Psychology and Aging
2011, Vol. 26, No. 3, 636–646

0882-7974/11/$12.00 DOI: 10.1037/a0022626

Self-Referencing Enhances Memory Specificity With Age

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Self-referencing has been identified as an advantageous mnemonic strategy for young and older adults. However, little research has investigated the ways in which self-referencing may influence older adults' memory for details, which is typically impaired with age, beyond memory for the item itself. Experiment 1 assessed the effects of self- and other-referencing on memory for visually detailed pictures of objects in thirty-two young and thirty-two older adults. Results indicate that self- and close other-referencing similarly enhance general (item) and specific (detail) recognition for both young and older adults relative to the distant other condition. Experiment 2 extended these findings to source memory, with young and older adults encoding verbal information in self-referent, semantic, and structural conditions. Findings suggest that self-referencing provides an age-equivalent boost in general memory and specific memory for specific source details. We conclude that the mnemonic benefits of referencing the self extend to specific memory for visual and verbal information across the lifespan.

Keywords: aging, memory, self, specificity, cognition

Self-referential processing takes place when an individual encodes information into memory in reference to the self. For instance, in everyday life one utilizes the notion of self-referencing upon encountering a novel item, such as an article of clothing, by thinking about one's desires and needs in order to determine whether or not the clothing should be purchased. Over the years, researchers have found that the likelihood of accurately remembering information once it has undergone self-referential processing is greater in comparison to information encoded using other processes, such as thinking about something in relation to another person or in regards to its semantic properties (Rogers, Kuiper, & Kirker, 1977). This phenomenon, known as the self-reference effect (Rogers et al., 1977; Symons & Johnson, 1997), has been found to facilitate stronger memory traces in people's abilities to remember items such as adjectives (Gutchess, Kensinger, Yoon, & Schacter, 2007), both desirable and undesirable traits (Glisky & Marquine, 2009; Mueller, Wonderlich, & Dugan, 1986), and photographic objects (Serbun & Gutchess, 2010).

Despite the fact that previous research has established self-referencing as an advantageous mnemonic strategy for remembering items, such as words or objects, little research has addressed the question of whether self-referencing facilitates superior specific memory (i.e., memory for detailed information) and how this strategy benefits a broad variety of types of memory for older adults compared to young adults. The self-reference effect remains intact with age, similarly increasing the amount of words retrieved by younger and older adults (Glisky & Marquine, 2009; Gutchess, Kensinger, & Schacter, 2010; Gutchess, Kensinger, Yoon et al., 2007; Mueller et al., 1986). Because the extant literature has mainly explored the self-reference effect on memory for verbal stimuli, which present abstract concepts rather than intricate perceptual details, it is difficult to assess the level of specificity encoded in memory. While self-referencing benefits young adults' memory for both item-level information as well as specific details (Serbun & Gutchess, 2010), older adults constitute an important population for studying such effects given a loss of specificity in memory. With age, memories become more general, with the "gist", or general theme information, preserved but the specific details lost (Koutstaal & Schacter, 1997; Tun, Wingfield, Rosen, Blanchard, 1998). For example, while older adults may remember having studied a picture of a car, they may lack the detailed representation in memory in order to distinguish the studied car from a novel car on the basis of perceptual details such as the color or shape. Thus, if utilizing a self-referential encoding strategy benefits older adults' memory for visual details, as is the case for young adults (Serbun & Gutchess, 2010), the tactic may provide older adults with a beneficial strategy to improve their mnemonic capabilities and reduce their reliance on gist in memory. Although young adult data suggest that self-referencing benefits item-level and specific memory, and one type of memory does not benefit disproportionately more than the other, it is possible that self-referencing predominantly benefits older adults' memory at a general level, only for the gist. Such a pattern would indicate that the lack of memory for detail with age cannot be ameliorated by self-referencing.

While the effect of self-referencing on memory for visual detail has not been examined with age, Kensinger, Garoff-Eaton, and

This article was published Online First April 11, 2011.

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The authors would like to thank Elizabeth Kensinger and Malcolm Watson for contributing valuable feedback on previous drafts and Leah Levy, Sapir Karli, and Shirley Lo for providing experimental assistance. This research was partially funded by the Brandeis University Undergraduate Research Program and the National Institute on Aging (R21 AG032382), and was conducted while A. H. G. was a fellow of the American Federation for Aging Research.

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Schacter (2007) investigated the effects of emotional content on the memory for visual details in young and older adults. They found that both young and older adults demonstrated enhanced recognition of visual details for negatively-valenced objects in comparison to positive or neutral objects. By utilizing objects comprised of rich, perceptual detail as stimuli during the initial encoding phase, the experimenters could establish a distinction between memories enriched with detail and memories lacking such specificity but maintaining accurate depictions of general visual elements. A particularly striking finding was that only older adults displayed enhanced general recognition for *both* positive and negative objects in comparison to neutral objects, while young adults' general mnemonic advantage was confined to negative objects only. These findings regarding the varying effects of emotional valence on general and specific memory can extend to the discussion of the self-reference effect on memory specificity seen with age. A parallel can be drawn between the mechanisms driving the specific memorial advantage of self-referencing and the specific memorial advantage provided by the processing of emotionally-valenced items, because referencing the self employs an intrinsically social and emotional context. In fact, self-referencing may contribute to the differential prioritization of positive and negative emotion with age (Kensinger & Leclerc, 2009). Based on the finding that emotional valence enhanced the encoding of specific details into memory, we predict that a self-relevant context will also improve memory for details. Given older adults' disproportionate loss of detail in memory (Koutstaal & Schacter, 1997), it is possible that self-referencing may support unique and superior enhancements to memory compared to other encoding conditions for older adults relative to young adults, should this strategy impact not only general memory, but also specific memory, with age.

The potential benefits of self-referencing also could extend to other social encoding conditions in order to reduce reliance on gist in memory. The self may exert its effects on memory through its function as a well-known and habitually used entity, thus creating a highly elaborated schema that provides multiple routes for the retrieval of information (Kihlstrom, 1993; Maki & Carlson, 1993; Markus, 1977; Rogers et al., 1977). Specifically, the self benefit could be derived by assimilating new information with a rich knowledge based prior experience and previously learned information (Bower & Gilligan, 1979) or by functioning like a superordinate schema that allows individuals to access the history of experience embedded within themselves therefore promoting significant embellishment and richness to incoming stimuli (Rogers et al., 1977). By the same token, referencing highly intimate others (i.e. one's mother or spouse) could provide greater elaboration and mnemonic benefits than referencing a less intimate other due to the fact that close other-referencing also is a frequently practiced schema and is associated with a rich store of information based on prior experiences. In accordance with Bower & Gilligan's (1979) finding that relating information to a target that participants know a great deal about, either the self or one's mother, promotes superior memory for words, relative to a familiar but distant other, it is possible that both self and close other orientations at encoding could improve memory for visual details. This was found to be the case for younger adults: both self and mother encoding conditions enhanced general and specific memory, relative to a distant other (Serbun & Gutchess, 2010). Despite similar effects of close and distant other referencing on item memory with age (Gutchess, Kensinger, Yoon, et al., 2007), it is possible that memory for specific details represents a more sensitive measure of the effects of changing social relationships (e.g., Charles, & Piazza, 2007; Coats & Blanchard-Fields, 2008; Siebert, Mutran, & Reitzes, 1999) and potential differences in the effectiveness of personally elaborated encoding strategies (Klein & Loftus, 1988) with age.

While the literature is consistent on the benefits of referencing the self compared to a personally unknown, non-intimate other, there is less consistency in the benefits of referencing the self over an intimate other. In a meta-analysis of the literature, it was found that the effect size for self-referencing relative to a close other was greatly reduced in comparison with the effect size for self-referencing relative to a nonintimate other (Symons & Johnson, 1997). The fMRI literature presents a similarly mixed picture, with some studies identifying greater engagement of medial prefrontal cortex for self relative to intimate others (Heatherton et al., 2006) and others failing to identify the difference (Schmitz, Kawahara-Baccus, & Johnson, 2004). Although one could predict that referencing close others would affect memory to the same degree or less than self-referencing, we predict that the young adult pattern (Serbun & Gutchess, 2010) of equivalent memory for self and close other (there, mother) referenced items in both specific and general memory will also characterize older adults.

Due to the limited study of how aging impacts self-referencing, we presently are unable to establish whether self-referential processing could aid both younger and older individuals in encoding and retrieving detailed and accurate specific memories, and if a self-referencing strategy has the potential to mitigate age-related decreases in the specificity of memory. If self-referencing improves both general and specific memory for young and older adults, it would suggest that this strategy provides individuals with a systematic way to enhance their memory capabilities. Such a finding would be particularly important for older adults, who typically experience a marked decline in long-term episodic memory, and increased reliance on gist in memory. However, if young adults achieve a disproportionately large mnemonic boost relative to the older sample, it would suggest that a self-referencing strategy is limited in its ability to enhance older adults' memory. Although we previously found that for young adults, self-referencing elevates the retrieval of detailed information in memory, relative to other person-referent and semantic encoding conditions (Serbun & Gutchess, 2010), the current study will attempt to replicate that finding under slightly different encoding conditions. Such a finding would indicate that self-referencing improves young and older adults' memory not only at a general level, but also for specific details. In the following two studies, we assess the effects of self-referential processing on young and older adults' memory for specific visual and source information of object images and verbal items, respectively.

Experiment 1

Method

Participants. Thirty-two young adults (ages 18-28) and thirty-two older adults (ages 61-90) participated in the study. One additional young adult was removed from analyses for misunderstanding the directions for the recognition task and responding with only two of the three response options for all items tested. Three older adults were removed from analyses for performing below chance on tests of general memory and one was removed to preserve equal-sized groups in each of the eight counterbalancing orders. Informed consent was acquired in a practice approved by the Brandeis University Institutional Review Board. All the participants spoke English fluently and reported adequate vision and hearing ability to complete the tasks, with all older adults achieving a minimum score of 26 (M = 28.94; SD = 1.05) on the Mini-Mental State Exam (MMSE) (Folstein, Folstein, & McHugh, 1975). The demographic information and average scores on neuropsychological measures are displayed in Table 1. As is consistent with most samples used in cognitive aging studies, older adults had significantly more years of education, $t(62) = 7.24$, $p < .001$, and higher vocabulary scores as assessed by the Shipley Vocabulary measure (Shipley, 1986), $t(62) = 6.87$, $p < .001$, than their young adult counterparts. On the other hand, young adults performed significantly better on the digit comparison task (Hedden et al., 2002), a measure assessing participants' speed of processing (Salthouse, 1996), than the older adults, $t(62) = 4.45$, $p < .001$.

Materials. Taken from a previous study (Serbun & Gutchess, 2010), which investigated the effects of self-referencing on the specificity of memory traces in young adults, a series of 144 pairs of color pictures of familiar purchasable objects were used for this study. Each pair included two objects with the same verbal label (e.g., ashtray, chess board) but differed in visual details, such as size, color, shape, number, or orientation. During encoding, participants viewed one object from the pair, with the item presented against a white background (see Figure 1). These objects were chosen in order to establish a realistic environment in which self- or other-referencing strategy could be implemented for objects and would potentially benefit the memory trace.

Encoding procedure. The study took place over the course of two days with an approximate 48-hour retention interval between the two sessions. On the first day, participants met with the experimenter and completed the encoding task in addition to several written tasks including a Close Other Description form. The Close Other Description form asked participants to select one individual to reference during the task as their "close other" and to characterize this individual. Young and older adults similarly selected close others who were well-known to them (young M = 8.56, SD = .76; older M = 8.38, SD = 1.34) and highly regarded (young M = 8.53, SD = .67; older M = 8.56, SD = .72) as reported on a 9-point scale where a rating of 9 indicates *extremely familiar* or *like very much* (ps > .45 for tests of age differences). The older participants predominantly selected a spouse or romantic partner as their close other (56%), with a friend/best friend (22%) or family member (16% for children and 6% for siblings) selected less often. Most young adults identified their close others as friends/best friends (37%), with selections of parents (25%) romantic partners (19%), and siblings (16%) reported less often. Additionally, older adults reported significantly longer-lasting relationships with their close others (M = 46.34 years; SD =17.66) than did young adults (M = 10.25 years; SD = 7.08); $t(62) = 10.73$, $p < .001$. Overall, the groups similarly identified close others they were highly familiar with and very fond of, although older adults reported having more experience with their close others, many of which involved romantic relationships, than young adults.

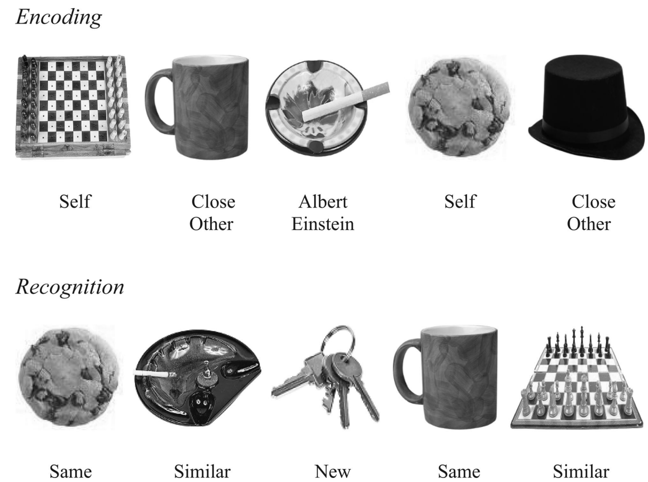

Figure 1. During encoding, participants viewed 108 objects for 500 milliseconds each and then answered one of three questions about each object. One third of these objects were paired with the question "Is this an object you would ever buy?," another third with "Is this an object your close other would ever buy?," and the remaining third with "Is this an object Albert Einstein would ever buy?." During recognition, participants viewed 144 objects for two seconds each and specified whether each object was the same as one seen in encoding, similar to an object seen in encoding, or new.

Table 1
Demographic Information and Mean (Standard Deviation) Test Scores for Young and Older Adults

	Experiment 1		Experiment 2	
	Younger	Older	Younger	Older
Age	18.72 (1.87)	74.94 (7.05)	23.19 (4.10)	72.85 (6.00)
N	32	32	27	27
Gender	11M, 21F	13M, 19F	7M, 20F	15M, 12F
Years of education	12.64 (1.32)	16.14 (2.39)*	15.32 (2.45)	16.56 (2.70)
Digit comparison	73.62 (13.46)	59.59 (11.71)*	85.78 (11.01)	56.44 (12.65)*
Shipley Vocabulary	31.63 (3.28)	36.91 (2.86)*	35.15 (3.67)	36.26 (3.46)

* Age difference is significant at $p < .001$.

Following a brief practice task with photographs of animals, participants viewed 108 pictures of purchasable objects and made judgments about whether an individual would buy the depicted object. The specific questions were: "Is this an object YOU would ever buy?," "Is this an object your CLOSE OTHER would ever buy?," or "Is this an object ALBERT EINSTEIN would ever buy?." The question remained on the computer screen for three seconds, followed by the image for 500 milliseconds. The participants had to respond using a key press of 1 if they were responding *yes* to the question or 2 if they were responding *no* to it. They were allotted three seconds to make their response before the next question appeared on the screen. The three conditions, represented by each of the three questions, were used in this study because previous literature has indicated that the mnemonic advantages resulting from other-referencing only take place if the person in question has an intimate or personal relationship with the participant. In order to provide a condition which poses a more neutral stance but ensures a social context (Symons & Johnson, 1997), Albert Einstein was selected as the familiar but personally unknown other due to the fact like self and close others, he is a well-known figure and is generally perceived in a positive manner. Previous studies indicate that younger and older adults perceive Einstein similarly (Gutchess, Kensinger, Yoon, et al., 2007).

The ordering of the presentation of the objects was randomized and the condition for each object was assigned based on one of eight counterbalancing schemes to allow for objects to be presented in each encoding condition (self, close other, Einstein) and as a same, similar or new objects across participants. The objects were distributed among four lists of 36 object pairs and any objects that seemed suited to one sex over the other, as determined by an experimenter, were divided equally among the lists. Each participant was presented with the same item within each pair of objects during the encoding task, however, participants were shown only three of the four object lists during encoding. The remaining objects in the fourth list were presented as new items during the recognition task only. Encoding and recognition tasks were presented with E-Prime software (Psychology Software Tools, Pittsburgh, PA).

Recognition procedure. The participants met with the experimenter after an approximately 48-hour delay and completed a surprise recognition test in addition to several paper-and-pencil tasks. They completed a practice task in which they decided if the image of the animal they were viewing was the same, similar, or new compared to an image seen during the first session. Participants were instructed to view the images on the screen (for a duration of two seconds) and respond using a key press indicating that they believed the object was (a) exactly the same as the object they saw during encoding, (b) similar (may be different in size, number, shape, etc) to the object they saw during encoding, or (c) a new object and thus one they did not see during encoding (see Figure 1 for an example). During the task, participants were shown 54 of the same objects they saw during encoding (18 from each encoding condition), 54 objects that were similar to the ones they saw during encoding (18 from each encoding condition), and 36 new objects that were not presented during encoding. The recognition task was self-paced and the program continued to the next image once a key press was made. This procedure was adapted from the methods used by Kensinger et al. (2007) in their study investigating memory traces for same, similar, and new objects with emotional valence across groups differing in age. Following the recognition task, participants completed a post-task questionnaire, Shipley Vocabulary measure, MMSE (older adults only), and a feedback form.

Results and Discussion

Encoding data. As a rough proxy to determine how both age groups perceived the items, we compared the percentage of "yes" purchase decisions during encoding to the prompt of, "Is this an object YOU/CLOSE OTHER/ALBERT EINSTEIN would ever buy?" across the conditions and age groups. Older adults (M = .66) made significantly more "yes" responses than young (M = .55), $F(1, 62) = 16.46$, $p < .001$. Although item endorsements differed across conditions, $F(2, 124) = 4.27$, $p < .02$, with more "yes" decisions for both self ($M = .63$; $t(63) = 2.43$, $p < .02$) and close other conditions ($M = .62$; $t(63) = 2.73$, $p < .01$) compared to Einstein ($M = .57$), there was no evidence that the pattern of judgments across conditions differed with age ($F < 1.2$).

Recognition data. We assessed the participants' specific and general memory for the objects presented in each of the three conditions (self, close other, and Albert Einstein) by calculating six memory scores for each participant. Specific recognition scores were calculated based on the equation used previously with this procedure (Kensinger et al., 2007; Payne, Stickgold, Swanberg, & Kensinger, 2008). Specific memory was calculated as the proportion of correct "same" responses given to items presented as the same at encoding and recognition. Using this equation, the specific memory score reflects participants' memory for the perceptual details of objects encoded and then presented again during the surprise recognition task. In order to evaluate participants' general memory, we used the equation from Kensinger & Schacter (2008), which accounts for all instances in which participants indicated a level of familiarity with those exact objects presented during encoding and again during recognition. General memory was calculated as the proportion of "same" and "similar" responses given to items that were the same at both encoding and recognition. Thus, we share Kensinger et al.'s (2007) conceptualization of general memory as memory for "*at least* the gist information, regardless of whether individuals also remembered the specific visual details" and "memory for the general theme of a single item" (p. P209). Due to the fact that our primary focus was to investigate the effect of self- and other-referencing on specific and general memory for encoded objects, we focused the analyses on those responses given to same (identical) objects during the recognition phase. While a "similar" response to a similar object is a correct response, we cannot directly infer whether this response constitutes general or specific recognition because such a response could result from either an accurate account of the object's appearance (in which case, the response demonstrates that the second object is only similar because it differs in its details) or from a participant's sense of familiarity with the object but no real recollection of its features. As a result, responses to similar objects were excluded in the calculations of general and specific memory.

In keeping with prior literature using this procedure (e.g., Kensinger et al., 2007; Kensinger & Schacter (2008); Payne, Stickgold, Swanberg, & Kensinger, 2008), we did not use a corrected recognition measure to incorporate false alarm rates. This was because while older adults tended to make more false alarms than young adults, $F(1, 62) = 5.17$, $p < .03$, partial eta = .08, and more false alarms were committed for similar than same items, $F(1, 62) = 111.51$, $p < .001$, partial eta = .64, there was no difference in the pattern of false alarms across the age groups ($F < 1$). See Table 2

We conducted a 2 × 2 × 3 mixed analysis of variance (ANOVA) on response accuracy with Age (Young/Older adults) as the between-subjects variable and Memory Type (Specific/General) and Reference Condition (Self/Close other/Einstein) as within-subject variables. The results are presented in Figure 2. The ANOVA revealed a main effect of Age, $F(1, 62) = 13.28$, $p < .002$, $\eta_p^2 = .18$, with young adults responding more accurately on the recognition task ($M = .77$) than their older adult counterparts ($M = .65$). The main effect of Memory Type was also significant, $F(1, 62) = 333.31$, $p < .001$, $\eta_p^2 = .84$, with participants demonstrating higher levels of performance for general recognition ($M = .83$) than for specific recognition ($M = .58$). In addition, the main effect of Reference Condition reached significance, $F(2, 124) = 19.44$, $p < .001$, $\eta_p^2 = .24$, with the response accuracy associated with the self ($M = .75$) and close other conditions ($M = .73$) reflecting better recognition performance than for objects encoded in the Albert Einstein condition ($M = .65$). To determine the relative advantage for self vs. others, we conducted three follow up ANOVAs with Memory Type (Specific/General) and comparisons between two of the three Reference Conditions: (a) Self vs. Close Other, (b) Close Other vs. Distant Other, and (c) Self vs. Distant Other. These contrasts revealed that objects encoded in the self condition were remembered significantly better than those encoded in the distant other (Albert Einstein) condition, $F(1, 63) = 36.95$, $p < .001$, $\eta_p^2 = .37$. While the participants' memory for close other-referenced objects was also superior relative to those referencing Einstein, $F(1, 63) = 20.38$, $p < .001$, $\eta_p^2 = .24$, there weren't any significant differences in memory performance between self-referenced objects and close other-referenced objects, $p > .15$.

The ANOVA yielded a significant interaction between Memory Type and Age, $F(1, 62) = 5.76$, $p < .02$, $\eta_p^2 = .09$, indicating that there are differences in the response accuracy of young and older adults with regard to specific memory (young adults $M = .66$, older adults $M = .51$) and general memory (young adults $M = .87$, older adults $M = .79$). Based on the graph (see Figure 2), it appears that there is a larger gap in memory performance as a function of age for specific memory relative to general memory, consistent with prior literature (Koutstaal & Schacter, 1997; Tun et al., 1998).

A significant Memory Type x Reference Condition interaction also emerged, $F(2, 124) = 4.14$, $p < .02$, $\eta_p^2 = .06$, demonstrating

Table 2
The Proportion of Same, Similar, and New Responses as a Function of Object Type and Reference Condition for Young and Older Adults.

Response Type	"Same"	"Similar"	"New"
Young Adults			
Self			
Same	.72 (.16)	.18 (.12)	.10 (.10)
Similar	.14 (.08)	.47 (.15)	.40 (.14)
Close Other			
Same	.68 (.16)	.22 (.12)	.10 (.09)
Similar	.14 (.09)	.45 (.18)	.42 (.17)
Albert Einstein			
Same	.57 (.19)	.25 (.15)	.18 (.13)
Similar	.13 (.09)	.45 (.16)	.42 (.14)
New	.03 (.03)	.23 (.13)	.74 (.13)
Older Adults			
Self			
Same	.55 (.23)	.27 (.15)	.18 (.13)
Similar	.19 (.14)	.38 (.16)	.43 (.18)
Close Other			
Same	.52 (.20)	.29 (.15)	.19 (.15)
Similar	.21 (.14)	.35 (.16)	.44 (.19)
Albert Einstein			
Same	.45 (.20)	.30 (.13)	.25 (.16)
Similar	.19 (.09)	.36 (.15)	.45 (.18)
New	.09 (.06)	.26 (.14)	.65 (.16)

Note. Responses are displayed as the mean, with standard deviation shown in parentheses. Specific recognition scores correspond to the "same" responses to same items (i.e., the first value in the first row for each condition), while general recognition scores correspond to the "same" and "similar" responses given to same items (i.e., summing across the first two columns in the first row for each condition, corresponding to same item presented at recognition).

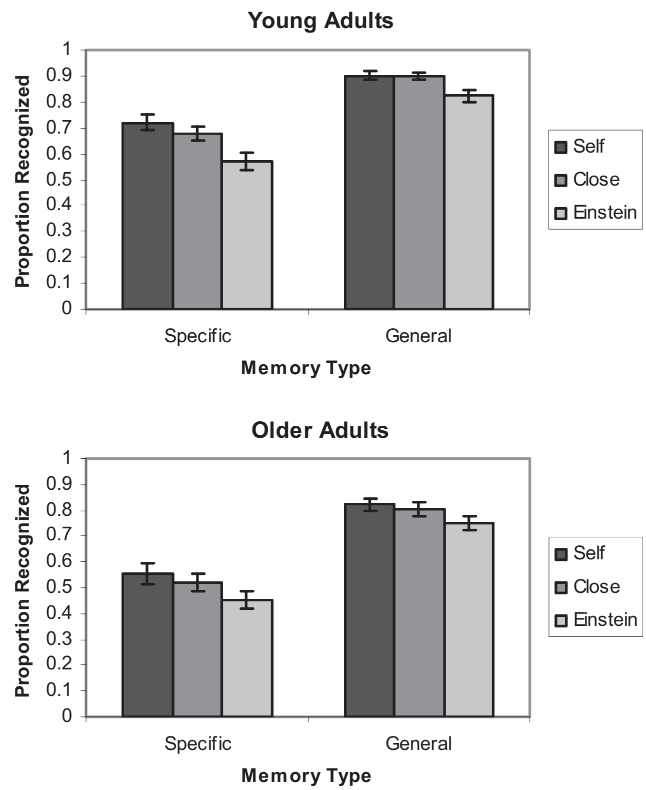

Figure 2. Recognition accuracy of young and older adults for specific and general memory for visual objects across self and other-referencing conditions. The mnemonic benefits of self-referencing not only applied to general or "gist" recognition but also extended to specific recognition (i.e. the ability to remember the details of items) in young and older adults alike. Overall, the larger age impairment in memory performance is evident in specific memory. Nevertheless, self-referencing improved specific memory disproportionately more than other conditions for both young and older adults.

that there are significant differences in subsequent specific vs. general memory performance varying between the three reference conditions. To further investigate the interaction, we conducted a series of two-factor ANOVAs with Memory Type (Specific/General) and two levels of the Reference Condition variable (Self/Close Other, Close Other/Einstein, Self/Einstein) and found that specific memory received a disproportionately larger mnemonic boost from self-referencing objects rather than encoding them in the Einstein condition (self $M = .64$, Einstein $M = .51$) relative to general memory (self $M = .86$, Einstein $M = .79$), $F(1, 63) = 10.54$, $p < .01$, $\eta_p^2 = .14$. The same pattern, although it is one of marginal significance, is seen between the self and close other conditions in specific memory (self $M = .64$, close other $M = .60$) relative to general memory (self $M = .86$, close other $= .85$), $p = .10$. However, this was not the case for objects encoded in the close other vs. Einstein conditions, $p > .25$. Interestingly, age differences did not emerge in the pattern of memory performance across the conditions. Neither the Age x Reference Condition interaction nor the Age x Memory Type x Reference Condition interaction reached significance, ps $> .45$[1]. Exploratory analyses assessing potential gender differences in memory accuracy across the conditions did not reach significance, ps $> .10$.

We also conducted exploratory analyses to compare the relative benefits from referencing different types of close others on memory. We collapsed across subcategories to separate individuals who referenced a romantic partner or family member, but did not find any significant effects of interactions related to this factor. Because this was likely due to the low power (cell sizes for this analysis ranged from 6-18 individuals), we increased the number of individuals in each group by collapsing across young and older adults, but this also did not reveal any effects of the type of relationship.

Consistent with previous studies of young and older adults' performance on a recognition task testing their memory for trait adjectives encoded self-referentially versus semantically or in relation to others (Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon, et al., 2007), we found that the self-reference effect was in fact maintained with age. Furthermore our data revealed that self-referencing provided an advantageous mnemonic strategy for both gist and detailed object memory in young and older adults alike. By using object images as stimuli during encoding and administering a recognition task using same, similar, and new items, Experiment 1 is the first to support the notion that self-referential processing promotes superior memory for both gist-based and detailed visual information across the lifespan, with young and older adults benefitting in a comparable manner. Our findings indicated that young adults' superior recognition accuracy was more pronounced in specific memory than general memory, which is consistent with prior work indicating a greater reliance on gist, or theme information, with age (Koutstaal & Schacter, 1997; Tun et al., 1998). However, a self-referencing strategy improved specific memory disproportionately more than a strategy of referencing others, and this benefit extended across young and older adults. This finding that socioemotionally meaningful strategies can benefit both general and specific memory is consistent with previous work on emotional valence, in which young and older adults benefitted across levels of memory when information was negatively valenced (Kensinger, Garoff-Eaton, & Schacter, 2007). These findings indicate that referencing self and others contributes to memory through the enhancement of memory for particular details as well as the general schematic, or gist-based, representations.

In accordance with reports that intimacy strongly influences the mnemonic benefits associated with person-referent encoding (Bower & Gilligan, 1979; Symons & Johnson, 1997), we found that referencing a person with whom participants had a close relationship elicited superior memory performance for young and older adults alike when compared to that of a condition referencing a familiar but socially irrelevant individual (in this case Albert Einstein). The failure to find more accurate memory overall for the self than the close other condition is consistent with reports of a diminution in the self-reference effect when the self is compared to an intimately close other (Bower & Gilligan, 1979). However, two distinct patterns emerged when comparing specific and general memory scores. For general memory, the discrepancy between self- and close other-referenced objects was negligible but once specific memory was evaluated, participants exhibited somewhat better memory for objects referenced to the self-concept relative to the close other condition. This indicates that although information about intimate others is well-known and highly elaborated given the frequent use of its schema, specific memory may be more sensitive to the advantages conveyed by the more elaborated and meaningful self-schema. Presumably the slight advantage of self-referential processing emerged for specific memory because encoding detailed information requires highly efficient and elaborated processing whereas the processing of gist information demands fewer cognitive resources.

When we evaluated participants' overall memory performance for objects encoded in the self versus close other conditions relative to Einstein, we found that self- and close other-referencing provided mnemonic boosts of equivalent magnitude when the two socially-meaningful schemas were each compared to the distant other condition. This makes theoretical sense because we frequently consider the opinions, desires, and needs of those closest to us when appraising an event or item encountered in our daily lives. The design of the encoding task, which required participants to decide whether they would purchase an object for themselves or a close other, simulated a realistic and customary situation in which people would typically employ self- and close other-referencing. Despite the fact that self- and close other-referencing enhanced participants' memory during a simulated shopping task suggests that the use of these strategies may be applicable to our every day routines, this encoding task also introduces a potential limitation in the generalizability of the results to other task contexts. Making immediate purchase decisions for the self and close other is a commonplace task which was likely highly familiar and easy for the participants. As a result, the superior memory performance evidenced in the self- and close other-referencing condi-

[1] We also verified this pattern of results using a corrected recognition measure that subtracted false alarm rates from the scores. Critically, the interaction of condition and memory type remained significant, and the follow up 2×2 ANOVAs converged with the original analyses (self vs. Einstein were significantly different, $p < .01$, with a marginal difference for self vs. close other, $p = .10$, but no significant difference for close other vs. Einstein, $p > .25$). Additionally, no interactions involving age and condition approached significance (Fs < 1). Although the main effect of memory type and the age x memory interaction were not significant, this is not surprising given the higher false alarm rates to the "similar" condition, such that the general recognition scores were reduced in the corrected recognition measures.

tions may reflect the participants' familiarity with the task and the resulting meaningful consideration of the objects shown, as opposed to the unfamiliar and unrealistic task of making purchase decisions in the Albert Einstein condition. This could have led participants to exert minimal cognitive effort to making the purchase decisions, or the effortful purchase decisions could have impaired encoding in the Einstein condition, resulting in poorer memory performance.

While stimuli were generally selected to be familiar everyday items for both young and older adults, they were not specifically normed to be age-equivalent. Although the age groups differed in the overall tendency to endorse items with a purchase decision, it is difficult to know whether this reflects the different needs of the age groups (e.g., the types of items purchased by students in a dorm room vs. older adults with a permanent home), the familiarity or desirability of the items themselves (e.g., biased towards an older generation), or a simple "yes" bias in older adults (e.g., possibly due to response bias or older adults' greater purchasing power than the average college Freshman). While it is difficult to speculate post-hoc on how the items could have been perceived differently across young and older adults, there is some evidence indicating changes across the lifespan in the types of objects that are meaningful. For example, one study revealed differences in young adults' emphasis on active and physical possessions vs. older adults' preference for items with symbolic and interpersonal meaning (Kamptner, 1991). Another questionnaire distinguished possessions acquired by primarily young adults, such as hi-tech materials, compared to those "staple goods" purchased as part becoming a family unit and more likely to be owned by older adults (Livingstone & Lunt, 1991). In addition, ownership may have different meaning to older adults based on unique needs and consideration, such as transmission of possessions across generations (Curasi, Prince, & Arnould, 2010). Future studies could be designed to address the types of features that make objects more appealing or useful, and thus potentially more memorable, for one age group than another.

Experiment 2 assesses the effect of self-referencing on specific memory under different task conditions. Because the majority of self-referencing research to date focuses on verbal stimuli, we sought to extend our findings to the oft-used adjective judgment paradigm (see review by Symons & Johnson, 1997). This would allow us to assess the effects of self-referencing not only on memory for verbal information, but also to assess the benefits for remembering a distinct type of specific detail. We investigated the effects of self-referencing on source memory, a different type of specific memory that requires memory for information beyond familiarity with the item itself. Namely, the source of information is external to the item itself, as opposed to the internal visual details of an object.

Experiment 2

Consistent with our findings that older adults encounter greater difficulty in accurately retrieving detailed visual information in Experiment 1, aging also results in poorer memory for details about the source of information. Source memory is another form of specific memory in which individuals remember the circumstances under which new information was acquired, such as the medium that delivered the information or whether it was merely a figment of one's imagination (Johnson, Hashtroudi, & Lindsay, 1993). The ability to identify source information is critical in everyday situations as source attributions are instrumental in our ability to evaluate the credibility and relevance of information we encounter in our surroundings. Memory for source is often disproportionately impaired with age compared to memory for items (Johnson et al., 1993; Old & Naveh-Benjamin, 2008; Spencer & Raz, 1995; but see Siedlecki, Salthouse, & Berish, 2005). Experiment 2 further addressed the question of whether self-referencing enhances memory for details by focusing on source memory, allowing us to assess whether the pattern of age-equivalent enhancement for memory for general and specific memory for visually detailed objects in Experiment 1 also extends to source memory for verbal information. Measuring source memory also offers a benefit over the methods employed in Experiment 1 in that errors, or false alarms, are associated with specific conditions (e.g., mistakenly labeling the source as "self"), allowing us to correct for the types of guessing errors (as opposed to Experiment 1 in which false alarms correspond only to "new" items and are not specifically associated with each self or other person condition).

Distinguishing the type of judgments made at encoding requires discriminating multiple similar internal sources, memories of which are characterized by cognitive operations (Johnson, Foley, Suengas, & Raye, 1988). Because age-related impairments of source memory are particularly pronounced when sources are similar (Hashtroudi, Johnson, and Chrosniak, 1989; Henkel, Johnson, & DeLeonardis, 1998), we sought to distinguish the features of the sources to assess the effects of self-referencing on source memory under conditions favorable to older adults. Thus, we adopted judgments that were more distinct than the person referencing orientations that were used in Experiment 1. On the other hand, using more dissimilar sources than those employed in Experiment 1 may also offer more sensitivity to detect a disproportionate advantage for self-referencing relative to other conditions, particularly for older adults.

Method

Participants. Twenty-seven young adults aged 18-30 and twenty-seven older adults aged 61-88 participated in the study. Informed consent was acquired in a practice approved by the Institutional Review Board. See Table 1 for sample characteristics. Compared to younger adults, older adults had marginally more years of education, $t(52) = 1.77$, $p < .10$, but performed significantly slower on the digit comparison task (Hedden et al., 2002), $t(52) = 9.09$, $p < .001$.

Materials and procedure. Participants incidentally encoded a series of trait adjectives by judging whether the word accurately characterized them (self), was encountered on a regular basis (common), or was displayed in upper case lettering (case). The common judgments offered a deep encoding condition in which participants reflected on the meaning of the word (Craik & Lockhart, 1972), but the task was selected to invoke more distinct cognitive operations than referencing an "other" person. The case condition provided a shallow comparison condition, consistent with prior studies (e.g., Gutchess, Kensinger, Yoon, et al., 2007). One-hundred and forty-four words, selected from Anderson's (1968) personality-trait norms, were presented for four seconds each. For each displayed adjective, participants were instructed to respond using *yes* or *no* key presses in response to the judgment presented for that trial (self, common, or case). The participants were assigned to one of three counterbalancing orders, which ensured that the adjectives were equally distributed across the encoding conditions. After a ten minute retention interval had elapsed during which time participants completed unrelated paper and pencil tasks, a self-paced surprise recognition test was administered. During the recognition task, 288 words (144 previously studied words, 144 novel lures) were presented as participants were asked to either determine the condition under which a word had been encoded, or whether it was new. They responded by pressing one of four keys corresponding to: *self*, *common*, *case*, or *new*.

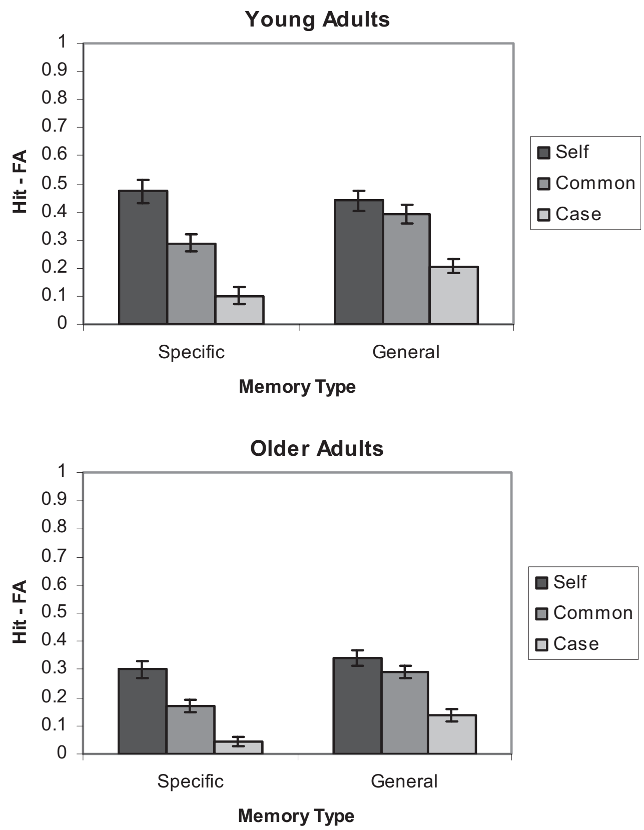

Figure 3. Recognition accuracy of young and older adults for specific source and general memory for verbal items across self-referent, semantic (i.e., common), and structural (i.e., case) conditions. The self-reference effect was unaffected by age and extended across memory for general and specific source information relative to the other encoding processes. There weren't any age-related gaps in assessments of general vs. specific recognition. Self-referencing benefitted specific memory disproportionately more than other conditions for young and older adults alike.

Results and Discussion

In order to correct for guessing, recognition scores were calculated using hit rates minus false alarm rates. Scores were calculated for both specific memory (i.e., correctly recalling the source) and general memory (i.e., correctly recalling if words are old—collapsing across source designations of self, common, and case—vs. new). Specific memory scores were calculated using a response-specific false alarm rate (i.e., the hit rate for "self" used the misapplication of "self" to other conditions as the false alarm rate) while calculations for general memory used an overall false alarm rate that was not condition-specific (new items were, by definition, not associated with any one encoding condition).

We conducted a 2 × 2 × 3 mixed ANOVA with Age (Young/Older) as the between-subjects variable and Memory Type (Specific/General and Condition (Self/Common/Case) as within-subject variables. Results are presented in Figure 3. The ANOVA revealed a main effect of Age, $F(1, 52) = 9.79$, $p < .004$, $\eta_p^2 = .16$, with young adults performing better on the recognition task ($M = .32$) than the elderly participants ($M = .21$). A main effect of Memory Type also emerged, $F(1, 52) = 94.62$, $p < .001$, $\eta_p^2 = .65$, with assessments of general memory ($M = .30$) yielding higher recognition scores relative to specific memory ($M = .23$). Additionally, a main effect of Condition reached significance, $F(2, 104) = 122.54$, $p < .001$, $\eta_p^2 = .70$, with higher memory scores in the self-referent condition ($M = .39$) than items encoded in the common ($M = .29$) and case ($M = .12$) conditions. In order to determine the relative mnemonic advantage for self-referent vs. deep (semantic) and shallow (structural) encoding, we conducted three follow up ANOVAs with Memory Type (Specific/General) and a series of contrasts with two levels of the Condition variable (Self vs. Common, Common vs. Case, Self vs. Case). These contrasts revealed that items encoded in reference to the self were remembered markedly better, for both general and specific verbal information, than items judged for their commonality, $F(1, 53) = 38.42$, $p < .001$, $\eta_p^2 = .42$, and case font, $F(1, 53) = 204.74$, $p < .001$, $\eta_p^2 = .79$. Consistent with the depth of processing paradigm (Eysenck & Eysenck, 1979), which states that information is better remembered when it has been encoded using deeper processes requiring meaningful consideration, we found that encoding source information semantically (i.e., evaluating words' commonality) resulted in higher memory scores than a shallow, structural encoding strategy (i.e., judging whether words are presented in uppercase), $F(1, 53) = 95.36$, $p < .001$, $\eta_p^2 = .64$.

Moreover, Memory Type interacted with Condition, $F(2, 104) = 17.93$, $p < .001$, $\eta_p^2 = .26$, with self-referencing benefitting specific memory disproportionately more than other encoding conditions (self $M = .39$, common $M = .23$, case $M = .07$) relative to general memory (self $M = .39$, common $M = .34$, case $M = .17$). To examine this interaction further, we conducted a series of two-factor ANOVAs using two levels of the Condition variable and found significant Memory Type x Condition interactions when self-referencing was juxtaposed with semantic encoding (i.e., self vs. common), $F(1, 53) = 27.93$, $p < .001$, $\eta_p^2 = .35$, and structural encoding (i.e., self vs. case), $F(1, 53) = 19.67$, $p < .001$, $\eta_p^2 = .27$. However, this interaction was not significant when comparing general and specific memory for source information in the common vs. case conditions, $F(1, 53) = .72$, $p > .40$, $\eta_p^2 = .01$. Our analyses revealed that Age did not interact with either Memory Type or Condition and the Age x Memory Type x Condition interaction did not reach significance, *ps* > .09.

In accordance with the results of Experiment 1 and the literature reporting that the self-reference effect remains intact with age at the item level (Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon, et al., 2007), we found that self-referencing similarly improved young and older adults' memory for general and specific source information relative to semantic and shallow structural encoding processes. This extended the finding that self-referencing enhanced memory for details, as found in Experiment 1, to verbal materials, which have been the focus of much of the literature thus far. Interestingly, self-referencing preserved specific memory at approximately the same level as general memory for both younger and older adults, whereas this was not true for the other conditions. This could reflect the greater advantage of self-referencing over nonsocial semantic conditions, rather than the contributions of self-referencing to source memory per se. Like Experiment 1, self-referencing enhanced both general and source memory, and this was equally true for younger and older adults. Even in comparison to a nonsocial comparison condition, older adults do not show any disproportionate benefit from self-referencing, relative to young adults.

One surprising finding is that our results indicate that the age-related deficits in memory performance were of comparable size for both general and specific recognition. This opposes the finding in Experiment 1 and much of the literature (e.g., Koutstaal & Schacter, 1997; Tun et al., 1998), which demonstrates that young adults tend to have superior specific memory than older adults, who tend to rely more strongly on gist and general memory. This may reflect the type of error correction that was used in the present study. Although false alarms were deducted from hit rates for both general and specific memory, the types of responses counted as false alarms varied across memory types. In general memory (distinguishing old from new), memory for the source was not necessary; participants needed to remember only that the word had been presented in one of the three encoding conditions originally. This likely resulted in high hit rates, but also relatively high false alarm rates because applying any label other than "new" to a lure would count as a false alarm. The case condition in particular resulted in poor memory, making it likely to be easily confused with the "new" condition. For specific memory, on the other hand, it may have been more difficult for participants to correctly remember the source of a previously studied item (counted as a hit), but there would also be lower rates of misapplication of the label corresponding to any particular condition to a new item (resulting in a false alarm).

General Discussion

The present studies investigated the ways in which aging influences the processes underlying the construction of memories within social contexts (i.e., self- vs. other-referencing) and the degree of detail embodied within these memories. Our primary goal was to examine whether the benefits of self-referencing at encoding differentially impact memory specificity across the lifespan. Our findings from two studies indicate that the mnemonic benefits associated with self-referential processing are not confined to memory for gist-based information but rather extend to the retrieval of specific details such as visual features (Experiment 1) and source information (Experiment 2). While the literature has predominantly reported a robust self-reference effect on item memory, particularly for words (Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon, et al., 2007; Mueller et al., 1986), little research has explored the level of detail retained in the memory traces of the encoded items. These findings support the notion that the construct of the self invokes greater elaboration to incoming stimuli (Anderson & Reder, 1979; Rogers et al., 1977; Symons & Johnson, 1997) and as a result, can be used as an advantageous cognitive strategy for enhancing individuals' mnemonic capacity and memory specificity.

Our findings suggest that self-referencing is a mnemonic strategy that stays intact with age; the strategy similarly enhances specific and general memory across young and older populations, despite the cognitive changes that occur with aging. Because older adults tend to have more general memory than young adults, failing to remember specific distinguishing details of items (Koutstaal & Schacter, 1997; Tun et al., 1998), identifying strategies that enhance memory for details is particularly important for older adults. Although previous findings suggest that under some conditions older adults may be limited in the extent to which self-referencing boosts accurate and detailed memories of encoded stimuli (Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon, et al., 2007), the present data indicate that memory for source and specific details are not prone to limitations in the benefits from self-referencing. The robust nature of self-referencing under these conditions may be surprising due to older adults' heightened reliance on gist-based information (Koutstaal & Schacter, 1997) and poor source memory (Johnson et al., 1993; Spencer & Raz, 1995). Despite these limitations in memory with age, self-referencing serves as an effective device in enhancing the ability to accurately retrieve specific visual and verbal information rather than just the general scheme or item-level trace of the information presented. Our results show that when older adults make effective uses of encoding strategies, as provided by self-referencing, they can benefit much like young adults in the encoding of specific details rather than exhibiting more gist-based memory errors than young. This suggests that older adults may be particularly poor at self-initiation of strategies at encoding, as opposed to retrieval deficits.

Notably, our results indicate that the benefits of self-referencing extend across specific and general memory, but are not carried predominantly by one level of memory, or age group, more than the other. Even when each age group is considered separately, the pattern of results holds. Whether similar neural mechanisms support these benefits for young and older adults, and for general and specific memory, should be established in future work. While older and younger adults may recruit substantially different networks to support encoding (Cabeza, Anderson, Locantore, & McIntosh, 2002; Grady, 2008; Gutchess et al., 2005; Reuter-Lorenz & Lustig, 2005), this may not characterize socioemotional domains (Gutchess, Kensinger, & Schacter, 2007; Kensinger & Schacter, 2008).

Across both experiments we found that young adults surpassed their older counterparts in overall recognition accuracy. This suggests that although self-referencing similarly enhanced the mnemonic capacities of all participants involved, its use did not boost the older adults' recognition accuracy scores to the extent at which they could achieve an equal footing with the young adults. Nevertheless, self-referencing was shown to mitigate the loss of memory specificity associated with aging to some extent, through young and older adults' disproportionate improvement in specific memory compared to general memory when self-referencing is compared to other-referencing (Experiment 1) or semantic or shallow encoding (Experiment 2).

While our data did not allow us to adequately distinguish amongst different types of close others, this is an important consideration for future studies. Thus far we have not identified differences with age in the mnemonic benefits of referencing a close other, even when young and older adults tended to identify different classes of close others (e.g., friends vs. life-long romantic partners), as was the case in this study and Gutchess, Kensinger, Yoon, et al. (2007) nor in an interactive laboratory experience in which participants remembered the source of actions as self, close other, or stranger (Rosa & Gutchess, 2010). Still, there is reason to suspect that developmental differences could emerge in these processes due to the greater cognitive overlap between self and close others (Aron, Aron, Tudor, & Nelson, 1991; Mashek, Aron, & Boncimino, 2003) who are highly intimate, as might be expected for long-married partners. In particular, shrinking social networks with age and the resulting greater focus on intimate others, as opposed to casual acquaintances, may differentially influence memory, in line with Charles & Piazza's (2007) finding that with age, emotional intensity of interactions varies based on the type of partner identity with age and can impact memory. Further investigation is needed to explore these questions using meaningful tasks and robust samples focused on different types of relationships.

Although a number of commonalities exist across both experiments, the two studies appeared to yield different levels of recognition accuracy, with better memory performance resulting from recognition tasks involving object details in Experiment 1 (general $M = .83$, specific $M = .58$) than those testing source memory for trait adjectives in Experiment 2 (general $M = .30$, specific $M = .23$). Note that the different memory measures should not be directly compared due to differences in the ways scores were calculated; because false alarms were specific to each condition in Experiment 2 (e.g., could respond "self" to a "case" item), it was important to subtract them from hit rates and employ corrected recognition measures, whereas false alarms were not specific to each condition in Experiment 1. This apparent discrepancy in levels of memory may be explained by superior memory for pictures over words (Paivio & Csapo, 1973), although differences in the experimental designs could also contribute. Because picture memory remains highly accurate over time, very brief presentation intervals and a two-day delay were employed in Experiment 1, whereas the adjectives in Experiment 2 were presented for longer intervals and tested in a single session. The framing of the tasks may also be important to understanding performance. In their meta-analysis, Symons and Johnson (1997) proposed that self-referential processing is most effective when employed for the organization and elaboration of stimuli usually encoded through self-referent appraisals. Their results indicate that self-referencing is "probably unique only in the sense that, because it is a highly practiced task, it results in spontaneous, efficient processing of certain kinds of information that people deal with each day—material that is often used, well organized, and exceptionally well elaborated" (p. 392). Experiment 1 replicated a typical shopping experience simulating a real-world setting in which self- and other-referencing would usually be used whereas Experiment 2 evaluated the self-reference effect within a context lacking the level of fluency and applicability (seen in Experiment 1) to realistic scenarios in which self-referent, semantic, and structural encoding would naturally take place. While trait adjectives are often encoded using person-referent and semantic conditions, people may process the concept associated with the items rather than any specific details external to the words themselves such as the nature of the encoding task. As a result, the source memory test may have resulted in lower recognition accuracy due to participants having retained adjectives' conceptual information rather than the condition in which they were presented. The importance of distinguishing details intrinsic to the central item itself (as in the visual details assessed in Experiment 1) from details extrinsic to the relevant information (as in the source of the judgments assessed in Experiment 2) corresponds to findings in the emotion literature, that emotion only enhances memory for the item itself, but not the peripheral details (Kensinger & Schacter, 2006).

In order to assert the viability of improving memory through the use of self-referential encoding in everyday life, further work should investigate whether the mnemonic benefits associated with self-referential processing remain when the strategy is applied in a flexible and spontaneous manner in the context of real-life situations that require an ability to remember detailed information. At this point, these findings hold promise for an aging population because older adults exhibit a profound need for mnemonic strategies that are both accessible and effective in reducing memory impairments with age, particularly for detailed information.

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Received July 13, 2010
Revision received December 8, 2010
Accepted December 19, 2010 ■