$, $p = .59$. There was also no significant main effect of age between older ($M = .19$, $SD = .16$) and younger ($M = .17$, $SD = .17$) adults, $F(1, 214) = 1.51$, $p = .22$. However, there was a marginal Age Group × Distraction Condition interaction, $F(1, 214) = 3.50$, $p = .063$, $\eta_p^2 = .02$. As we predicted, a planned comparison revealed that in the ignore condition, older adults ($M = .21$, $SD = .16$) received higher creativity scores than younger adults ($M = .14$, $SD = .17$), $F(1, 214) = 4.71$, $p = .031$, $\eta_p^2 = .02$. In the control condition, older ($M = .18$, $SD = .17$) and younger ($M = .19$, $SD = .17$) adults did not differ in their creativity scores, $F(1, 214) = .21$, $p = .65$. In other words, when participants had to ignore distraction, older adults generated a greater proportion of creative uses for a brick than younger adults.

Taken together, the results of Study 2 replicated the main findings from Study 1. Compared to Study 1, the sample size of older adult participants more than doubled as a result of collecting the data on Mechanical Turk. Results consistently showed that in the absence of distracting information, younger adults and older adults performed similarly on a creativity task. However, when distracting information was present, older adults' greater vulnerability to distraction led them to generate more creative outcomes compared to younger adults on a subsequent task. These results support our proposition that distracting information increases creativity for older adults when the distracting information is congruent with or relevant to the target task response. The replication of our effects with older adults across two studies using two different creativity tasks provides greater confidence that the present findings reflect meaningful effects of distraction on creativity in older adults.

General Discussion

We find evidence across two studies that greater age-related vulnerability to distracting information enhances older adults' creativity on subsequent recipe generation and unusual uses for a brick tasks when the distracting information is relevant to the target creativity task response. Our findings are consistent with the growing body of literature indicating that problem solving and creativity can actually benefit from task-congruent distraction (Carson et al., 2003; Jarosz, Colflesh, & Wiley, 2012; Reverberi, Toraldo, D'Agostini, & Skrap, 2005; Rowe, Hirsh, & Anderson, 2007; White & Shah, 2006, 2016; Wieth & Zacks, 2011). Extant literature suggests that whether distracting information interferes with or provides a benefit to older adult information processing depends on the situation (cf. Healey et al., 2008). In situations that are relevant to the distracting information, older adults' processing may be enhanced, whereas the same distracting information can be disruptive in irrelevant situations (cf. Healey et al., 2008). The present research advances our understanding of how distraction can provide an age-related performance boost on tasks involving creative thinking that benefit from access to relevant distracting information. When individuals are less able to ignore relevant distractions, this information can facilitate more idea generation on subsequent, ostensibly unrelated tasks. Our findings suggest that older adults may be able to capitalize on distraction when performing tasks involving creativity.

One interesting finding in Study 2 is that younger adults' creativity scores were not at all boosted by distraction. This may be evidence of successful suppression in younger adults. However, in Study 1, some benefits of distraction in younger adults did emerge. Future research should seek to investigate in what contexts younger adults are more or less successful at suppressing distracting information.

Future research should also seek to replicate these distraction findings with other populations and should extend the inquiry into creativity domains beyond recipe generation and unusual uses for a brick. It is possible, for example, that the enhanced creativity effects will not be obtained in domains requiring specialized expertise. In addition, research is needed to further examine the relationship between inhibitory mechanisms and creative processing, as well as whether enhanced creativity following distraction is relevant mostly to the quality of the creative outcomes (as our results suggest) or if in some domains, the quantity (i.e., number of items generated) of creative outcomes could also be enhanced. Specifically, while our findings suggest that distracting information benefits older more than younger adults' creativity, it is also interesting to note that we consistently showed no relationship between exposure to distracting information and the quantity of creative ideas generated. Additional research is needed to investigate if this difference is an artifact of the recipes and brick uses in our study being generated on a computer, with which younger adults tend to have greater facility than older adults, or if the quantity of creative ideas is not facilitated by distraction effects. Age-related differences in typing speed may have been exacerbated in our studies by the brief time limits that were imposed on participants while they were generating their creative recipes or brick uses. It is thus possible that the present results underestimate the true level of creativity benefits afforded to older adults by relevant distracting information. Despite this, we nonetheless found that older adults in the distraction conditions showed an advantage on our creativity-related outcomes compared to younger adults.

One alternative explanation for the present findings is that the observed increases in creativity following relevant distracting information could be merely due to exposure to the distraction, rather than the result of age-related decrements in ignoring distraction that renders this information more accessible. If distraction did not play an important role in our findings, then we would have seen greater creativity in the presence of distracting information compared to the control equally across age groups. Indeed, this alternative explanation also cannot account for the growing body of evidence suggesting that exposure to a variety of different types of information, both relevant and irrelevant, plays a greater role in subsequent task performance for older than for younger adults due to age-related decrements in inhibitory processing (cf. Biss, Rowe, Weeks, Hasher, & Murphy, 2018; Hartman & Hasher, 1991; Hasher, Quig, & May, 1997; Hasher et al., 1999; Healey et al., 2008; Neumann et al., 2018; Radel et al., 2015). Consistent with this, our findings indicate that older adults' creativity is enhanced with relevant distraction, compared to younger adults. Such age-related enhancement is unlikely to occur if reductions in inhibitory processes did not also contribute to the accessibility of distracting information. Future research should continue to investigate the inhibitory mechanisms underlying the observed age-related boosts in creativity following distraction, and it should determine the extent to which congruency between the distracting information and the creativity domain is critical.

Another alternative explanation is that older adults may have strategically used the distractor information despite being told to ignore it. Indeed, recent research suggests that asking people to "avoid" information enhances idea originality more than if no "avoid" instruction is provided (George & Wiley, 2020). However, in the present studies, while distractor information boosted creativity in both younger and older adults on the recipe originality score, the benefit only occurred for older adults in the common uses for a brick task. This suggests that even if the "ignore" condition was encouraging people to shift their focus toward more creative ideas, older adults were still more sensitive than younger adults to this distracting information. It should be noted that older adults may have also taken longer to read the passages in our studies about the shopping trip and the architecture tour, and thus their responsiveness to the distraction could have reflected greater exposure to the cue words than younger adults. Future research should use a distraction task that controls for exposure time.

Further, future investigations should specifically examine the extent to which words that appear in the distraction task also appear in the subsequent creativity task. The creativity tasks used in the present research differed on several dimensions that limited our ability to make meaningful comparisons of the effects that the distractor words might have on the creative ideas generated. For example, the distractor words in the recipe study were brainstormed by the present authors so that their basic composition (e.g., word length, structure) matched the original inhibition paradigms developed by Hasher and colleagues (e.g., Kim et al., 2007). The words were thus not pretested (whereas in Study 2, they were pretested). The recipes that were generated in Study 1 also often lacked specific details (e.g., chicken burrito without specific ingredients), and so a distractor word that could have been contained within a recipe may not have been listed. Indeed, a cursory examination indicated that there was no significant Age $\times$ Distraction Condition interaction on the number of distracting words generated in the creativity tasks in either study. Future studies should pretest the food-related distractor words to ensure that the words are reasonable to include in recipes and also require that generated recipes include greater specificity. Future research should also continue to investigate the conditions under which aging and distraction affect people's likelihood of incorporating distracting information into subsequent, ostensibly unrelated tasks. Finally, a better understanding of how age-related changes in the ability to ignore distraction influences decision making and general well-being would constitute valuable advances in knowledge.

This line of research has the potential to generate insights that meaningfully enhance well-being as people age. Extant research on creativity suggests that consumers rate products they creatively design more positively (Dahl & Moreau, 2007). It is thus possible that enhanced creativity resulting from an inability to ignore distracting information will further boost the well-documented positivity bias associated with aging (Charles & Carstensen, 2010), such that both older and younger adults will feel more positive toward and satisfied with their creative products. Specifically, we propose that when individuals are faced with tasks that draw on creative processes (e.g., choosing recipe ingredients at a supermarket, putting together gift ideas, designing custom-made handbags or toys), those who cannot ignore congruent distraction and consequently generate more creative products may feel especially satisfied with the final outcome. This is not only because putting effort into the product creation enhances liking (i.e., "The Ikea Effect"; Norton, Mochon, & Ariely, 2012) but also because taking an interactive role in the creative development and making choices during the product generation process are likely to induce positive feelings, such as pride, interest, and contentment (Atakan, Bagozzi, & Yoon, 2014).

In conclusion, our findings lend support to the emerging body of evidence suggesting that cognitive declines associated with normal aging can have positive consequences. We specifically find that distraction can boost creativity. These gains in creativity may in turn generate more positive feelings and experiences. Future research should be directed toward the elucidation of factors that affect inhibitory control, creativity, and task performance, as well as the benefits they may provide to support greater well-being across the adult life span.

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