

## BRIEF REPORT

# Source Memory for Action in Young and Older Adults: Self vs. Close or Unknown Others

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The present study examines source memory for actions (e.g., placing items in a suitcase). For both young and older adult participants, source memory for actions performed by the self was better than memory for actions performed by either a known (close) or unknown other. In addition, neither young nor older adults were more likely to confuse self with close others than with unknown others. Results suggest an advantage in source memory for actions performed by the self compared to others, possibly associated with sensorimotor cues that are relatively preserved in aging.

*Keywords:* memory, self, aging, source memory, cognition

As time goes by, our memories for events in our lives begin to fade, becoming more general and less specific. While memory for source details, such as who said or did something, (Johnson, Hashtroudi, & Lindsay, 1993), is particularly prone to age-related loss (Henkel, Johnson, & De Leonardi, 1998; Spencer & Raz, 1995), information connected to oneself may be prioritized in memory (for review see Symons & Johnson, 1997). This self-related benefit may also extend to information related to those who are close to us due to the overlap in the representations of self and close others (Aron, Aron, Tudor, & Nelson, 1991). However, a potential downside of an overlap in representations of self and close others is that such overlap may make it more difficult to distinguish between items or actions associated with the self and close others in memory, particularly for older adults, who are prone to memory errors (Lyle, Bloise, & Johnson, 2006). The present study investigated the effects of aging on the ability to distinguish between self and others in source memory for actions.

Processing information by connecting it to the self may improve memory in various ways. The self is a well-known entity allowing for easier encoding and retrieval (Greenwald & Banaji, 1989) that is spontaneous and efficient particularly when dealing with information commonly related to the self (Kuiper & Rogers, 1979;

Rogers, Kuiper, & Kirker, 1977; Symons & Johnson, 1997). The varied aspects of our selves allows for greater opportunities to make connections or associations to new information thus facilitating more organized (Klein & Kihlstrom, 1986) and elaborate encoding ( Craik & Lockhart, 1972; Hartlep & Forsyth, 2000). Although most of the studies to date have focused on information accurately encoded into memory, there is some evidence that self-referencing can lead to unique patterns of memory errors, with highly self-descriptive information prone to false recognition due to its automatic and schematic association with the self (Rogers, Rogers, & Kuiper, 1979; Rosa & Gutchess, 2010).

The self-reference effect appears to remain consistent as we age with little difference found between young adults and elders (Glisky & Marquine, 2009; Gutchess, Kensinger, & Schacter, 2007, 2010; Gutchess, Kensinger, Yoon, & Schacter, 2007). While older and younger adults appear to receive a similar boost in memory from explicitly relating information to themselves, the benefits from self-referencing do not eliminate or reduce age differences in memory (Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon et al., 2007; Mueller, Wonderlich, & Dugan, 1986). When task contexts do not overtly require self-referencing, older adults may apply the strategy less flexibly and more narrowly than younger adults, limiting the mnemonic benefits of self-referencing (Gutchess, Kensinger, Yoon et al., 2007).

While the benefits of self-reference in item memory have been supported in the literature, less is known about the role played by close others and whether they provide a benefit similar to that seen in self-reference. Research has shown that referencing an intimate other can, in some cases, improve memory to nearly the same extent as referencing the self (Aron et al., 1991) and that the mnemonic benefits of referencing another person remain consistent with age (Gutchess, Kensinger, Yoon et al., 2007). To the extent that a close other's personality and characteristics are well known by us, we may see an overlap with our own self representation (Symons & Johnson, 1997) and we may incorporate our close others into our own self-concept (Aron & Aron, 1986; Aron,

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Aron, & Smollen, 1992; Aron et al., 1991; Mashek, Aron, & Boncimino, 2003). This overlap between close others and self representations may allow close others to offer the same mnemonic benefits as self-reference (Bower & Gilligan, 1979; Mashek et al., 2003).

Self-referencing may also play a role in memory for actions. Previous research on memory for actions has demonstrated that, similar to memory for other types of information, age matters (Cohen & Faulkner, 1989; Kausler, Wiley, & Phillips, 1990; Kersten, Earles, Curtaune, & Lane, 2008; Knopf & Neidhardt, 1989; McDaniel, Lyle, Butler, & Dornburg, 2008). However, the source of the action plays a role as well. While familiar actions may be easier to remember than novel actions (Knopf & Neidhardt, 1989), familiar *actors* may lead to source confusion, particularly for older adults (Cohen & Faulkner, 1989; Kersten et al., 2008). Studies have shown that self-performed actions are associated with better memory than actions that are imagined (McDaniel et al., 2008), observed (Manzi & Nigro, 2008), or studied (Knopf & Neidhardt, 1989). As a result, we are more likely to remember actions that we perform ourselves rather than actions that we observe being performed by others. However, previous studies have focused on differences in source memory for performed versus observed or imagined actions (Cohen & Faulkner, 1989) and for actions performed by an actor who was previously observed engaged in a different action (Kersten et al., 2008). It is unknown whether the advantage in memory for self-performed actions is maintained in comparison with actions performed by close others, or if the overlap in the representation of self and close others reduces the distinction between these actors.

The present study looks at whether close others provide the same benefit in source memory as the self does in a task that more closely resembles a real life scenario than previously studied tasks. While previous studies have focused on the ways that self-referencing influenced memory for items such as traits and adjectives (e.g., Aron et al., 1991; Gutches, Kensinger, Yoon et al., 2007; Mashek et al., 2003) and details of pictures (Hamami, Serbun, & Gutches, in press), research has not examined the role of self-reference in source memory for actions performed by the self and others. Using an interactive scenario allowed us to assess the role of other as a concrete and physical entity (e.g., an actor), rather than as an abstract representation. Previous research on item memory has shown that representations of self and close others are similar in memory (Aron & Aron, 1986; Aron et al., 1992; Aron et al., 1991; Ferguson, Hashtroudi, & Johnson, 1992; Henkel et al., 1998; Mashek et al., 2003) which may lead to source confusion. However, it is not clear if this overlap in the representation of self and close others in memory extends beyond item memory to memory for actions. While some have found that source recognition is better for performed than observed actions (Knopf & Neidhardt, 1989; Manzi & Nigro, 2008; McDaniel et al., 2008), others have shown that merely observing the actions of another can lead to source confusion (Lindner, Echterhoff, Davidson, & Brand, 2010). Cohen and Faulkner (1989) found that older adults are particularly susceptible to confusion between self and other actions, especially when the others are familiar (Kersten et al., 2008). It is possible that older adults experience greater difficulty distinguishing between similar sources due to difficulties with remembering sensory-perceptual details (Hashtroudi, Johnson, & Chrosniak, 1990). While there has been research showing age

differences in memory for actions (Kausler, Wiley, & Lieberwitz, 1992; Kausler et al., 1990; Kersten et al., 2008; Knopf & Neidhardt, 1989) and in self versus others for nonactions (Glisky & Marquine, 2009; Gutches, Kensinger, & Schacter, 2007; Gutches et al., 2010; Gutches, Kensinger, Yoon et al., 2007), only one study has examined the role of aging for self versus other actions (Cohen & Faulkner, 1989). The present study is the first to compare memory for actions performed by the self and others that vary in closeness to the self.

The present study investigated whether people are more likely to confuse sources of actions, comparing one's own actions with those of close and unknown others. We expected both young and older adults to show more confusion between self and close others than unknown others in memory for actions because of the greater overlap in similarity in representation between self and close than unknown others (Mashek et al., 2003). Older adults may be more likely to confuse the self and close others because older adults have more difficulty than young adults when two sources are similar (Ferguson et al., 1992; Henkel et al., 1998). We predicted that older adults would, relative to young adults, have particular difficulty in discriminating between memories of actions performed by self and close others than between actions performed by the self and unknown others.

## Method

### Participants

Forty-four young adults (ages 18-26) and 46 older adults (ages 61-91) participated in the study. An additional one young and two older adults were removed from the sample for scoring below chance in two or more conditions. Older adults were drawn from a laboratory database of community dwelling elders and younger adults were recruited from Brandeis University. Further characteristics of these samples are presented in Table 1. All participants provided written informed consent prior to inclusion in the study.

### Procedure

Participants worked in groups of three, all drawn from the same age group but varying in gender composition. Within each triad, there were two participants who knew each other and one who was not known by the other two. To form the triads, participants were contacted and asked to bring a close friend with them to the session. These participants made up the close-other pairs in each group. Additional participants were contacted to form the unknown other in each group. These participants were asked to come in by themselves and to work with the close-other pair of participants who knew one another. Close-other pairs were asked to verify that the 3rd individual was unknown prior to participation. Due to the removal of three low-scoring performers (all from pairs of "close others"), not all members of every group were utilized in the data analysis. Of the 90 participants used in data analysis, 59 were "close others" and knew each other. The remaining 31 were strangers to the others in each triad and made up the "unknown other" group. Each participant completed 16 actions themselves and observed 16 actions performed by each of the two others. Actions were performed as part of two scenarios, first packing a picnic basket (Hashtroudi et al., 1990) and then packing a suitcase.

Table 1  
Participant Demographics, Including Means and Standard Deviations

	Young adults		Older adults	
	Close other	Unknown other	Close other	Unknown other
Age	20.5 (1.64)	21.13 (2.59)	75.73 (7.29)	76.56 (9.85)
<i>N</i>	29	15	30	16
Gender	3M, 26F	4M, 11F	14M, 16F	4M, 12F
Years of education	13.91 (1.55)	14.97 (2.18)	16.43 (2.61)	14.75 (4.39)
Digit comparison*	76.59 (13.70)	74.67 (16.11)	53.73 (12.26)	51.25 (13.82)
Shipley vocabulary*	32.90 (3.24)	32.67 (3.56)	35.17 (4.68)	37.27 (2.19)

Note. The data are separated by participation status, indicating whether participants completed the study with a close other (the focus of the primary source memory analyses) or unknown others.

\* Significant difference between young and old participants ( $p < .001$ ).

Participants were instructed to work together and took turns placing items such as a tablecloth, utensils, clothing, and personal care items into either the suitcase or picnic basket. Participants sat in a semicircle facing the suitcase or picnic basket and were instructed to refrain from talking during the task. The experimenter placed the items one at a time in the center of the table. Participants were instructed to pick up and then place the item into the picnic basket or suitcase once the name of the item was presented. Item names were identified by the experimenter both verbally and visually, printed on a notecard displayed at the start of each trial. Participants were further instructed not to remove an item once it had been placed in the picnic basket or suitcase. Items were counter-balanced across new and old conditions and presented in one of four predetermined orders. Each trial simultaneously acted as a self, close other, or unknown other action across the members of each triad, therefore it was not necessary to explicitly counterbalance trials across different conditions.

After a 10-min delay, during which time participants completed measures of cognitive ability including speed of processing and vocabulary measures (for results see Table 1), all participants received a surprise self-paced memory test. For each listed item, participants circled which of the three participants (labeled A, B, and C, and designated with placecards in front of each participant throughout the experiment) placed the item in the basket/suitcase or if the item was new. The memory test included the 48 old items, 8 new items appropriate for picnic baskets, and 8 new items appropriate for suitcases. Participants then completed a brief questionnaire and the Inclusion of Others in Self (IOS) scale (Aron et al., 1992). This information was used to determine how closely connected they were to other members of their triad and how long they had known one another. The majority of older adults in the close-other condition participated with a spouse (76.67%) while most younger adults participated with a friend or roommate (86.21%). Although older adults reported knowing their close other significantly longer ( $M = 47.90$  years) than young adult pairs ( $M = 1.90$  years), there were no age differences in the ratings of close others on the IOS scale ( $p > .05$ ). Finally, participants were debriefed about the true intent of the study.

## Results

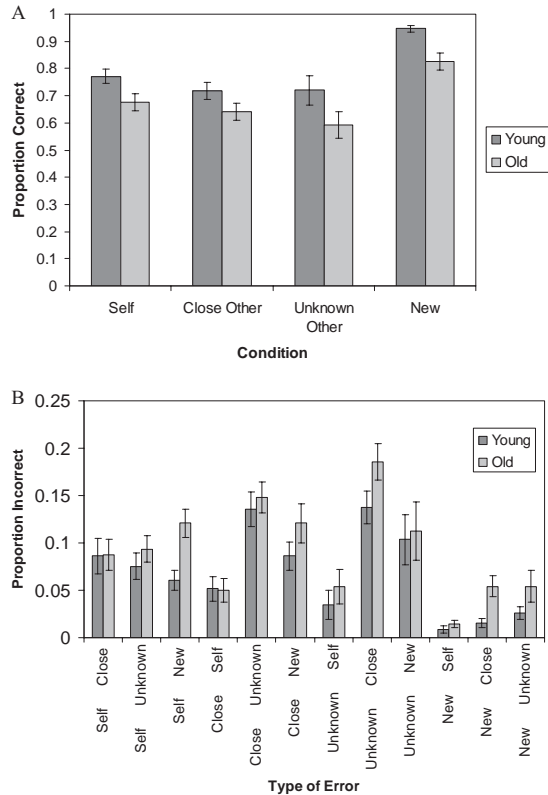
Unless otherwise noted, analyses are based on data from two individuals in each triad who participated with close others (young

sample,  $n = 29$ ; older sample,  $n = 30$ ). These are participants for whom we have data in each of the three conditions (self, close other, unknown other); unknown others did not have a close other in their triad.

The proportions of items for which participants gave correct source attributions (e.g., self items correctly recalled as "self") were analyzed using a  $2 \times 4$  mixed design ANOVA with age as the between-subject variable and condition (self, close other, unknown other, new) as a within-subject factor (see Figure 1A). There was a main effect of age,  $F(1, 57) = 10.26, p < .01, \eta_p^2 = .15$ , reflecting better performance of young ( $M = .79$ ) than older adults ( $M = .68$ ). There was a main effect of condition,  $F(3, 171) = 43.14, p < .001, \eta_p^2 = .43$ . Subsequent analyses indicated better memory for self ( $M = .72$ ) than either close other,  $M = .68$ ;  $F(1, 57) = 4.79, p = .02, \eta_p^2 = .08$ , or unknown other,  $M = .65$ ;  $F(1, 57) = 8.73, p < .01, \eta_p^2 = .13$  items, with no difference between close and unknown other conditions,  $F(1, 57) = 1.63, p > .10, \eta_p^2 = .03$ . Age and condition did not interact,  $F(3, 171) = .53, p = .65, \eta_p^2 = .01$ . We also compared responses to old items only, removing new items from the  $2$  (age)  $\times$   $3$  (self, close other, unknown other) ANOVA, and found the same pattern of results.

As shown in Figure 1B, we also analyzed incorrect source attributions (e.g., self called close other, self called unknown other, close other called self, etc.). Correcting for sphericity using Greenhouse-Geisser, the main effect of age was significant,  $F(1, 57) = 5.19, p = .03, \eta_p^2 = .08$ , with older adults ( $M = .09$ ) committing more errors across conditions than young adults ( $M = .07$ ). The main effect of condition was significant as well,  $F(7.67, 437.37) = 22.46, p < .001, \eta_p^2 = .28$ . Further analysis indicated fewer errors involving self items than other items,  $F(1, 57) = 86.47, p < .001, \eta_p^2 = .60$ . A specific comparison of self items called close other and self items called unknown other indicated that participants were not more likely to call self items close other than with unknown other,  $F(1, 57) = .23, p = .64, \eta_p^2 < .01$ . Furthermore, there was no age  $\times$  condition interaction,  $F(7.67, 437.37) = 1.04, p = .41, \eta_p^2 = .02$ .

We also examined the effects of self and others on the accuracy of action memory. Corrected recognition scores were calculated using hit rates minus false alarm rates to correct for guessing. Scores were calculated for each condition (self, close other, unknown other). An overall false alarm rate was used (i.e., new actions attributed to any of the three actors). Using a  $2$  (age)  $\times$   $3$



**Figure 1.** A, Correct responses (e.g., “self” given a self item) for those participating with a close other. B, Errors (e.g., self items called “close”) for those participating with a close other showing that older adults tended to make more errors than young adults across all conditions and that participants made fewer errors on self items than on close and unknown-other items.

(condition) mixed ANOVA and correcting for sphericity using Greenhouse-Geisser, there was a non-significant ( $p > .10$ ) trend with actions performed by the self ( $M = .81$ ) leading to better memory than actions performed by close ( $M = .79$ ) or unknown others ( $M = .78$ ). There was also no interaction effect,  $p > .10$ , but there was a main effect of age,  $F(1, 57) = 14.16, p < .001, \eta_p^2 = .20$ , with younger adults ( $M = .86$ ) performing better than older adults ( $M = .73$ ).

Because the above analyses were restricted only to those participating with close others, we conducted exploratory analyses to compare the source accuracy of those who participated with close others compared to those who did not participate with close others. Looking at the proportion of correct source attributions, the main effect of participation status was significant,  $F(1, 86) = 6.58, p = .01, \eta_p^2 = .07$  with those participating with close others performing better ( $M = .76$ ) than those participating with unknown others ( $M = .69$ ). There were no significant interactions involving age. We also verified that the samples of participants who had close others vs. those who did not were equated on measures of cognitive ability. There were no differences ( $p$ 's  $> .10$ ) between the two groups in measures of speed or vocabulary for either the younger or older adults.

## Discussion

In the present study we explored the effect of aging on source memory for actions performed by the self and others to understand ways that the self benefits memory. Our findings mirror those from previous studies, indicating that self-related items are more likely to be correctly recalled than other-related items (Symons & Johnson, 1997). Our results extend prior research by showing that source memory for self-performed actions was better than source memory for actions performed both by close or unknown others. One interpretation of this benefit for self-performed actions is that the self is a well-known entity (Greenwald & Banaji, 1989) and allows for deeper, more elaborate encoding, even for older adults. The ability to remember if we performed an action such as taking a medication or merely observed such an action is important (McDaniel et al., 2008) and based on the present study, it appears that the advantage in memory for self over other is spared with age.

Consistent with prior findings that older adults were more likely than younger adults to make source memory errors (Hashtroudi et al., 1990), we found that this was also true when the sources were the self and others in an interactive realistic task context. While older adults experience greater difficulty distinguishing between similar stimuli (Ferguson et al., 1992; Henkel et al., 1998) and lose specificity of memories over time (Henkel et al., 1998), we found that older adults were more likely to lose the specifics of who performed an action regardless of the source of the action. The presence of age differences in source memory, even when the self is invoked (Glisky & Marquine, 2009; Gutches, Kensinger, Yoon et al., 2007), may reflect the pervasive nature of cognitive declines with age (McDaniel et al., 2008). Although the self enhances memory (Kuiper & Rogers, 1979; Rogers et al., 1977; Symons & Johnson, 1997), it does not reduce age differences.

We were further interested in the types of source memory errors made by young and older adults. We initially predicted that there would be an overlap in cognitive representations of the self and close others (Mashek et al., 2003) and difficulty distinguishing between similar stimuli (Ferguson et al., 1992; Henkel et al., 1998) would lead to more source memory errors for actions between highly confusable sources (self and close others) than between sources that are less easily confused (self and unknown others), especially in older adults. However, we did not find more confusion between the self and close others than between the self and unknown others for either young or older adults. In short, despite previous findings that older adults tend to experience greater difficulty determining whether they performed an action themselves or they watched an action performed by another (Cohen & Faulkner, 1989), older adults were not disproportionately more likely than young adults to confuse self and close others compared to unknown others.

While we expected there to be an overlap in the cognitive representation of the self and close others, perhaps there was a greater overlap between the close others and the unknown others simply because they were not the self. It is possible the information in the present study was merely encoded as an action performed by the self or an action not performed by the self (Manzi & Nigro, 2008). Given that it appears as though older adults continue to utilize sensorimotor cues in memory decisions (Hashtroudi, Johnson and Chrosniak; 1989), it may be that younger and older adults in the present study used such sensorimotor cues in a similar

manner. When we asked participants to recall the source of an action as either being the self, a close other, or an unknown other, the availability of additional sensorimotor information (Hashtroudi et al., 1990) may have allowed them to better identify those actions they performed themselves from those actions performed by others. However, the additional sensory cues needed to distinguish which of two others was the source were not well encoded in younger or older adults.

Although the primary analyses were conducted on the subset of participants who participated with close others and thus had data in all three conditions, we completed an exploratory analysis comparing these participants to those who participated only with strangers. Given that there were no apparent differences in cognitive ability between those in the close-other group and those in the unknown-other group, it appears as though participation with someone known may facilitate memory. It may be that the collaborative nature of the task (Duff, Hengst, Tranel, & Cohen, 2006) and the social support of having close others present during testing (Stevens, Kaplan, Ponds, & Jolles, 2001) decreased anxiety associated with study participation and allowed participants to better focus on the task at hand (Beaudreau & O'Hara, 2009). However, this finding and explanation are tentative because participants were not randomly assigned to participate with close others or with unknown others.

In conclusion, using a naturalistic setting (packing a picnic basket/suitcase) we replicated previous findings that source memory is more accurate for self-performed actions than for other-performed actions. The findings were also consistent with those of previous studies indicating that although older adults show a self-reference effect, it is not greater than the self-reference effect shown by young adults and thus does not reduce the gap in memory performance between young and old. Furthermore, despite previous findings indicating that close others are conceptually similar to the self and provide a boost similar to the self in item memory (Aron et al., 1991), the present study found that self-performed actions were better recalled than close-other performed actions for both young and old. Therefore, it appears as though young and older adults are both using the additional cues provided by having performed an action, for example, sensorimotor information.

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