Journal of Gerontology: PSYCHOLOGICAL SCIENCES
2007, Vol. 62B, No. 4, P230–P233

The Enhanced Effects of Pictorial Distraction in Older Adults

Lixia Yang[1] and Lynn Hasher[2,3]

[1]Department of Psychology, Ryerson University, Toronto, Ontario, Canada.
[2]Department of Psychology, University of Toronto, Ontario, Canada.
[3]The Rotman Research Institute of Baycrest Centre, Toronto, Ontario, Canada.

Using a picture–word paradigm, we investigated age differences in distraction from to-be-ignored pictures. On each trial, participants viewed a prime word that was superimposed on an irrelevant picture, followed by a test word. The task was to determine whether the prime and test words were semantically related. The pictures were either congruent or incongruent with the response. On control trials, pictures were neutral with respect to the response. Consistent with an age-related reduction in distraction regulation, the results demonstrate an enhanced pictorial distraction effect for older adults, even after age-related general slowing was controlled for. Older adults also tended to take longer to suppress distraction from picture labels than did young adults.

OLDER adults are differentially sensitive to the presence of distraction in the context of a target task. Such effects have been shown in a variety of tasks, including visual search, perceptual speed, reading, and problem solving (e.g., Connelly, Hasher, & Zacks, 1991; Lustig, Hasher, & Tonev, 2006; May, 1999; Plude & Hoyer, 1986). There is also evidence for distraction effects in semantic priming that is tested by use of a picture–word paradigm (Duchek, Balota, Faust, & Ferraro, 1995; Gernsbacher & Faust, 1991, Experiment 3). In this paradigm, participants view a context display of a word that is superimposed on a nameable picture, followed by a test word or a picture. Participants are instructed to attend to either the picture or the word in the context display, and to indicate whether it is related to the test item. Using this task, Duchek and colleagues found that verbal distraction, but not pictorial distraction, differentially slowed older adults. Because recent evidence suggests that older adults have greater difficulty than young adults do in ignoring pictures (Gazzaley, Cooney, Rissman, & D'Esposito, 2005), we revisited the age differences in pictorial distraction by using a modified picture–word paradigm.

In the modified paradigm, only pictures served as distractors and all judgments were made on words. We also included pictures that were congruent, incongruent, and neutral with respect to the response. This manipulation enabled us to assess the distraction effect, indexed not only by interference from incongruent pictures but also by facilitation from congruent pictures. As in previous studies, we varied the interstimulus interval (ISI) between the offset of the context display and the onset of the test word from 50 ms to 1,000 ms to examine the time course of distraction effect. We also examined whether older adults are more vulnerable to and thus less likely to reject distractors than young adults in a subsequent incidental recognition task.

Methods

Participants

The final sample included 45 older adults (age, $M = 69$ years, range, 60–88) who were paid $10 for participation and 47 young undergraduates (age, $M = 20$ years, range, 17–28) at the University of Toronto who received course credit for participation. There were 23 older and 22 young adults tested in the short-ISI (50 ms) condition, as well as 22 older and 25 young adults tested in the long-ISI (1,000 ms) condition. Using the Short Blessed Test (Katzman et al., 1983), we screened older adults for cognitive impairment. We had all participants tested at their relatively optimal time of day.[1] We replaced 16 participants, 3 older adults for technical problems, 6 older adults for low accuracy on the priming task (below 80%), and 7 adults (5 older and 2 young) for serious health problems such as depression. Older adults had more years of education ($M = 16.58$) than did young adults ($M = 13.85$), $t = 5.98$, $p < .001$, and they had higher vocabulary scores ($M = 36.20$), as assessed with the Shipley–Hartford Vocabulary Test (Shipley, 1940), than did young adults ($M = 31.19$), $t = 7.93$, $p < .001$.

Materials

We selected 80 critical pictures from the Snodgrass and Vanderwart (1980) materials (e.g., *shoe*). For each, we chose a semantically related word (e.g., *heel*) as a test word, along with two prime words, one semantically related (e.g., *foot*, on the congruent trials) and the other unrelated (e.g., *crib*, on the incongruent trials) to the test word. The two prime words roughly matched on length, concreteness, and familiarity. We then replaced the critical picture with an unrelated but visually matched picture (e.g., *sandwich*) to create control trials. All the pictures have unambiguous verbal labels. The prime word and the verbal label of the distractor were equally well associated with the test word (i.e., the average forward association strength is 0.11 for each of them; see Nelson, McEvoy, & Schreiber, 1998).

Across participants, we had each test word used once in each of the four trial types, thus creating four sets of materials, each containing 20 congruent trials, 20 incongruent trials, 20 congruent control trials, and 20 incongruent control trials. We also created 10 filler trials, each using a related picture–word prime coupled with an unrelated test word in

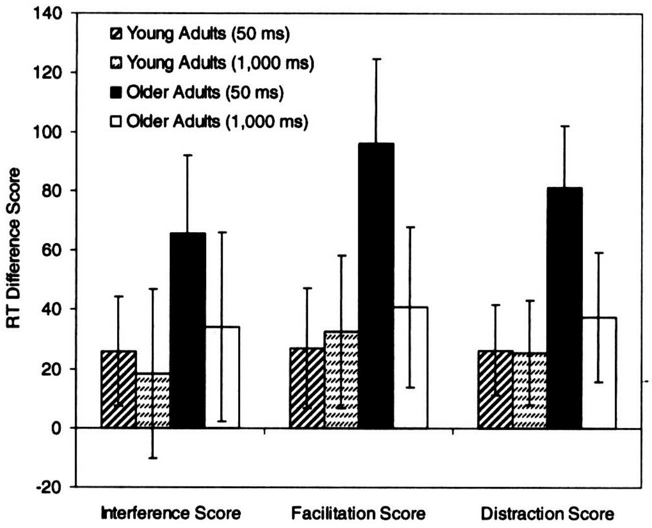

Figure 1. Distraction effects in the picture–word semantic priming task. Interference score = reaction time or RT (incongruent trials) – RT (incongruent control trials); facilitation score = RT (congruent control trials) – RT (congruent trials); distraction score = average of facilitation and interference score. Error bars denote a 95% confidence interval.

order to reduce strategic anticipation for a "yes" response. Each participant completed 95 trials, including 5 buffers at the beginning. We randomized the order of the trials, with no more than 3 trials of the same type occurring consecutively.

In a subsequent unexpected yes–no recognition task, each participant viewed 160 words. The 80 old items included 40 prime and 40 test words presented in the first task. The 80 new items included 40 verbal labels of distractor pictures and 40 new control words (i.e., prime words from the other counterbalance conditions).

Procedure

Each trial began with a centered fixation cross (500 ms), which was replaced with a context display (800 ms) followed by a test word (2,000 ms or until terminated by a response) with an ISI of either 50 or 1,000 ms. Participants responded as quickly and accurately as possible by pressing the slash ("/") key, labeled *yes*, with the right index finger or the "z" key, labeled *no*, with the left index finger to indicate that the two words are related or unrelated, respectively. Each response was followed by a feedback on accuracy and latency. Prior to the test trials, we provided 20 practice trials, half requiring yes responses (i.e., 5 congruent and 5 congruent control trials) and the other half requiring no responses (i.e., 3 incongruent, 3 filler, and 4 incongruent control trials).

The recognition task followed immediately with participants instructed to identify as old only those items that had appeared as words in the first task. Each trial started with a centered fixation cross (500 ms) that was replaced with a word (3,000 ms or until terminated by response). Participants responded by pressing the slash or "z" key to indicate whether the word was old or new, respectively, as quickly and accurately as possible. Similarly, feedback was provided on accuracy and latency on each trial. We provided 12 practice trials, using picture labels

Table 1. Recognition Performance for Young and Older adults

Variable	Age: Young	Age: Old
Hits	0.66 (0.11)	0.63 (0.10)
FAs for the new control words	0.19 (0.09)	0.23 (0.12)
Corrected recognition score (Hits – FAs)	0.47 (0.13)	0.41 (0.13)
RT for correctly recognized words	793 (120)	1105 (187)
FA cost score	0.11 (0.09)	0.10 (0.10)
RT cost score	25 (42)	55 (96)

Notes: FAs = false alarms; RT = response time; FA cost score = FA (picture labels) – FA (new words); RT cost score = RT (correctly rejected picture labels) – RT (correctly rejected new words). The hits, FAs, corrected recognition, and the FA cost score are given as a percentage; The RT and RT cost score are in milliseconds. Standard deviations are given in parentheses.

and words from the practice trials of the first task as well as some new words, prior the test trials.

Results

Picture–Word Semantic Priming

After excluding incorrect responses, we trimmed response times (RTs) for outliers by using a 2.5-*SD* criterion for each condition; we consequently removed 1.5 % of the responses.

To explore the distraction effect, we first calculated interference and facilitation scores by subtracting RTs for incongruent control trials and congruent trials from those for incongruent trials and congruent control trials, respectively (see Figure 1). Then we conducted an overall 2 (age: young vs. older) × 2 (ISI: 50 ms vs. 1,000 ms) × 2 (distraction: interference vs. facilitation) analysis of variance. This analysis revealed a significant age effect, $F(1, 88) = 13.19$, $MSE = 3856.78$, $p < .001$; a reliable ISI effect, $F(1, 88) = 5.87$, $MSE = 3856.78$, $p < .05$; and a reliable age × ISI interaction, $F(1, 88) = 5.38$, $MSE = 3856.78$, $p < .05$. Because none of the effects involving the nature of distraction was significant ($ps > .14$), we explored the interaction by using a composite distraction score that combined facilitation and interference scores. Older adults ($p < .01$) but not young adults ($p = .93$) showed a reliable reduction in distraction with delay. Age differences were significant at the short ISI ($p < .001$) but not at the long ISI ($p = .37$). To control for age-related slowing, we reanalyzed the data on proportional RT difference scores (e.g., Kim, Hasher, & Zacks, in press). The age effect ($p < .05$) and the ISI effect ($p = .06$) remained at or close to significance, but the interaction did not ($p = .13$). Nevertheless, the proportional RT analysis confirmed that older adults ($p < .05$) but not young adults ($p = .78$) reduced distraction effect from the short delay (i.e., 50 ms) to the longer delay (i.e., 1,000 ms).

Analyses on the distraction scores based on error rates or the proportional error rate scores showed no significant effects ($Fs < 1.21$, $ps > .27$),

Unexpected Recognition

Corrected recognition and RTs.—The 2 (ages) × 2 (ISIs) analysis of variance on the corrected recognition scores (hit rates for old words minus false alarms to new control words; see Table 1)[2] revealed that young adults ($M = 0.47$) outperformed older adults ($M = 0.41$), $F(1, 88) = 5.84$, $MSE = 0.02$, $p < .05$. The same analysis on RTs of all correct responses showed that young adults responded faster than older adults, $F(1, 88) = 89.80$, $MSE = 24849.38$, $p < .001$.

False-alarm and RT cost scores.—To determine whether older adults are less able to reject distractors, we analyzed false-alarm cost scores (false alarms for the picture labels minus false alarms for new words; see Table 1)[2] and found no reliable effects, $Fs < 1$. We also analyzed RT cost scores (RTs to correctly rejected picture labels minus RTs to correctly rejected new words; see Table 1). Older adults tended to show a larger RT cost, $F(1, 88) = 3.86$, $MSE = 5549.75$, $p = .05$, an effect that became unreliable in the analyses on the proportional RT cost scores ($p = .21$).

Discussion

Consistent with previous reports of age-related decline in distraction regulation (e.g., Hasher & Zacks, 1988; Lustig, Zacks, & Hasher, in press; Malmstrom & La Voie, 2002; May, 1999), our results suggest that older adults are more distracted by to-be-ignored pictures, and this is over and above the general age-related slowing. However, this conclusion might seem at odds with the findings of Duchek and colleagues (1995), who reported no interference from pictures for either older or young adults. The precise factors contributing to this discrepancy remain to be determined, but presumably some differences between the two studies may be relevant. In particular, we included facilitation trials, which might have encouraged attention to distractors because they facilitate the semantic judgments on some trials. In addition, the matched distractor-test and prime-test association strength might make pictures more competitive for attention in the current task. Nevertheless, Duchek and colleagues did find differentially greater verbal interference for older adults than for young adults. Our study joins with the work of Gazzaley and associates (2005) to show that older adults have greater difficulty than young adults do in regulating distraction from irrelevant pictures, as has previously been found for words.

At the 50-ms interval, older adults show a larger distraction effect than young adults do, suggesting that older adults allow more irrelevant information to enter working memory at this presumably automatic activation phase. The distraction effect tends to decrease after a longer delay (i.e., 1,000 ms), and this is exclusively true for older adults because older but not young adults reduced distraction effect with a longer delay and this reduction is over and above age-related slowing. This is consistent with the evidence that older adults take longer to overcome the effects of activated but irrelevant information than young adults do (Oberauer, 2005). However, the age × ISI interaction disappeared after we controlled for general age-related slowing, suggesting that the interaction may have been driven by the fact that older adults are generally slower than young adults. In any event, we should keep in mind that, as in previous studies (e.g., Gernsbacher & Faust, 1991), the delay is manipulated as a between-subjects variable, and thus it prevents us from explaining the pattern as an intraindividual change across time.

Recognition data confirm the well-established age-related deficit in explicit memory (Light, 1996). The tendency in the raw RT cost scores for older adults to take longer than young adults to reject picture labels seems primarily to be due to the general age-related slowing.

Taken together, it is clear that older adults are more disrupted by the pictorial distraction in the current picture–word task than are young adults. Older adults also take longer to suppress distraction in this task and take longer to conquer the competition of distractors in the subsequent recognition task.

Acknowledgments

This work was supported by the National Institute on Aging under Grant R37 AGO4306. We thank Ji-A Min and Ursula Wiprzycka, and many other research assistants, for their help in data collection.

Correspondence

Address correspondence to Lixia Yang, Department of Psychology, Ryerson University, 350 Victoria St., Toronto, Ontario M5B 2K3, Canada. E-mail: lixiay@ryerson.ca

References

Connelly, S. L., Hasher, L., & Zacks, R. T. (1991). Age and reading: The impact of distraction. *Psychology and Aging, 6*, 533–541.

Duchek, J. M., Balota, D. A., Faust, M. E., & Ferraro, F. R. (1995). Inhibitory processes in young and older adults in a picture–word task. *Aging and Cognition, 2*, 1–12.

Gazzaley, A., Cooney, J. W., Rissman, J., & D'Esposito, M. (2005). Top-down suppression deficit underlies working memory impairment in normal aging. *Nature Neuroscience, 8*, 1298–1300.

Gernsbacher, M. A., & Faust, M. E. (1991). The mechanism of suppression: A component of general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17*, 245–262.

Hasher, L., & Zacks, R. T. (1988). Working memory, comprehension, and aging: A review and a new view. In G. H. Bower (Ed.), *The psychology of learning and motivation : Advances in research and theory* (Vol. 22, pp. 193–225). San Diego, CA: Academic Press.

Horne, J. A., & Östberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *International Journal of Chronobiology, 4*, 97–110.

Katzman, R., Brown, T., Fuld, P., Peck, A., Schechter, R., & Schimmel, H. (1983). Validation of a short Orientation-Memory-Concentration Test of cognitive impairment. *American Journal of Psychiatry, 140*, 734–739.

Kim, S., Hasher, L., & Zacks, R. T. (in press). Aging and a benefit of distractibility. Psychonomic Bulletin & Review.

Light, L. L. (1996). Memory and aging. In E. L. Bjork & R. A. Bjork (Eds.), *Memory* (pp. 443–490). San Diego, CA: Academic Press.

Lustig, C., Hasher, L., & Tonev, S. T. (2006). Distraction as a determinant of processing speed. *Psychonomic Bulletin and Review, 13*, 619–625.

Lustig, C., Zacks, R., & Hasher, L. (in press). Inhibitory deficit theory: Recent developments in a "new view." In D. S. Gorfein & C. M. MacLeod (Eds.), *The place of inhibition in cognition*. Washington, DC: American Psychological Association.

Malmstrom, T., & La Voie, D. J. (2002). Age differences in inhibition of schema-activated distractors. *Experimental Aging Research, 28*, 281–298.

May, C. P. (1999). Synchrony effects in cognition: The costs and a benefit. *Psychonomic Bulletin & Review, 6*, 142–147.

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1998). The University of South Florida word association, rhyme, and word fragment norms. http://www.usf.edu/FreeAssociation/.

Oberauer, K. (2005). Control of the contents of working memory—A comparison of two paradigms and two age groups. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*, 714–728.

Plude, D. J., & Hoyer, W. J. (1986). Age and the selectivity of visual information processing. *Psychology and Aging, 1*, 4–10.
Shipley, W. C. (1940). A self-administering scale for measuring intellectual impairment and deterioration. *Journal of Psychology, 9*, 371–377.
Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental psychology: Human Learning and Memory, 6*, 174–215.

Received September 1, 2006
Accepted March 2, 2007
Decision Editor: Thomas M. Hess, PhD

End Notes

[1]We controlled the testing time because distraction control is greater at peak times than at off-peak times of day (May, 1999). We tested participants' circadian patterns by using the Morningness–Eveningness Questionnaire (Horne & Östberg, 1976). All the older adults are either morning type or neutral type and were tested in the morning (i.e., 9–11:30 a.m.). In contrast, all the young adults are either evening type or neutral type and were tested in the afternoon (i.e., 1–4:30 p.m.).

[2]In the initial analyses on recognition data that included age, ISI, and trial type as factors, semantically related words (i.e., on congruent or congruent control trials) were better recognized than unrelated words (i.e., on incongruent or incongruent control trials), and the more related a picture was to the prime (i.e., congruent trials) or the test word (i.e., incongruent trial), the more likely were false alarms to its label and the longer it took to reject its label. However, considering that trial-type effect was not the major concern of our study, and that it was the same for both age groups, we collapsed across trial types in the analyses on recognition. The age effects remain the same in the two sets of analyses, and neither showed a reliable ISI effect.