

RUNNING HEAD: Aging-related changes in memory-based choices

Memory dynamics and decision making in younger and older adults

Dinámicas de memoria y toma de decisiones en adultos jóvenes y mayores

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## ABSTRACT

The main aim of this research was to study whether memory dynamics influence older people's choices to the same extent as younger's ones. To do so, we adapted the retrieval-practice paradigm to produce variations in memory accessibility of information on which decisions were made later. Based on previous results, we expected to observe retrieval-induced forgetting (RIF) and choice bias in younger and older participants after they engaged in retrieval practice of some studied attributes. In addition, we aimed to compare both age groups' performance in an experimental condition in which retrieval practice was replaced by reading aloud practice of the same studied items. The results indicated that whereas both age groups showed RIF after performing retrieval practice, biased decisions were observed only in the younger participants. Interestingly, neither older nor younger people showed memory impairment or choice bias in the condition of reading practice. These results extend previous findings and support the idea that, under specific circumstances, elderly people may make better choices than younger people.

Keywords: Aging, memory-based choices, memory inhibition, decision-making, forgetting

## RESUMEN

El objetivo principal de esta investigación fue estudiar si los cambios en accesibilidad de la información en la memoria influyen en las elecciones de las personas mayores de la misma forma que en los jóvenes. Para ello, adaptamos el paradigma de práctica en la recuperación para producir variaciones en la accesibilidad de la información en la memoria sobre la que posteriormente se tomaban decisiones. Basándonos en resultados previos, esperábamos obtener olvido inducido por la recuperación (OIR) y sesgo en la elección en los participantes jóvenes y en los mayores después de haber realizado práctica en la recuperación de algunos de los atributos estudiados sobre una alternativa de elección. Además, comparamos la ejecución de ambos grupos de edad en una condición experimental en la que la práctica en la recuperación fue reemplazada por práctica en lectura de los mismos atributos. Los resultados demostraron que aunque los dos grupos de edad mostraban OIR después de realizar la práctica en la recuperación, el sesgo en la decisión sólo se observaba en los participantes jóvenes. Curiosamente, ni los mayores ni los jóvenes mostraron olvido ni sesgo en la elección en la condición de práctica en lectura. Estos resultados amplían los encontrados previamente y sugieren que, bajo ciertas circunstancias, las personas mayores pueden tomar mejores decisiones que las más jóvenes.

Decision making (DM) relies strongly on primary cognitive functions (e.g., Allaire & Marsiske, 1999; Kirasic, Allen, Dobson, & Binder, 1996; Smith & Ratcliff, 2009). For example, purchasing the car best suited to our needs requires the acquisition of information about alternative choices, focusing on their relevant features (ignoring the irrelevant ones), comparing them with each other and selecting the most advantageous. Thus, to the extent to which the cognitive processes underlying DM operate more or less efficiently, individual differences in decisions could emerge (Thornton & Dumke, 2005).

It is widely acknowledged that aging involves declines in a variety of cognitive domains such as working memory, episodic memory, speed of processing, and executive control (e.g., Hasher, Lustig, & Zacks, 2007; Lustig, Hasher, & Zacks, 2007; Salthouse, 2004; Salthouse, Atkinson, & Berish, 2003; Treitz, Heyder, & Daum, 2007). As a result, it is not surprising that age differences in DM have been observed in different studies. When compared with younger people, older adults, for instance, consider a smaller set of information before deciding (e.g., Berg, Meegan, & Klaczynski, 1999; Meyer, Russo, & Talbot, 1995), discard choice options without considering all available information (Riggle & Johnson, 1996), and prefer decision contexts with less choice options (Reed, Mikels, & Simon, 2008). Nevertheless, it is also clear that older adults do not always perform more poorly than younger adults when making decisions (e.g., Mather, 2006; Yoon, Cole, & Lee, 2009, for reviews). By using a blackjack-like card task, Dror, Katona, and Mungur (1998) demonstrated that older and younger adults became similarly more disinclined to take additional cards (in order not to go over 21 points) as the risk level increased. More recently, Kim and Hasher (2005; see also Tentori, Osherson, Hasher, & May, 2001) showed that older adults were less vulnerable than young adults to the attraction effect, a phenomenon in which adding an irrelevant alternative into an existing consideration set increases the probability of

choosing an alternative from the original set, indicating less consistent DM behavior in young people.

Two different approaches have dealt with this apparent discrepancy between cognitive functioning and DM performance. One suggests that older adults develop heuristics to compensate their cognitive decline (e.g., Peters, Hess, Västfjäll, & Auman, 2007; Yoon, Cole, & Lee, 2009). Heuristics refers to processing strategies that involve judgment rules, often considered shortcuts, and are primarily based on easily processed cues and minimal cognitive demands (for a review, see for example, García-Retamero & Dieckmann, 2006; Iglesias-Parro, De la Fuente, & Ortega, 1999; Payne, Bettman, & Johnson, 1993). In this way, using decision heuristics such as the fluency heuristic (by which easily retrieved information is considered to have greater value; Arias, Iglesias-Parro, & Morales, 2006; Gigerenzer & Goldstein, 1996; Schwarz et al., 1991), could lead to optimal decision making under some circumstances (but see Payne et al., 1993). An alternative view on the observed discrepancies between cognitive functioning and DM performance highlights that some of the cognitive functions critical to DM are age invariant or even improve with aging (Healey & Hasher, 2009). Thus, older adults may be at least as capable as younger adults to make proper decisions. Indeed, general semantic knowledge (e.g., Verhaeghen, 2003) and implicit memory (Healey, Campbell, & Hasher, 2008, for a review), both generally preserved with healthy aging, could support older adults' decision making in some contexts. Rather than being antagonist, the two above mentioned perspectives, heuristic use and preserved ability, probably draw together the better picture of the preserved DM capabilities in aged people (Healey & Hasher, 2009).

## Memory accessibility and choices

A critical process in memory-based DM is retrieval of relevant information from long-term memory (Hastie & Park, 1986). In this type of decision making people must first retrieve relevant available information in order to generate a consideration set from which an alternative can be selected (Ratneshwar & Shocker, 1991). Hence gains or losses in memory accessibility for choice alternatives might affect the consideration-set configuration and, in turn, influence the outcome of DM. Thus, it is important to investigate how retrieval dynamics could shape the consideration-set structure and subsequent choices.

Recent evidence of the role of memory accessibility in memory-based DM comes from a study by Iglesias-Parro and Gómez-Ariza (2006; see also Iglesias-Parro, Gómez-Ariza, & Arias, 2009) who explored the relation between retrieval-induced forgetting (RIF) and preference in a choice task. RIF refers to memory impairments for specific items as a consequence of previously retrieving related items and is usually studied with the retrieval-practice (RP) paradigm (Anderson, Bjork, & Bjork, 1994). Although repeated retrieval of some items increases their accessibility in a later test, it also reduces memory accessibility for related items as compared to a baseline condition. Thus, the RP paradigm becomes an useful tool to study the influence of memory dynamics on DM.

In their study, Iglesias-Parro and Gómez-Ariza (2006) had participants study a set of attributes for two characters, each of which was paired with six different attributes. The material was elaborated so that the two characters could be deemed as equally good candidates for a phone insurance salesman position. In this way, three of the attributes of each character were not relevant at all for the job (e.g., Antonio-single or Braulio-sporty) whereas the remaining three were relevant and positive for working as a phone seller (e.g., Antonio-verbal fluency or Braulio-loquacious). After studying the whole set of character-attribute pairs, the participants moved to the RP phase. Thus, they were to perform retrieval

practice of the irrelevant characteristics from one of the characters. This practice was induced by presenting a character's name together with an attribute stem (e.g., Antonio-per\_\_\_\_) and was expected to enhance the recall of the irrelevant attributes (facilitation) as well as the forgetting of the unpracticed relevant characteristics of the practiced candidate (RIF). The effects of RP on decision making and memory were assessed through two different tests: a surprise choice task and a final memory task. Importantly, whereas the participants were told about the memory test from the very beginning of the experimental session, they were not informed about the decision task until this phase of the experiment. Thus, they were first told to imagine themselves as a part of a personnel selection team and asked to evaluate and choose the best candidate for a telephone insurance sales job. Finally, the accessibility of the studied attributes was measured with an item-specific cued-recall test on all experimental candidates' attributes. The results of the study were straightforward; as expected, the participants showed selective forgetting of the unpracticed (relevant) attributes of the practiced character (Rp- items) but enhanced recall of the practiced (irrelevant) attributes (Rp+ items). More interesting, a clear bias in choice probabilities emerged; namely, the participants chose as the best candidate that one whose attributes were not practiced (Nrp items). If, as usual, RIF is interpreted as a consequence of an inhibitory executive-control mechanism that decreases the accessibility of competing memory traces (Anderson, 2003; Román, Soriano, Gómez-Ariza, & Bajo, 2009), then the relevant attributes of the practiced character would have a lower probability of being a part of the consideration set which, in turn, would reduce their impact in a choice setting.

Iglesias-Parro, Gómez-Ariza, & Arias (2009) extended previous results by adding a new experimental condition to disentangle alternative theoretical interpretations on choice bias after RP. Because participants performed RP of irrelevant attributes from one candidate, the choice bias could also be thought of as a consequence of the increased memory

accessibility of these attributes rather than as a result of the reduced accessibility (inhibition) of the relevant ones. If a participant's consideration set comprises the non-relevant attributes from the practiced candidate together with the relevant ones from the unpracticed candidate, then it could have wisely led participants to choose the unpracticed candidate whose critical features were more easily retrievable. In other words, interference rather than inhibitory processes could underlie the choice bias found by Iglesias-Parro & Gómez-Ariza (2006). To test for this possibility, and in addition to the retrieval practice group, Iglesias-Parro et al. (2009) included a second group in which this phase was replaced by practice in reading aloud the irrelevant attributes of one candidate. As the results of a number of studies suggest (e.g., Anderson & Bell, 2001; Anderson, Bjork, & Bjork, 2000), and in agreement with the inhibitory account of RIF, this reading aloud (RA) practice should enhance accessibility of non-relevant attributes whereas leaving relevant ones untouched. As no retrieval competition is generated by reading, memory inhibition becomes unnecessary and forgetting is not expected to occur. Thus, it was predicted that no choice bias should be observed in the reading aloud group. The results confirmed this expectation and showed a clear relation between memory and choice. While RIF and choice bias were found in the RP group, what replicates previous results, neither forgetting nor bias were evident in the RA group.

### The present study

Our study deals with age related differences in memory-based choices. Specifically, our aim was to investigate whether or not accessibility dynamics influence older people's choices to the same extent as younger's ones. Thus, the study described here essentially conforms to the experimental design used by Iglesias-Parro et al. (2009). Manipulating the practice status of the studied items (Rp+, Rp- and Nrp) as well as the type of practice condition (retrieval and reading) allows us to create an appropriate scenario to explore

relevant theoretical issues. First, our study could provide us with new insights on how aging modulates the relations between memory retrieval and decision making. Like in young people, memory inhibition could lead older adults to show RIF and preference bias against the practiced candidate. In fact, findings from recent studies have shown that older and younger adults show comparable RIF after RP (e.g., Aslan, Bäuml, & Pastötter, 2007; Gómez-Ariza, Pelegrina, Lechuga, Suárez, & Bajo, 2009; but see Ortega, Gómez-Ariza, Román, & Bajo, 2011). Hence if elder people's configuration sets are created under the same memory constraints as younger's ones, it seems reasonable to expect older people to bias their choices against the alternative on which RP was performed, as young people do. However, whether or not this is the case is an empirical question that requires testing.

On the other hand, our study could help clarify the mechanism underlying RIF in older people. Because older adults are more vulnerable to memory interference (Gerard, Zacks, Hasher, & Radvansky, 1991), to some extent RIF could be also expected in our older participants after reading practice. Since reading practice should increase memory accessibility of the practiced attributes of the practiced candidate, this could block access to the unpracticed attributes of this candidate. Hence if the name of the practiced candidate is presented in a later test, Rp+ attributes would have a greater probability of being activated and will compete with Rp- (relevant) attributes. If so, in a choice setting older participant's consideration set would include the non-relevant attributes from the practiced candidate and their choices could be biased against this candidate. To test for this possibility, and unlike our previous studies (Iglesias-Parro & Gómez-Ariza, 2006; Iglesias-Parro et al., 2009), in the present study the candidate names were never presented as a cue in the final memory test. Instead, only the initial letters of the attributes were provided. The choice task, however, required participants to pay attention to the candidates' name in order make a decision. Thus, a preference for the unpracticed candidate when RIF is not observed in an interference-free

memory test could be interpreted in terms of interference-induced bias against the practiced candidate. In addition, observing no RIF after reading practice would be theoretically relevant because, to our knowledge, no study so far has addressed the role of interference processes in producing RIF in older adults. While it has become clear in young adults that RIF is independent of Rp+ items' strength (e.g., Anderson, 2003; Anderson et al., 2000; Anderson & Bell, 2001; Iglesias-Parro et al., 2009), it remains to be clarified in older adults. Thus, a secondary aim of the present work was to address this issue.

### Method

*Participants and design.* Thirty-nine young adults (Mean age = 23.01, Range = 18-30) and forty-two older adults (Mean age = 66.21, Range = 60-75) participated in the experiment. All of them were students at the Universidad of Jaén. The younger participants were Psychology or Education students and the older were students enrolled in the program University for Older People. The younger participants received course credit whereas the older participants were given a gift for their participation. Before the experimental task, participants were required to provide information about their physical and psychological health by using a scale ranging from 1 (*very bad*) to 10 (*very good*). Physical health self-report was 7.7 points on average for younger and 7.2 for older participants. Psychological health was 7.5 points on average for younger participants and 7.8 for the older ones.

To control global cognitive functioning, we administered the two digit memory span tests of the WAIS-III test (Wechsler, 1993) and the vocabulary subtest of the Spanish version of the PMA (Thurstone & Thurstone, 1996). In the following analysis, data belonging to 12 older and 8 younger participants were lost. On the direct digit test, the younger participants showed a mean score of 6.10 ( $SD= 1.17$ ) and the older participants obtained a mean of 5.58 ( $SD= .96$ ); these scores did not differ significantly,  $F(1,60) = 3.75$ ;  $MSE = 1.14$ ;  $p > .05$ . On

the inverse digit scale, the younger participants' mean score was 4.38 ( $SD = 1.04$ ) and the older participants' mean was 4.12 ( $SD = .96$ ) which did not differ from one each other,  $F(1,60) = 1.02$ ,  $MSE = 1.00$ ,  $p > .05$ . As usually found (e.g., Verhaeghen, 2003), in the vocabulary test a significant lower score was observed in the younger group ( $M = 12.52$ ,  $SD = 3.33$ ) than in the older group ( $M = 18.06$ ,  $SD = 5.19$ ),  $F(1,60) = 24.21$ ,  $MSE = 19.58$ ,  $\eta_p^2 = .26$ .

The experiment conformed to a 2 (Age group: younger and older) x 2 (Practice: retrieval and reading) x 4 (Items status: Rp+, Rp- and Nrp) mixed design with the latter as a within-participant factor.

*Materials.* The to-be-studied items (candidate-attribute pairs) were obtained from a normative study (Iglesias-Parro & Gómez-Ariza, 2006). In that study 90 (25 male) management students from the University of Jaén (ages ranging from 18 to 24 years) were told to imagine themselves as part of a personal selection team in charge of elaborating a profile for a phone insurance salesman position. On a booklet provided by the experimenter participants were to write as many good, poor and irrelevant characteristics for the specified job as they could. In all cases, a minimum of five characteristics was required. The obtained responses were ordered in accordance to their relative frequencies (weights). After eliminating category overlaps, some responses were used as experimental attributes and others as filler attributes to create six sets of candidate-attribute with six attributes each.

For the present experiment, two candidates were described by three good and three irrelevant characteristics and were used as experimental candidates. To make these two candidates as highly similar as possible, their respective attributes were selected in order to have similar weights. The remaining four candidates were elaborated to minimize primacy and recency effects at study and to be used as filler items during the corresponding (retrieval

versus reading) practice. These filler candidates were characterized by irrelevant and poor attributes for a phone insurance seller (see Appendix).

To check the stimuli similarity, the experimental candidates were presented to a different group of 38 management students (age range from 19 to 26 years). The information was presented in a Candidate by Attribute matrix on a computer screen. The experimental candidates were ordered randomly and, for each candidate, the attribute order was randomized. The participants were asked to choose the best for a phone insurance seller job: 50% of students selected each candidate as the best. A pretty similar procedure was used with a sample of 22 older adults (age ranged from 65 to 85 years), but candidates were presented in a sheet of paper. The distribution of selections did not differ from one each other (54.54% and 45.46%,  $p = .51$ ).

*Procedure.* The procedure was similar to the one used by Iglesias-Parro et al. (2009). Before starting participants were informed they were taking part in a memory study. The experimental session involved four different phases. First, participants were asked to study six sets of candidate-attribute pairs (two experimental, e.g., Antonio-persuasive, and four filler candidates, e.g., Fernando-blue eyes). Six randomly selected attributes from the four filler candidates were presented at the beginning and at the end of the study list. The 12 experimental candidate-attribute pairs were presented randomly mixed with the remaining 12 filler candidate-characteristic pairs in the middle of the filler blocks. The learning sequence was presented twice. Each candidate-attribute pair was presented for 5 s on the computer screen.

After study, half of participants from each age group (retrieval practice condition, RP) engaged in a retrieval practice phase on the irrelevant attributes from one of the experimental candidates. For each item, they performed four trials of retrieval practice. This was induced by presenting a candidate's name together with an attribute stem (e.g., Antonio-per\_\_\_\_\_) on

the computer screen for 5 s. Participants were asked to say aloud the studied attribute that started with the same letters as the stem cue. The experimenter wrote down the answer in a sheet of paper. The practiced candidate was counterbalanced between subjects. The remaining participants of each age group (reading aloud practice condition, RA) were presented complete candidate-attribute pairs (e.g., Antonio-persuasive) and asked to read them. The practiced candidate was also counterbalanced between participants. Like in the retrieval practice condition each item was practiced four times.

In the next phase of the experiment participants were asked to imagine themselves as a part of a personnel selection team of an insurance company. Specifically, the participants were asked to choose the best candidate for a telephone insurance sales job. To do so, the names of the two experimental candidates were shown on the PC screen and the participants were told to select, by saying the name, the best candidate for the job. To be highlighted is that the participants were not informed about this choice task until this moment. After making the choice, the participants performed an item-specific cued-recall test on the whole set of studied attributes (e.g., Per\_\_\_\_\_). Unlike the memory test used during the RP phase, no candidate name was presented as part of the memory cue. Participants were to say aloud the corresponding attribute, if remembered, and the experimenter wrote down the answer in a sheet of paper.

## Results

A significance level of .05 was used for all analyses described here. We first describe performance on memory tasks and then describe the results in the choice task.

### Recall performance

*Retrieval practice.* The mean proportion of correct responses in the retrieval practice phase (RP condition) was .75 ( $SE = .04$ ) for the younger participants and .71 ( $SE = .04$ ) for the

older ones. These means did not differ from each other ( $F < 1$ ).

*Final memory test.* To check for the forgetting effect, we compared the proportion of recall for the unpracticed relevant-attributes of the practiced character (Rp- items) with the unpracticed relevant-attributes of the unpracticed character (Nrp-R items) (see Table 1 for descriptive statistics). A 2 (Item: Rp- vs. Nrp-R) x 2 (Age group: younger vs. older) x 2 (Practice: retrieval vs. reading) mixed analysis of variance (ANOVA), with type of item as a within-participants factor, showed a significant interaction between Item and Practice,  $F(1,77) = 6.05$ ,  $MSE = .07$ ,  $\eta_p^2 = .07$ . Simple-effect analyses confirmed reliable RIF after RP,  $F(1,39) = 60.94$ ,  $MSE = .06$ ,  $\eta_p^2 = .61$ , but not after RA, ( $F < 1$ ). This pattern was similar in both age groups ( $F < 1$  for the second order interaction).

We also checked for facilitation after practice by comparing the recall for the practiced irrelevant-attributes of the practiced character (Rp+ items) with the unpracticed irrelevant-attributes of the unpracticed character (Nrp-I items). Thus, we conducted a 2 (Items: Rp+ vs. Nrp-I) x 2 (Age group: young adults vs. older) x 2 (Practice: retrieval vs. reading) mixed ANOVA. The analysis showed a significant effect of type of items: Rp+ attributes (77 %) were reliably more recalled than Nrp-I ones (50%),  $F(1,77) = 29.22$ ,  $MSE = .09$ ,  $\eta_p^2 = .27$ . The effect of age was also significant: the younger participants recalled more items (68%) than the older participants (59%),  $F(1,77) = 4.75$ ,  $MSE = .07$ ,  $\eta_p^2 = .06$ . None of the interactions reached significance (type of items x age,  $F(1,77) = 2.77$ ;  $MSE = 0.09$ ,  $p > .10$ ; remaining  $F$ s  $< 1$ ).

TABLE 1 ABOUT HERE

## Choice performance

The effect of practice on the participants' choices was analyzed with Chi-square tests. As can be seen in Table 2, in the RP condition, the younger participants' choices were significantly biased against the practiced candidate,  $\chi^2_{(1)} = 8.89$ , whereas there was no choice bias in the older group  $\chi^2_{(1)} = 0$ . In the RA condition, however, none of the age groups showed a preference for practiced or unpracticed candidates ( $\chi^2_{(1)} = .20$ , in both groups).

TABLE 2 ABOUT HERE

## Discussion

The aim of our study was to explore the extent to which memory dynamics influence older people's choices to the same extent as younger's ones. To do so, we adapted the retrieval-practice procedure (Anderson et al., 1994) to produce variations in memory accessibility of information on which decisions could be made. Based on results of previous studies, we expected to observe RIF and choice bias in younger and older participants after they engaged in retrieval practice of some studied items. Forgetting the relevant attributes of a candidate should render the other candidate the preferred choice. In addition, we aimed to compare both age groups' performance in an experimental condition in which retrieval practice was replaced by reading practice of the same studied items. Whereas previous research has shown that reading practice causes neither RIF nor biased choices in young people (Iglesias-Parro et al., 2009), its effect in older people has not been addressed so far. Our results show both similarities and dissimilarities between young and older adults.

Replicating previous findings (Iglesias-Parro & Gómez-Ariza, 2006; Iglesias-Parro et al., 2009), retrieval practice of some (non-diagnostic, irrelevant) attributes of a given candidate led younger participants to prefer the unpracticed candidate in the choice task.

Because they also showed memory impairment (RIF) for the diagnostic attributes of the practiced candidate, the choice bias against this candidate may be thought of as a consequence of loss of accessibility in memory. Interestingly, the pattern of performance was different in the older group that carried out retrieval practice. Whereas the elderly showed forgetting of the unpracticed attributes of the practiced candidate, so extending findings of previous RIF studies with older people (e.g., Aslan et al., 2007; Gómez-Ariza et al., 2009; Ortega et al., in press), no preference bias was evident in this age group.

The absence of choice bias in the presence of RIF in the elderly was striking but is in agreement with previous findings that show more appropriate decisions in older than in younger adults (Mather, 2006; Yoon et al., 2009). In showing no choice preference, our older group displayed more adequate decision behavior than our younger participants. Because the two candidates upon whom decisions had to be made were similarly good for the seller job, as the normative studies suggested, from a rational point of view the choice probability for both candidates should be the same. Consistent with this, previous studies have found that older adults are as effective as, if not better than, young adults in many DM contexts (e.g., Kim & Hasher, 2005; Tentori, Osherson, Hasher, & May, 2001).

A possible explanation for the better choice performance shown by older adults might be related to older people's tendency to rely on heuristic information processing rather than analytic/systematic information processing (e.g., Kim & Hasher, 2005; Klaczynski & Robinson, 2000). This differentiation comes from previous theoretical and empirical work in the field of social cognition distinguishing between memory-based and on-line information processing (e.g., Hastie & Park, 1986). From this point of view, memory-based processing involves a reliance on the retrieval of previously stored relevant information from memory and the construction of preferences on the basis of this information. In contrast, on-line processing refers to the construction of a judgment concurrent to information availability

concerning a specific stimulus. This processing mode is most likely to occur when individuals approach information with a particular processing objective in mind, such as forming impression of persons (Hastie & Park, 1986; Sanbonmatsu & Fazio, 1990). In line with this, whereas our younger group's preference choices seem to be modulated by memory accessibility of relevant pieces of information, the older participants do not seem to draw upon retrieval of specific memories to make memory-based choices. Thus, young adults could be more prone to make choices on the basis of memory contents whereas older adults' choices would rely on already constructed preferences about the alternatives, presumably generated during the encoding phase. Researchers on social cognition have coined terms such as social expertise (Hess & Auman, 2001) or life pragmatics (Staudinger & Pasupathi, 2000) to refer to the manner in which social information is interpreted and remembered as a function of age-related accumulation of social experience. In short, experience gained with age concerning social circumstances could render older people more prone to form impressions about others and, thus, to on-line processing. Of course, the extent to which this idea may account for our adults' choice performance is unknown, but it emerges as a plausible hypothesis.

An alternative account of our results is that older adults could not be motivated enough to engage in making choices. Research has shown that, relative to younger adults, cognitive performance of older adults is enhanced by increases in the personal or social relevance of materials (Germain & Hess, 2007; Hess, Germain, Rosenberg, Leclerc, & Hodges, 2005). Although we did not measure motivation or engagement level of the participants in our tasks, it became apparent from informal post-experimental conversations that most of them were highly motivated and committed to the task. More important, the fact that older and younger participants had a pretty similar performance both in the RP task and

the final memory test can be taken as an index of comparable engagement in the experimental setting.

As for the reading-aloud condition, both age groups showed neither RIF nor choice bias. In agreement with findings of previous RIF studies with young adults (e.g., Anderson et al., 2000; Bäuml, 2002; Iglesias-Parro et al., 2009), replacing retrieval-practice with reading practice of Rp+ items produced facilitation of these items but failed to cause forgetting of Rp- items. If RIF was due to associative interference of practiced items, the forgetting effect should be expected in the two practice conditions (retrieval and reading) because both types of practice strengthen the Rp+ items and make them more accessible (such as the respective facilitation effects confirm). Our results, however, show that this is not the case regardless of age and are of theoretical importance as they go against the interpretation of RIF as a consequence of strength-based associative interference (Anderson, 2003), even in a population thought to be more prone to memory interference (e.g., Gerard et al., 1991). To the best of our knowledge, this is the very first demonstration that RIF is also retrieval-specific in people over 65 years-old.

More relevant here, no biased choices were observed in any of the age groups in the reading aloud condition. This finding replicates previous results with young people (Iglesias-Parro et al., 2009) and extends them to older adults. At first glance, the lack of choice bias after reading practice, which according to memory performance did not lead to reduced accessibility for Rp- attributes, could suggest that our participants' choices always relied on the accessibility of relevant information in memory. Although it is likely the case in the younger group (a clear relationship between RIF and choice bias is systematically found across several studies), our results do not allow one to go so far with respect to the elderly. Whereas they could draw upon heuristics only in conditions of reduced memory accessibility,

the use of heuristics or strategies in memory-based DM could be the rule in people experiencing aging-related memory failures.

To conclude, our results are suggestive of how memory dynamics differentially affect choice outcomes with aging. Older people made better decisions than younger adults despite both age groups showing parallel memory performance. However, because we did not assess decision strategies themselves, further studies are necessary to better understand how older adults make memory-based decisions. Given the relevance of proper decision-making outcomes in day-to-day life, it is necessary to consider how aging and decision making relate to one another.

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## TABLE CAPTIONS

### TABLE 1

Mean proportion of recall (and standard errors) in the final memory test as function of practice condition, items' status, and age of participants.

### TABLE 2

Proportion of choices as a function of practice condition, candidates' status, and age of participants.

TABLES

Table 1

Practice condition	Items' status	Age Group	
		Younger	Older
Retrieval	Rp+	.77 (.05)	.77 (.05)
	Rp-	.21 (.07)	.26 (.06)
	Nrp-I	.59 (.08)	.44 (.07)
	Nrp-R	.43 (.07)	.38 (.06)
	Facilitation	.18	.33
	RIF	.22	.12
Reading	Rp+	.77 (.05)	.75 (.05)
	Rp-	.40 (.06)	.33 (.06)
	Nrp-I	.58 (.07)	.40 (.07)
	Nrp-R	.35 (.06)	.33 (.06)
	Facilitation	.19	.35
	RIF	.05	.00

Note: Rp+ = Practiced irrelevant-attributes from practiced candidates, Rp- = unpracticed relevant-attributes from practiced candidates, Nrp-I = Unpracticed irrelevant-attributes from unpracticed candidates, Nrp-R = Unpracticed relevant-attributes from unpracticed candidates. RIF = Nrp-R – Rp-. Facilitation = Rp+ - Nrp-I.

Table 2

Practice condition	Candidate	Age Group	
		Younger	Older
Retrieval	Unpracticed	.84	.50
	Practiced	.16	.50
Reading	Unpracticed	.55	.55
	Practiced	.45	.45

## APPENDIX

Candidates' attributes used as study material in the experiment.

Experimental Candidates		Filler Candidates			
ANTONIO	BRAULIO	CARLOS	DAVID	ESTEBAN	FERNANDO
Verbal fluency	Nice voice	Unpleasant	Twanged	From Seville	Blue eyes
Persuasive	Loquacious	Stuttered	Aggressive	Blond	Beard
Dynamic	Extraverted	No motivated	Unpunctual	Quiet	Orderly
Left-handed	Atheistic	Freckled	Liberal	Thin	Tattoo
Single	Sporty	Tall	Music-lover	Lame	Contact lens
One child	Nonsmoker	Graduated	Middle-class	Stamp collector	Driver