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Stronger evidence for own-age effects in memory for older as compared to younger adults

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Three studies examined whether younger and older adults better recall information associated with their own than information related to another age group. All studies compared young and older adults with respect to incidental memory for previously presented stimuli (Studies 1 and 2: everyday objects; Study 3: vacation advertisements) that had been randomly paired with an age-related cue (e.g., photo of a young or an old person; the word “young” or “old”). All three studies found the expected interaction of participants’ age and age-associated information. Studies 1 and 2 showed that the memory bias for information arbitrarily associated with one’s own as compared to another age group was significant for older adults only. However, when age-relevance was introduced in a context of equal importance to younger and older adults (information about vacations paired either with pictures of young or older adults), the memory bias for one’s own age group was clearly present for both younger and older adults (Study 3).

Keywords: Own-age effect; Memory bias; Age relevance; Ageing.

Memory is highly selective. Well-known memory effects include primacy and recency effects, or result from stimulus attributes such as familiarity or salience (e.g., Crowder, 1976). In this paper we argue that the relation of information to age might lead to selective information processing and memory. We propose that information related to one’s own age is better remembered than information related to another age group, and that this “own-age effect” should be particularly pronounced in older adults. In the following we provide a short overview of the cognitive and

developmental literature on the “own-age bias” that served as the basis for the present studies.

AGE-RELEVANT INFORMATION PROCESSING

A growing number of studies provide evidence for an “own-age bias” (e.g., Anastasi & Rhodes, 2005, 2006; Bartlett & Fulton, 1991; Fulton & Bartlett, 1991; Lamont, Stewart-Williams, & Podd, 2005). This literature is almost exclusively

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concerned with face recognition. The general finding in these studies is that children as well as adults of all ages exhibit better recognition performance for faces that belong to their own age group. This effect might be due to enhanced encoding of faces belonging to one's own age group. For instance, Malatesta, Izard, Culver, and Nicolich (1987) report that young, middle-aged, and older adults identify emotional expressions best when the faces belong to their own age group. If people are better in recognising faces of their own age group, this might help them to encode these faces better and hence lead to better recognition.

Note that the literature on the own-age effect is predominantly based on face recognition. The present studies investigate if the effect also extends more broadly to stimuli associated with a certain age group. Faces of younger or older persons are stimuli that carry the age-associations within them. These studies, then, may confound the familiarity stemming from the amount of exposure to one's own age group with an information-processing bias due to the association of a stimulus with a certain age group (Anastasi & Rhodes, 2006). In fact, a recent study by Ebner and Johnson (2009) found that younger and older adults were less able to identify the emotional expressions of faces of the other age group the more contact they had with their own age group. Similarly, recognition of older faces was better for younger adults, the more contact with older adults they reported. Confirming the "contact hypothesis" as an explanation for the own-age bias, Harrison and Hole (2009) found that young adults who had a lot of contact with children (i.e., teacher trainees) recognised children's faces faster than own-aged faces. In contrast, undergraduate students who spent most of their time with same-age peers showed a recognition bias for faces of young adults.

There is some evidence for generally enhanced memory for members of one's in-group as, for instance, defined by race (Meissner & Brigham, 2001). Going beyond better memory for own-race faces, Horry and Wright (2008) showed that white participants did not differ in their hit rates in recognising white or black faces but made substantially more errors in recognising black faces (false alarms). Interestingly, when asked to identify the context in which the face was shown (e.g., class, prison), participants' memory was significantly better for their own race than for that of the other race. To our knowledge, this is the only

study demonstrating that the in-group memory bias extends to the context in which the target of the memory test was encoded. The current study seeks to extend this finding to the same-age bias as well as to free recall rather than recognition memory.

As in the case of the own-age bias, the contact hypothesis has also been suggested as one of the mechanisms underlying the own-race effect. People typically have more contact to other persons of their own race and hence might have better elaborated cognitive schemata for members of this group that, subsequently, help them to recognise them. However, a meta-analysis by Meissner and Brigham (2001) revealed that contact played only small—albeit statistically reliable—mediating role in explaining the own-race bias. Slone, Brigham, and Meissner (2000) suggest that, compared to cognitive factors, contact might be of lower predictive validity for explaining in-group biases. The present set of studies will test the role of familiarity for enhanced processing of stimuli related to one's own age by using not only young and old faces but also the words "young" and "old" that are equally familiar to both age groups, or even artificially created names for young and old people. If familiarity drives the own-age effect, it should disappear when using equally (un)familiar age-related stimuli.

Age-related difference in the processing of age-associated information

In line with the expectation of an own-age bias in information processing, Mueller, Wonderlich, and Dugan (1986) found that older adults were faster at judging "old" as compared to "young" traits (i.e., traits rated in a previous study as being highly descriptive for older or young adults, respectively). Interestingly, no such effect was found for young adults. This effect cannot be attributed to older adults generally exhibiting an advantage for processing information that is related to their self: Generally the self-reference effect seems to be equally strong in younger and older adults. Recent studies even suggest that older adults might exhibit a weaker self-reference effect (e.g., Glisky & Marquine, 2009; Gutches, Kensinger, Yoon, & Schacter, 2007). This suggests that it was the *age* relation rather than the *self* relation that led to fast reaction times in the

Mueller et al. study. Age-associated information, then, might be particularly salient for older adults.

One interpretation of the age-related difference in the processing of age-associated information is that, as cognitive resources tend to decline with age (Li et al., 2004), older adults might have to be more selective regarding the information they process. As a result, then, older adults might depend more strongly on strategies that help them select the information of high personal relevance than younger adults (Castel, 2008). One cue that signals relevance of information might be whether it is related to one's age. If this interpretation is true, an age-related difference in the own-age bias should be evident in memory performance, a functional domain that is negatively affected by age (e.g., Li et al., 2004; Verhaeghen, Marcoen, & Goosens, 1993). The hypothesis of a stronger own-age effect in older adults is consistent with the recent finding of "agenda-based" encoding of information that is valued as particularly important (Ariel, Dunlosky, & Bailey, 2009). Specifically, Castel (2008) has argued that, due to their—relatively to younger adults—impaired memory performance, older adults might rely more on prioritising information that is of high value for them. Supporting this assumption, Castel, Benjamin, Craik, and Watkins (2002) have demonstrated that older adults can selectively remember information of high value better than information of low value (see also McGillivray & Castel, 2011). Moreover, Firestone, Turk-Browne, and Ryan (2007) found that, although younger adults show overall better face recognition of both younger and older faces, older adults more accurately recognise older compared to younger faces. In line with this research, then, we hypothesise that older adults show a more pronounced own-age bias in memory than younger adults.

The present studies

To our knowledge, all studies that have demonstrated an own-age bias in face recognition, or in the response time for judging a stimulus as being self-descriptive or not, have used stimuli that, in themselves, carried a previously established association with age (such as the face of a young or an old person). As pointed out above, using stimuli that are strongly associated with a certain age group in studies testing an own-age bias is problematic as it might reflect familiarity due to

higher exposure to people of one's own age group (Ebner & Johnson, 2009; Harrison & Hole, 2009).

The vast majority of the studies on the own-age effect use recognition rather than recall paradigms. In general, memory performance is higher in recognition as compared to recall tasks. In the context of face recognition, the findings by Bartlett and Fulton (1991) support the hypothesis that older adults rely more on resemblance of faces than younger adults when judging whether or not they have seen a face before. This bias can be excluded when using a recall instead of a recognition paradigm. To our knowledge, only one study has tested the own-age-bias using recall. Lindholm (2005) showed pictures of younger and older adults in everyday clothing. After a filler task, participants had to answer 10 questions recalling details of the picture just shown (e.g., gender, age, clothes). In line with research on face recognition, younger adults showed an own-age bias such that they recalled more details correctly and showed an own-age-bias towards the information provided with the pictures of younger adults. That is, younger adults were able to recall more information regarding the pictures of younger adults correctly than of the pictures of older adults. Older adults recalled information regarding both age groups equally well. This study, then, provides first evidence for an own-age effect in memory using a recall paradigm in an intentional memory task. Also using cued recall, McGillivray and Castel (2010) have recently shown that the associative memory deficit of older compared to younger adults when remembering associations between age and a face can be reduced when participants generated the age rather than being provided with the information of the age of the face. This suggests that older adults profit particularly from elaboration at the encoding stage. This study also used an incidental memory paradigm, showing that younger adults were better in remembering the correct age of a given face. In our studies we will go one step further and test if the own-age effect also holds in the same way when using an incidental memory task for stimuli that are arbitrarily paired with age-related cues. This allows us to counteract possible strategic encoding along the categories "young" and "old" when knowing that information will have to be recalled later. This paradigm seems most appropriate for testing the hypothesis that older adults *automatically* attend more to information related to their

own age group than to information about other age groups.

As is true for the other studies on the own-age effect, in Lindholm's (2005) study the information to be recalled was itself age-related. For instance, the clothes and accessories that people wore were not identical for young and old adults, and hence might have been age-related (most older adults do not wear the same kinds of clothes as younger adults, such as, for instance, pyjama bottoms combined with a tank top). To our knowledge there exist no studies that have tested the own-age effect by using age-neutral stimuli that are arbitrarily associated with age-related stimuli. Therefore, in the present studies, we attempt to extend findings of previous studies on the own-age bias to stimuli that are merely (and arbitrarily) associated with age-related stimuli.

Taken together, to test the age-differential hypothesis of an own-age bias, we conducted three studies that compared young and older adults with respect to recall of information that was arbitrarily paired with cues related to young or old adulthood (e.g., photos of young vs old adults; the word "young" vs "old").

STUDY 1

The main purpose of Study 1 was to test if the own-age bias can be demonstrated with stimuli that do not carry any age-related information in them but are arbitrarily combined with an age-related cue. Based on previous results by Mueller et al. (1986), we expected older adults to show a stronger own-age bias than younger adults.

Method

Participants

Participants were recruited from an existing pool maintained by the Lifespan laboratory at the Max Planck Institute for Human Development in Berlin, Germany, as well as via newspaper advertisements, flyers, and word of mouth in the city of Berlin, Germany. The sample comprised 64 adults: 32 young adults (19–29 yrs, $M = 23.8$) and 32 older adults (60–77 yrs, $M = 68$). Gender was equally distributed (50% women). Most of the young adults were high school or university students (84.4%). All of the older adults were retired.

Cognitive functioning was measured using two performance tests—the Spot-a-Word test (Lehrl, 1977) and the Digit-Symbol Substitution Test (Wechsler, 1982), which assess crystallised and fluid intelligence, respectively. As shown in Table 1, both cognitive tests revealed age differences in line with the literature on the developmental trajectories of crystallised and fluid intelligence (e.g., Li et al., 2004).

Tasks and materials

In this study an incidental pair-associative memory task and an intentional pair-associative memory task were used. In both tasks, stimuli were presented on a computer screen.

Incidental memory. In the *incidental pair-associative memory task* photos of 16 everyday objects (e.g., cup, bar of soap, pen) that had been judged in a pilot study as not associated with young or older adulthood were combined with either a young or an old face. Eight faces for each age group were used. The faces were taken from the Age Implicit Association Test (Nosek, Greenwald, & Banaji, 1998; <https://implicit.harvard.edu/implicit/Study?tid=-1>) and showed only the centre of the face (no hairline or chin). In each of 16 displays a simple black and white photograph of an everyday object (e.g., a cup) was presented half to the right of a black and white photograph of a young or old face (see Figure 1).

We told participants that we were interested in testing a new, minimalist kind of advertisement of various everyday objects. Participants were asked to judge the attractiveness of each of the displays. Each display was replaced with the next one

TABLE 1
Cognitive functioning of young and older adults in Studies 1, 2, and 3

Cognitive test	Young		Older		T	p
	M	(SD)	M	(SD)		
<i>Study 1</i>						
Digit Symbol	63.75	(10.3)	44.38	(8.3)	8.29 ^a	< .01
Spot-a-Word	24.69	(3.8)	28.69	(2.8)	-4.8 ^a	< .01
<i>Study 2</i>						
Digit Symbol	63.17	(9.8)	42.10	(7.0)	13.81 ^b	< .01
Spot-a-Word	23.02	(3.9)	27.67	(6.8)	-4.65 ^c	< .01
<i>Study 3</i>						
Digit Symbol	64.06	(18.8)	37.30	(11.7)	7.10 ^d	< .01
Cued Recall	8.29	(3.3)	3.15	(2.7)	6.96 ^c	< .01

^adf = 62, ^bdf = 115, ^cdf = 119, ^ddf = 57, ^edf = 66.



Figure 1. Example of a display used in Study 1. A picture of an everyday object was presented along with a picture of a young or an older face.

immediately after the attractiveness judgement was entered on the keyboard. After a retention interval of approximately 4 minutes during which participants filled out a sociodemographic questionnaire, participants were to recall as many of the previously presented objects as possible (free recall) by writing them down on a piece of paper. The dependent variable was the number of correctly recalled objects that had been previously associated with young vs old faces.

There were two experimental sets pairing any given object with either a young or an old face. Half of the participants were randomly assigned to one set, half to the other. In order to test whether results differed by stimulus set we ran control analyses examining the stimulus set by age group interaction for both pair-associative memory tasks. For these analyses, neither the main effects of stimulus set nor the interaction with age was significant; all $F(1, 60) < 0.58$, *ns*, indicating that younger and older adults' memory performance was not related to the specific stimulus sets. As no differences for the two sets were observed, analyses for the two combined sets are reported.

Intentional memory. The second task was included to fulfil two purposes: First, we wanted to test if results that might be found for pictures would also generalise to verbal material. Second, we were interested if results obtained in an incidental pair-associative memory task could also be replicated in an intentional pair-associative memory task. Therefore we asked participants in the *intentional pair-associative memory task* to memorise a list of word pairs that consisted of a noun (e.g., table, button, wood, tulip) and either the word “young” or “old”. Participants were

informed that they would be asked to recall as many of the word pairs as possible after the entire list had been presented. Again, nouns referring to everyday objects were selected that had not elicited associations with either young or old adulthood in a pilot study. A total of 18 word pairs were presented on a computer screen, one at a time for 4 seconds each, with an interstimulus interval of 1 second. The sequence of word pairs was randomised (with the exception that the same word pairs could not appear consecutively) and each pair was presented three times. Immediately after the word pairs had been presented, participants were asked to write down as many word pairs as possible within 3 minutes. The dependent variable was the number of correctly recalled word pairs (i.e., “young” vs “old” word pairs).

One might argue that older adults' memory performance might profit particularly from the presentation of stimuli along with a dichotomous category such as “young” vs “old”. Older adults might make use of one of these cues—maybe the one that is more closely related to them such as the word “old”—to retrieve the stimuli during recall. Therefore, in a control condition, we tested the effect of categorisation on memory performance by presenting a list of 18 different nouns (e.g., nail, basket, shirt) paired with the adjective “salty” or “sweet”. Otherwise the task was identical to the previous one. Again, two sets were constructed in which the words were paired with either the word “sweet” or “salty”, and pairing was counterbalanced. No differences in the results using the two sets were observed. Hence, the combined results will be reported.

Procedure

Testing sessions took place in small groups of one to four participants. The two age groups were tested separately as pilot testing had shown that older adults feel insecure when performing a cognitive task along with young adults. After providing written informed consent, participants performed the two cognitive tasks (Digit-Symbol Substitution, Spot-a-Word), followed by the incidental pair-associative memory task and the intentional pair-associative memory task. The final task was the control task. The testing session took approximately 45 minutes. Afterwards participants were thanked, debriefed, and received a monetary compensation (equivalent to approximately 16 USD at that time).

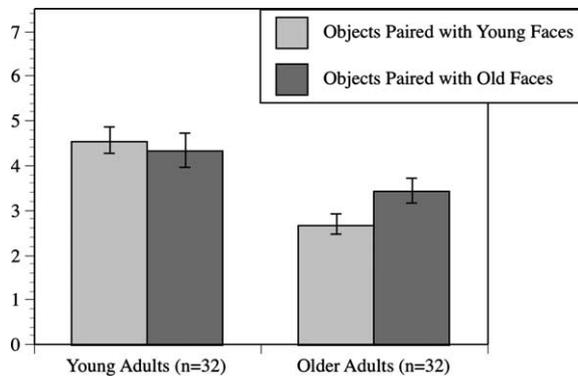


Figure 2. Results of incidental pair-associative memory task in Study 1 (Means and 95% CIs for between-participants comparisons of the number of recalled objects that were paired with young or old faces): Older adults show better memory for objects displayed together with old faces.

Results

Incidental pair-associative memory task

We conducted a 2×2 mixed analysis of variance (ANOVA) on the number of correctly recalled items with “Age of Participant” (young vs old) as the between-groups variable and “Age Cue” (young vs old) as the within-group variable. The significant main effect of “Age of Participant”, $F(1, 62) = 21.54, p < .01, \eta^2 = .26$, reflects that, on average, older adults recalled fewer items than young adults ($M_{\text{young}} = 8.91, SD = 2.54; M_{\text{old}} = 6.13, SD = 2.24$). This is in line with one of the most robust findings in the ageing literature, namely that memory declines across adulthood (e.g., Li et al., 2004; Verhaeghen et al., 1993). More importantly in the present context, and as expected, we found a significant interaction between “Age of Participant” and “Age Cue”, $F(1, 62) = 4.02, p < .05, \eta^2 = .06$. Follow-up analyses showed that the difference between the number of objects recalled that had been paired with young or old cues, respectively, was only significant for the older adults, $t(31) = -2.34, p < .05$. The interaction between “Age of Participant” and “Age Cue” was not affected by the attractiveness ratings. Results are shown in Figure 2.¹

¹The marker of fluid intelligence (Digit-Symbol Substitution Test) was highly correlated with age ($r = -.76, p < .001$) and therefore not used as a control variable. Using our indicator of crystallised intelligence (vocabulary) as a covariate did not affect the results.

Intentional pair-associative memory task

Here we expected to find a significant interaction between participant age and the age-associated component of the to-be-recalled word pair. We tested for the expected two-way interaction in a 2 (Age of Participant: Young vs Old) $\times 2$ (“Age Cue”: Young vs Old) mixed analysis of variance (ANOVA) on the number of correctly recalled word pairs. Results are presented in Figure 3 (Panel A). Contrary to our expectations, the two-way interaction was not significant, $F(1, 62) = 0.34, ns$. However, because of the results of the incidental pair-associative memory task we ran univariate follow-up tests and found the same pattern of results for the intentional pair-associative memory task: Older adults recalled significantly more words pairs containing the word “old” than those containing the word “young”

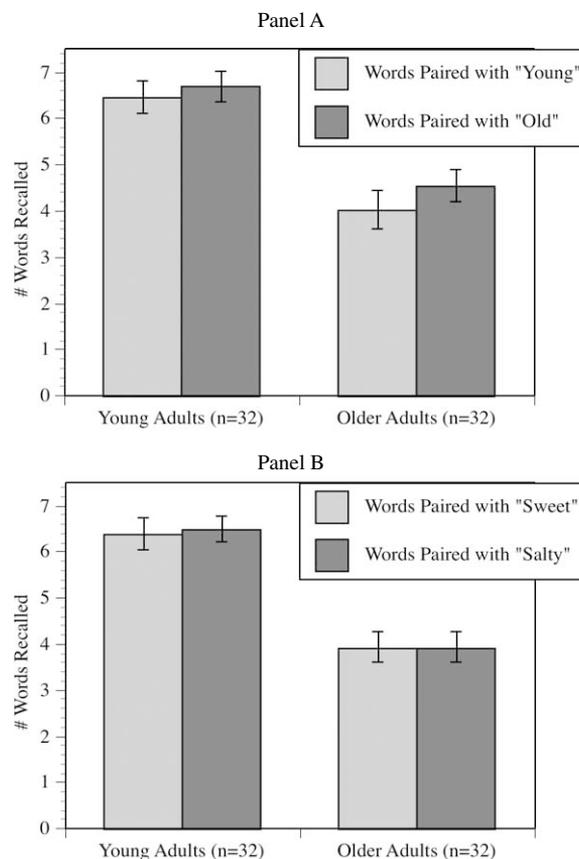


Figure 3. Results of pair associate learning task in Study 1. Panel A shows the Means and 95% CIs for between-participants comparisons of the recalled nouns paired with the word “young” or “old”: Older adults remember better words that were associated with their own age. Panel B shows the control condition (association of nouns with the words “salty” or “sweet”).

($M_{\text{young}} = 4.03$, $SD = 2.40$; $M_{\text{old}} = 4.56$, $SD = 1.92$); $t(31) = -2.11$, $p < .05$, while young adults did not show a memory bias ($M_{\text{young}} = 6.47$, $SD = 1.97$; $M_{\text{old}} = 6.69$, $SD = 1.91$); $t(31) = -0.49$, ns . As shown in Panel B of Figure 3, no significant effects were found in the control condition, in which we compared recall of word pairs containing the word “sweet” versus “salty”; all $t(31) < 0.20$, ns .

Brief discussion

The results of both tasks of Study 1 provide initial evidence that information related to one’s age might be important for older adults’ memory performance. As predicted, older adults showed better recall for stimuli paired with cues related to their own age group (older faces, the word “old”) as compared to stimuli paired with cues related to young adulthood or a non-age-associated dimension (“salty” vs “sweet”).

In the incidental pair–associative memory task, we used young and old faces as age-related cues. The memory bias in the subsequent free-recall task favouring one’s own age group that we found for older adults might be due to greater familiarity with faces from one’s own age group, as adults tend to spend more time with their peers than with people of other age groups (Ebner & Johnson, 2009). As reported above, some evidence has been reported for better *recognition* of faces from one’s own as compared to another age group (Anastasi & Rhodes, 2005, 2006; Bartlett & Fulton, 1991; Fulton & Bartlett, 1991; Lamont et al. 2005). Note, however, that the faces were not presented as cues during the free-recall task. Moreover, it is unlikely that the own-age effect for memory of objects paired with young vs old faces found in Study 1 is due exclusively to greater familiarity with faces from one’s own age group, as the effect was replicated in the intentional pair–associative memory task, which used the words “young” and “old” as age-related cues. This generalisation of the effect across age-associated stimuli suggests that it is related to the concept of age rather than specific kinds of stimuli such as faces or words. In Study 2 we went one step further and used artificially constructed “names” that were arbitrarily presented as names that were typical for either young or older adults respectively, eliminating any possible previously established differential

familiarity with the stimuli related to young or older adults.

As expected, young adults did not show a memory bias for information related to their own age. This finding is consistent with the results reported by Firestone et al. (2007) in the area of face recognition. As laid out in the introduction, one interpretation of this age-differential pattern of memory performance is that age is less salient for young adults. This interpretation is consistent with the findings by Mueller and colleagues (1986) who found that younger adults were not faster in judging traits as “young” or “old,” whereas older adults were faster in judging “old” traits.

STUDY 2

One interpretation of the finding that the own-age bias was significant in the group of the older adults only is that, unlike older adults, young adults, due to their superior memory, do not—automatically or intentionally—use age as a possible memory cue for encoding or retrieving information. We conducted Study 2 to test this interpretation. Therefore, in Study 2 we increased the difficulty level of the memory task so that even the young adults might need to use memory cues (e.g., age) for encoding or recalling information, thus possibly resulting in a memory bias favouring their own age group.

Method

Participants

Participants were recruited via newspaper advertisements, flyers, and word of mouth in the city of Zurich, Switzerland. The sample ($N = 129$) comprised a group of 53 young adults (20–31 yrs, $M = 24.8$, $SD = 3.0$) and 76 older adults (63–84 yrs, $M = 70.1$, $SD = 4.5$). Gender was distributed approximately equally in both age groups (young: 54.7% female, old: 52.3% female). The majority (89.8%) of the young adults were students, 7.1% were unemployed. Most of the older adults (96.1%) were retired.

Cognitive functioning was again measured using the Spot-a-Word test (Lehrl, 1977) and the Digit-Symbol Substitution Test (Wechsler, 1982). Age group differences were comparable to those in Study 1 (see Table 1), older adults attaining

better verbal knowledge scores (i.e., crystallised intelligence) and young adults higher speed (i.e., fluid intelligence).

Materials and tasks

For this study we made the incidental pair-associative memory task for age-associated information more difficult than in Study 1 by adding a preceding learning phase of artificially constructed names said to be typical for either young or older adults. Instructions and stimuli for the name-learning task and for the incidental pair-associative memory task were presented on a computer screen.

Name-learning task. In the name-learning task participants were to learn 16 “new names”, of which half were said to be typical for young and half typical for older adults. The names generated were three-letter strings with no resemblance to names actually given in Switzerland (e.g., Ota). Participants viewed a pair of stimuli, a “new name” and the word “young” or “old” for 6 seconds, one pair at a time, on a computer screen. In the cued-recall part of the task, which began immediately thereafter, one name at a time was presented and participants were asked to categorise each as old or young. As forming an association between the new name and an age classification was central for the subsequent incidental pair-associative memory task, participants were only allowed to continue their participation in the experiment if they were able to correctly categorise all new names three times without making a mistake within the time allotted (1 hour). The young adults were all able to do so, but 18 older adults (23.68%) were not. Thus these older participants did not participate in the rest of the experiment, which reduced the sample of older adults to $n = 59$ (63–84 yrs, $M = 69.7$). On average it took younger adults 3.4 trials to reach the criterion and older adults 7.2 trials.

Again two sets of word pairs were constructed, in which the names ostensibly typical for young or older adults were counterbalanced. As no differences were found between the two sets, combined results will be reported.

Incidental pair-associative memory task. In a second step, participants completed an incidental pair-associative memory task identical to the one used in Study 1 except that, instead of photos of young and old faces, photos of 16 everyday

objects (see above) were combined with either a “young” or “old” new name. As in Study 1, participants were asked to judge the display (photo of everyday object alongside a new name) regarding its attractiveness. After a period of about 4 minutes, during which participants filled out the sociodemographic questionnaire, participants completed a cued-recall task. One at a time, the new names were presented as cues and participants were to type the name of the everyday object with which it had been paired. A cued-recall task was chosen because it tests memory for the previously formed associations between the new names and corresponding everyday objects more directly than a task involving only free recall of the everyday objects. The dependent variable was the number of correctly recalled everyday objects that had been paired with the cues (i.e., the specific “young” versus “old” names).

Procedure

Testing took place in small groups of between one and four participants. After providing written informed consent, participants completed the two cognitive tasks (Digit-Symbol Substitution, Spot-a-Word) and then the name-learning task. Only those able to correctly categorise each new name as “young” or “old” three times within 1 hour in a cued-recall task were allowed to continue their participation by performing the incidental pair-associative memory task. At the end of the session, which lasted about 1 hour on average, participants were thanked, debriefed, and received 15 Swiss francs (equivalent to 15 USD) as compensation.

Manipulation check: Difficulty of the task. We succeeded in making the task very difficult in order to push even the young adults to the limits of their memory performance. More specifically, attesting to the difficulty of the incidental pair-associative memory task when objects were combined with the newly learned “young” and “old” names, a substantial proportion of young (15.1%) and an even higher proportion of older participants (42.4%) were not able to correctly recall any objects in the cued-recall task. These participants were excluded from further analyses. The rationale for the exclusion was that it is logically impossible to detect any kind of factor potentially impacting memory performance when memory performance is zero.

Note that the difficulty of the task resulting in a high percentage of participants who were unable to recall any objects in the test phase was not a flaw of the design, but was in fact intended. The task was made to be very difficult to test whether younger adults would show enhanced memory for same-age information when pushed to their memory limits. Therefore it is not surprising that a number of young, but an even larger number of older adults showed extremely poor memory performance on the task. The resulting sample consisted a total of $N = 79$ ($n = 45$ young adults, $n = 34$ older adults).

Results

Incidental pair-associative memory task

A 2×2 mixed analysis of variance (ANOVA) on the number of correctly recalled items with “Age of Participant” (young vs old) as the between-groups variable and “Age of Name” (young vs old) as the within-group variable revealed a main effect of “Age of Participant”, $F(1, 77) = 14.26$, $p < .001$, $\eta^2 = .16$, reflecting that, on average, older adults recalled fewer items than young adults did ($M_{\text{young}} = 1.87$, $SD = 0.16$; $M_{\text{old}} = 0.94$, $SD = 0.18$). More importantly, and as expected, the interaction between “Age of Participant” and “Age of Name” was significant, $F(1, 77) = 4.55$, $p = .05$, $\eta^2 = .05$ (see Figure 4). Because we held directed hypotheses, follow-up analyses were conducted using one-tailed significance testing. These analyses showed that the difference between the number of recalled items paired with young versus old cues, respectively, was significant for older adults, $t(33) = -1.77$,

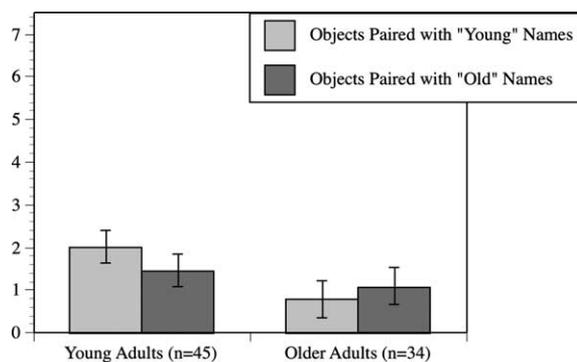


Figure 4. Results of cued recall (Means, 95% CIs for between-participants comparisons) in Study 2: Older adults show better recall for objects paired with names previously learned as being typical for their own age group than for young adults.

$p < .05$, but not for young adults, $t(44) = 1.34$, $p > .10$.²

As a consequence of the difficulty of the task, memory performance was very low in both younger and older adults. Could this represent a floor effect that might have prevented the own-age effect from being detected in the young adults? Three arguments speak against this possibility. First, if anything, older adults’ performance was closer to floor than young adults’. Second, the *SDs* of memory performance were comparable for both age groups ($SD_{\text{young}} = 0.16$; $SD_{\text{old}} = 0.18$). Third, the follow-up analyses of the significant interaction of age group \times stimulus age revealed a significant own-age effect in the group of the older adults, suggesting that differences can, in principle, be detected with this amount of variability.

Another consequence of the difficulty of the task was that a substantial number of participants had to be excluded due to extremely low performance. In order to test whether the results concerning the own-age effect were affected by the exclusion of participants who did not remember items cued with either an old or young name, we re-ran the analysis including all of the participants who had successfully completed the first step of the experiment. The hypothesised interaction of participant age group by the age relatedness of the information remained significant, $F(1, 110) = 4.17$ $p < .05$, $\eta^2 = .04$.

Brief discussion

The results of Study 2 replicate those of Study 1. Again, older participants showed better recall for stimuli previously associated with their own age group (i.e., names ostensibly typical for older adults) as compared to those previously associated with young adults (i.e., names ostensibly typical for young adults). We found an interaction of age group and recall performance for stimuli associated with “young” versus “older” adults but the difference was significant in older adults only.

In this study the incidental pair-associative memory task was designed to be very difficult, in

²As was true for Study 1, fluid intelligence (Digit-Symbol Substitution Test) was highly correlated with age, $r = -.74$ ($p < .001$). Because cognitive performance and age were nearly redundant in this study, then, we did not use the Digit-Symbol Substitution data as a covariate for these analyses. Controlling for crystallised intelligence (vocabulary) did not affect the interaction.

that participants could not rely on well-learned age cues (such as young/old faces or the words “young”/“old”). Instead, they established associations between artificially constructed names ostensibly typical for young or older adults (i.e., arbitrary age cues) and everyday objects. We chose this procedure for two reasons: (1) to make the pair-associative memory task very difficult which might push young adults to their memory limits and thereby result in a memory bias for information related to their own age group; (2) to test the robustness of the effects observed in Study 1. The effect was again significant in older adults only.

In this study we intentionally made the task so difficult that even young adults struggled. Because of the task’s difficulty, a substantial number of older participants were excluded from the study as they were unable to learn sufficiently well the new names as old or young, or did not remember any of the objects presented with these names. One might ask, then, if the sample of older adults remaining in the study might have been highly selective and if this selectivity might have affected the results. When comparing participants who were excluded with those who continued within age groups, there was a tendency in the group of the older adults who were excluded to exhibit lower fluid cognitive abilities, $t(48) = 1.37$, $p = .09$, one-tailed, but no significant differences regarding verbal cognitive abilities, self-rated physical health, or general life satisfaction (as measured with single items) occurred in the group of the older adults; all $t < 0.70$, *ns*. Similarly, in the group of younger adults there was a tendency for those who were excluded to exhibit lower fluid cognitive abilities, $t(61) = 1.60$, $p = .06$, one-tailed, but no significant differences regarding verbal cognitive abilities, self-rated physical health, or general life-satisfaction; all $t < 0.98$, *ns*. In general, then, and as was to be expected, those who were either unable to learn the new “names” or did not remember at least one item presented with a young or old name had a tendency to show lower fluid cognitive abilities.

Could selective attrition have artifactually generated our results? One possibility to consider is that the own-age bias emerged in the older group because their memory performance was lower than that of the younger group. In that case, excluding older participants with particularly poor memory performance should work against the pattern we obtained. Moreover, we repeated

the key analyses with all participants included, and the outcome was unchanged.

Taken together, the pattern of results of Study 2 suggests that processes other than general decrease in memory performance in older adults might be responsible for the age-differential finding of an own-age effect in Study 1.

As mentioned above, one interpretation of the age-differential own-age effect might be that age cues are less important for young adults than for older adults (Firestone et al., 2007). This might lead older adults to pay closer attention to and elaborate more on information related to their own age group. Younger adults might pay equally attention to all presented stimuli as, for them, age-related cues might be less important. To test this hypothesis, Study 3 introduced a context that is equally important to younger and older adults, namely information about vacation packages. In this context, younger adults should also be more interested in attending to and elaborating on information related to their own age group.

STUDY 3

Study 3 investigated whether younger adults might demonstrate an own-age bias in their memory performance when the age-associated information is embedded into a context that is more relevant to them than a cake of soap or a cup. Study 3 therefore embedded the age relevance into information about vacation offers, because vacations are likely to be just as important to younger as to older adults. We expected that, when the information is relevant to them, younger adults would also demonstrate the same-age bias.

Method

Participants

Participants were mainly recruited through a database of adults interested in research participation that is maintained by the Life Management Laboratory at the University of Zurich, and also via flyer advertisement on campus. One person had to be excluded from the sample because her mother tongue was not German and she had problems understanding the instructions. The resulting sample comprised $N = 68$ young and older adults (young adults: $n = 35$,

20–29 yrs, $M = 24.14$, $SD = 2.71$; 63% female; older adults: $n = 33$, 60–75 yrs, $M = 69.39$, $SD = 3.46$; 61% female). All of the older adults were retired. The majority of the young participants were university students (77.2%), the others were either employed (17.1%) or unemployed (5.7%).

Tasks and materials

Cognitive performance. Cognitive performance was measured using the Digit-Symbol Substitution Test (Wechsler, 1982) as an indicator of fluid intelligence. Age group differences were comparable to those in Studies 1 and 2 (see Table 1). In Study 3 we also included a control cued-recall task testing memory for verbal material. This task was included to closely resemble the experimental task. Twelve displays of three words each were presented for 10 seconds per display. After a 2-minute retention interval (during which participants engaged in a simple mental arithmetic exercise involving addition or subtraction), participants were presented two words of the triplets on the computer screen and asked to write down the third word. As expected, a comparison of the two age groups showed that young participants showed better memory performance (see Table 1).

Incidental memory task. An incidental memory task was used in Study 3 to test the influence of age-associated information on memory performance. After being told that we were interested in how advertisements affect people of different ages, participants were asked to evaluate two advertisements for vacation packages (one involving bicycling, the other Nordic walking) that were presented on the computer one at a time. Both advertisements were newly constructed so that their layout and the kind of information they offered were similar (see Appendices A and B). Both advertisements consisted of a title, two pictures (in one condition of young adults, in the other of older adults), a brief general introduction to the vacation package, the features of the vacation (e.g., number of days, description of the hotel, number of meals included in the package), and cost. The text did not include any age-related information, so that it could be paired with pictures of either young or older adults without changing the text itself. Thus the only age-related cues were the two pictures, both showing either young or older persons engaged either in biking

or Nordic walking, respectively. Each participant was presented with both advertisements (Nordic walking, biking). There were two sets of advertising materials: In each set, one advertisement was combined with pictures of older adults, the other with pictures of young adults, allowing again for within-participant testing of the effect of combining information with cues of young versus older adults.

Two sets of advertisements for vacation packages were constructed, counterbalancing the combination of the activity (Nordic walking, biking) with photos of young or older adults engaging in the activity. As no differences between the two sets were found, the combined results will be reported. Moreover, the order of advertisements associated with one's own or the other age group was counterbalanced. Subsequent analysis showed no order effects. In addition, in order to test whether the type of vacation might have influenced age-related differences in memory for vacation-related information, we included this as an additional factor in the analyses. "Type of vacation" did not interact with age in either of the two memory tasks ($p > .30$), nor did it affect the results regarding memory for information related to one's own or other age groups. Therefore, type of vacation will not be considered further.

First, participants viewed the first advertisement as a whole for 70 seconds. In order to ensure that participants read the advertisements carefully, they were then presented with the different parts of the first advertisement, one at a time, in a fixed order, and for a fixed time interval, and asked to evaluate their attractiveness. The second advertisement was then presented using the same procedure. Pilot testing showed that presenting the stimulus materials less frequently or for a shorter amount of time resulted in a floor effect for memory performance.

The two advertisements did not differ in their overall attractiveness ratings; $t(67) = 0.13$, $p = .89$. Moreover, young and older adults did not differ in the frequency with which they had taken a vacation similar to the one described in the advertisement ("Have you done a similar vacation?" yes – no), engaged in the described activities ("Have you engaged in the activities described in the advertisements?" yes – no), or planned to engage in these activities ("Do you plan to engage in the activities described in the advertisement in the future?" yes – no) (all $\chi^2 < 1.10$, all $p > .30$).

As in Study 2 we used a cued-recall task to measure memory for age-associated information. Participants received a piece of paper with the advertisement they had read first (along with the same pictures of either young or older people), but this time the text contained 38 blank spaces (see Appendices C and D). Participants were asked to fill in the appropriate missing words. The same procedure was used for the other advertisement. No time limit was set for completion of the cued-recall task.

The number of correctly recalled items in the cued-recall task served as the dependent variable. Two independent raters assessed the recalled information with respect to correctness. Words recalled by the participants were compared to the original text of the respective advertisement. Every correct “hit” (e.g., a correct type of accommodation, type of advertised sport activity, or type of meals offered) was counted as one point. Even when the wording of the recalled information was slightly different from that presented in the advertisements, the response was rated as correct when the meaning stayed equivalent (e.g., free of charge = gratis). Inter-rater reliability was satisfactory for both types of advertisements (Kendall’s tau > .85; $p < .001$).

The memory task proved to be rather difficult: Seven of the older adults and one of the young adults were excluded from further analyses because they did not recall any words in the experimental tasks or the verbal memory tasks. The excluded participants were distributed equally across the two sets of stimuli. Due to the exclusion of participants, the sample included in the further analyses consisted of $n = 34$ young and $n = 26$ older adults.

Procedure

Testing sessions took place in small groups of one to four participants. After providing written informed consent participants rated the two advertisements, which were displayed on a computer with fixed presentation times. During a subsequent 3-minute retention interval they performed a cognitive task (Digit-Symbol Substitution Test) followed by the recall task. After that a second measure of cognitive performance (verbal memory) was administered. Participants then filled out a sociodemographic questionnaire and reported whether they engaged in the two activities and type of holiday described in the

advertisements (i.e., Nordic walking, biking). Testing sessions lasted 30–50 minutes. Afterwards participants were thanked, debriefed, and received a compensation of 15 Swiss francs (equivalent to 15 USD).

Results

Results of the cued-recall replicated the expected interaction of “Age of Participant” and “Age Cue”, $F(1, 58) = 9.40$, $p < .01$, $\eta^2 = .14$ (see Figure 5). Follow-up analyses, again using a one-tailed significance level because of directed hypotheses, showed that both age groups recalled more information of advertisements presented with pictures of persons of the same age group as the participant: young adults: $t(33) = 2.45$, $p = .01$; older adults: $t(25) = -2.03$, $p < .05$. As expected, there was also a main effect of “Age of Participant”, $F(1, 58) = 15.96$, $p < .01$, $\eta^2 = .22$, showing that, on average, older adults recalled fewer items than did young adults ($M_{\text{old}} = 12.00$, $SD = 3.79$; $M_{\text{young}} = 16.31$, $SD = 4.38$). The interaction between “Age of Participant” and “Age Cue” on memory performance was not affected when controlling for general memory, personal engagement in the described activities, or the attractiveness ratings of the advertisements.

As expected, in Study 3, in which the participants’ task involved materials that are more similar to the kinds of age-associated information they encounter in everyday life, younger adults also showed the same-age effect, and exhibited better memory performance for information related to their own age group than they did for

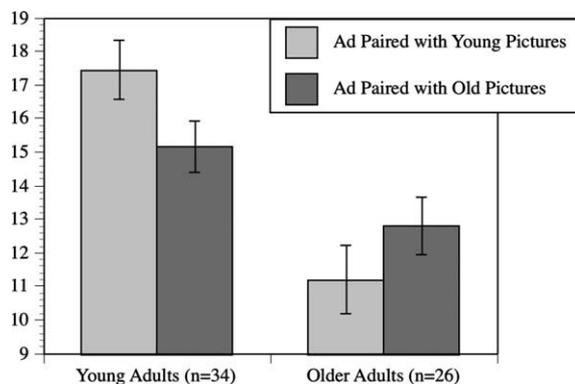


Figure 5. Memory performance in Study 3 (Means, 95% CI for between-participants comparisons) in the cued recall task: Results indicate better memory for information associated with own than with different age group for both young and old adults.

information related to older adults. Participants of both age groups showed a memory bias for information pertaining to advertisements presented with a picture of a person of their own rather than another age group.

GENERAL DISCUSSION

Can we better remember information associated with our own age? Are older adults more biased towards information associated with their age? These questions were tested in a set of three experiments that provided converging evidence for an age-related memory effect favouring information linked to one's own age group. The effect emerged consistently across studies for older adults and only emerged for younger adults when the information was potentially relevant to them.

To our knowledge the current studies are the first to demonstrate the own-age effect with materials that were arbitrarily associated with age-related cues. Thus the findings extend previous research on face recognition where the memory item (i.e., a young or old face) is itself age-related and might therefore be more familiar to same-aged people. Our results suggest that the mere association of an item with one's own age group leads to an own-age effect in older adults.

Studies 1 and 2 used a paradigm in which objects (presented as a word or a picture) were arbitrarily paired with an age cue (i.e., pictures of young or older adults, the word "young" or "old", or artificially constructed "young" or "old" names). In Studies 1 and 2 the effect was significant only for older adults. It seems, then, that the mere association of an object with a cue of one's own age group is sufficient to create the bias in memory performance in older adults. The finding of an own-age effect only for older adults cannot be attributed to the higher difficulty of the task for older adults (see also Lamont et al., 2005). Study 2 used a very difficult, modified version of the incidental pair-associative memory task of Study 1, but younger adults still did not exhibit an own-age effect. Only when increasing the potential importance of the age-related information by using information about vacation packages presumably geared towards younger or older adults in Study 3 did the age-related memory effect become significant in the group of the younger adults as well.

Taken together, this set of findings supports the theoretical assumption put forth by Castel (2008) that older adults are more selective in their information processing. On the basis of the findings of Castel and colleagues (2002) and McGillivray and Castel (2011) one could speculate that age-related information is of higher value to older compared to younger adults. More specifically, age-related information can serve as an important standard of comparison for judging oneself and one's goals, and can direct attention towards age-related opportunity structures and goal-relevant resources (e.g., Cantor, 1994; Freund, 1997; Heckhausen, 1999; Neugarten, 1968; Nurmi, 1992). The value of age-related information might increase in old adulthood for two reasons. First, there are fewer age-related social norms and expectations in old as compared to young and middle adulthood (Settersten, 1997), which can serve as guides for selecting and pursuing personal goals. Second, in old age goals have to be selected more carefully due to a general decrease in goal-relevant resources and future time-perspective (Freund, 2007; Freund & Baltes, 2002). Together this might lead to a stronger information-processing bias for own-age information in older than in younger adults (see Castel, 2008, for a similar argument).

This interpretation is supported by the results of Study 3. Here we increased the relevance of the age cue by pairing it with information about vacations, a life-domain that younger adults might value just as much as older adults. The personal relevance might have increased the likelihood of younger adults paying more attention to stimulus material related to their own age group. Pictures of younger adults next to a vacation description should indicate that this advertisement contains information that is particularly relevant for younger adults (and vice versa for older adults). In line with this interpretation, for both age groups we found better memory performance for an advertisement when it was associated with one's own as compared to the other age group. Vacations are a meaningful—and hopefully enjoyable—part of most people's lives and hence most likely carry more personal relevance than pictures of objects like paper clips, a bar of soap, or a cup. Personal relevance, then, seems to be one of the factors contributing to the age-related memory bias in young adults. In contrast, for older adults the mere association with their own age seems sufficient.

The current studies cannot address the question concerning when during information processing the own-age bias occurs. People might pay more attention to stimuli related to their own age group because they might hold potentially important information regarding age-related opportunities such as the age-dependent availability of resources (Freund, 2007). As ageing is related to a loss in resources (e.g., Baltes, 1997), perhaps older adults have to be more vigilant in seeking potential opportunities for resource attainment. Information related to one's own age, then, might be more attention grabbing for older than for younger adults. This might contribute to the finding of the present studies that a significant own-age effect emerged consistently across studies for the older but not the younger adults. The memory bias, however, could also occur during encoding (e.g., more elaborate memory structures for one's own age group), retention (e.g., forgetting material not related to one's age faster), or retrieval (e.g., more memory cues for age-relevant information).

According to Castel (2008), the value of information might impact both selective encoding and strategic retrieval. The current set of studies does not allow us to disentangle where exactly in the memory process the own-age bias occurs. This question goes beyond the realm of this research, which was targeted at establishing the phenomenon of an age-differential own-age effect in memory using materials that are not in themselves related to age and that go beyond face recognition. The current results can serve as a basis for future studies that address specifically the question of whether the larger own-age bias in older adults' memory performance arises because stimuli representing one's own age (i) direct attention, (ii) impact on encoding, or (iii) serve effective retrieval. More research is needed to identify the exact processes leading to better memory for information related to one's own as compared to other age groups. A very promising recent attempt has been put forth by Hugenberg and colleagues regarding the own-race effect (Hugenberg, Young, Bernstein, & Sacco, 2010). Their categorisation-individuation model predicts under which circumstances the own-race bias occurs with what effect size, by integrating social categorisation, motivated individuation, and perceptual experience. It would be very

interesting to apply this model to the own-age effect.

The results of the current studies are also interesting for the associative deficit hypothesis (Chalfonte & Johnson, 1996; Naveh-Benjamin, 2000). This hypothesis posits that older adults have a deficit to form and retrieve associations. In fact a meta-analysis by Old and Naveh-Benjamin (2008) showed that older adults are more disadvantaged when having to recall associations rather than single items. However, they also found that the effect is not equally strong for all kinds of memory paradigms. For instance, McGillivray and Castel (2010) showed that older adults can profit from the "generation effect" (i.e., generating an association rather than reading it) in the context of age-related associations. In their meta-analysis, Old and Naveh-Benjamin showed that older adults' memory performance seems to suffer particularly in intentional learning paradigms and is less impaired in incidental learning paradigms that were also used in our studies. Going beyond this finding, our results also suggest that the content of the associated items might play a role. Older adults showed better memory for items associated with their own age than for items associated with another age group.

The associative deficit hypothesis might also help to explain differences from other studies on the own-age effect that have yielded different results. As mentioned in the introduction, Lindholm (2005) found the opposite pattern of results; namely a stronger own-age effect for younger adults. One of the differences between Lindholm's and our study was that Lindholm used an intentional memory task where older adults had to build associations between certain attributes (e.g., their clothing or their hairdo) and a younger or older person, respectively. Compared to younger adults, older adults might have had particular difficulties with this task as they first had to bind these pieces of information and subsequently recall them (see, however, McGillivray & Castel, 2010, using an incidental encoding paradigm). In our studies participants were asked to recall single items and were not required to recall associations. Moreover, Lindholm used an intentional learning paradigm which leads to stronger association deficits compared to the incidental learning paradigms like the ones used in our studies. Future research needs to address systematically under

which conditions younger or older adults are more likely to show an own-age effect.

The results of the current studies are not only interesting regarding cognitive processes. Taking a social psychological perspective, the memory bias could also be a result of social categorisation. Social categorisation, defined as the tendency to group people into social categories by distinguishing self from others (Allport, 1954), creates in-groups (i.e., groups we feel we belong to) and out-groups. Age, as one of the visible and hence highly accessible dimensions, can easily be used to categorise people including oneself. In this sense, then, simultaneous presentation of stimuli and age cues might highlight not only the potential relevance of the stimulus to a person of a certain age but also one's affiliation to a certain age group and thereby result in a bias in information processing. As suggested by Firestone et al. (2007, p. 602) "age may not be as strong of an indicator of group status for the younger adults", leading with a higher likelihood to an own-age effect in older compared to younger adults.

According to social-identity theory, members of the in-group are evaluated more positively than members of the out-group (Tajfel & Turner, 1979). Interestingly, however, in Study 1 the attractiveness ratings favoured the displays of objects with young faces not only in younger adults (i.e., the in-group) but also in older adults (for whom younger adults represent the out-group). Similarly, a pilot study for Study 2 showed a non-overlapping distribution of likeability ratings of actual, typical young and older first names, with young names receiving higher ratings. Older adults did not rate names typical for their in-group more favourably than names typical of younger adults. These results, then, speak against some of the predictions of social identity theory regarding a positivity bias towards the in-group. However, they are consistent with research by Heckhausen and Krueger (1993) showing that older adults tend to judge their own age group less favourably than they evaluate young age groups, which in turn can serve as a source of self-serving downward comparisons.

Regardless of possible self-enhancing processes, however, one could argue that information related to one's in-group is of high importance because it may provide valuable information about one's social group (e.g., about access to resources, social norms, or expectations, etc.).

This interpretation, again, speaks for a heightened attention for information related to one's own as compared to other groups. In conclusion, then, the current findings highlight the importance of age for information processing.

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APPENDIX A

Example of one of the advertisements (Biking vacation), with pictures of adults. *Note.* To view this figure in colour, please visit the online version of this Journal.



Sports experience in Grünberg

Bicycles are the core of our sports program. Occasional bike rides in the vicinity of the hotel or all-day guided tours – our bicycles make you mobile.

Our bicycles are always available to you so you can discover the surroundings with its many natural treasures. The bicycles and guided tours are free of charge. Some additional costs may arise from bus transfers.




The offer comprises:

- 5 overnight stays in a three-star hotel (Post Hotel) in Merzen
- Nutritious fitness dinner
- Guided bike tour through the national park past the historical monuments

Package price for 6 days: 2,600 Swiss francs for two people; travel costs to and from Merzen included

APPENDIX B

Example of one of the advertisements (Nordic walking vacation), with pictures of younger adults. *Note.* To view this figure in colour, please visit the online version of this Journal.



Pure Nature in Vorderwald

The idea of this vacation is to enjoy a grandiose landscape while Nordic walking. This vacation package offers sports and fun for everyone.

Nordic walking is more than just a fashion trend: Walking with the specially designed poles is a highly effective form of endurance training that is very easy on the joints. We show you the various techniques and how to perform them correctly. The poles are provided at no extra charge.



The offer comprises:

- 13 overnight stays at Edelweiss Mountain Hotel in Albruck
- An organic breakfast buffet to give you lots of energy
- A freshly mixed fitness drink when you return from your Nordic walking sessions

Package price for 14 days: 6,800 Swiss francs for two people, including travel to and from Albruck



APPENDIX C

Example of cued recall (Nordic walking vacation with pictures of younger adults). *Note.* To view this figure in colour, please visit the online version of this Journal.



Pure Nature in Vorderwald

The idea of this vacation is to _____ while _____.
 This vacation package offers _____ and _____ for _____.
 _____ is more than just a fashion trend: _____ with _____
 is a highly _____ that is _____. We show
 you the _____ and how _____. _____ are provided at no
 extra charge.



The offer comprises:

- _____ overnight stays at _____ in _____
- _____ to give you lots of energy
- _____ when you return from your Nordic walking sessions

_____ price for _____ days: _____ Swiss francs for _____, including _____

APPENDIX D

Example of cued recall (biking vacation with pictures of older adults). *Note.* This is an English translation of the original German material. The attentive reader will find that there are only 29 blank spaces in the translated advertisement whereas the number given in the text is 38. This is due to the use of compound nouns in the German original. In German a property of a thing (which in other languages might be given by adjective) is a part of the noun (so-called compounds; e.g., “Tagestouren” translates into “day tours”). When participants correctly filled in both parts of the compound, they received two points. When they remembered only one part of the compound (e.g., “tours”), they received only one point. To view this figure in colour, please visit the online version of this Journal.



Sports experience in Grünberg

_____ are the _____ of our sports program. Occasional _____ in the vicinity of the hotel or _____ – our _____ make you mobile.

Our _____ are always available to you so you can discover _____ with _____ and _____ are free of charge. Some additional costs _____ from _____.



The offer comprises:

- ___ overnight stays in a _____ in _____
- _____ following _____
- Guided _____ through the _____ past the _____

_____ price for ___ days: _____ Swiss francs for _____, including _____