

AGING AND PROSPECTIVE MEMORY:
THE ROLE OF CUE FAMILIARITY

by

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ABSTRACT

Older adults often show age-related declines in retrospective and prospective memory (PM). However, when memory is tested in a way that allows for reliance on familiarity, age-related declines are eliminated. Recent research has indicated that on a number of tests of PM, no age-related memory deficits were found. It is hypothesized that such tests allow older adults to rely on familiarity to detect the PM cue. The current study uses a PM task on which reliance on familiarity will lead to a measurable error that can be distinguished from a general PM deficit. It is hypothesized that older adults will make more familiarity-based errors than younger adults while performing worse overall

INTRODUCTION

Remembering to stop at the grocery store on your way home from work, remembering to tell a friend about an upcoming event when you see him or her, and keeping in mind that you have to take your medications after dinner are all examples of *prospective memory* (PM). In general, prospective memory refers to memory for a future action. This can be contrasted with *retrospective memory* (RM), which refers to the ability to recall events that have already occurred, such as what you had for dinner the night before or the name of your second grade teacher. Both types of memory are understood to decline with age. However, although a relatively large amount of research has examined effects of aging on RM, considerably less emphasis has been placed on PM and aging.

Prospective Memory and Aging

In general, findings on PM suggest that older adults perform worse than younger adults. However, as mentioned previously, these differences have been studied to a lesser extent than age deficits in RM. One main distinction between RM and PM is that PM requires an individual to remember to do something in the future. The intended action might need to be performed after a particular time interval, such as taking a pill every eight hours. This type of PM is referred to as *time-based PM*. A second type of PM is *event-based PM*, which refers to performing an intended action in the presence of an external cue. An example of event-based PM would be if a spouse said “When you see Ted tomorrow, remember to tell him that dinner is going to be at six instead of seven”.

When the event of seeing Ted occurs, the PM action is supposed to be initiated. Of particular interest to the current research is the latter type of PM.

Performance on demanding cognitive tasks, including PM tasks, is often improved to some extent when environmental support is provided (Craik, 1982). For example, when participants are presented with semantically related word pairs followed by a cued-recall test, memory performance is higher than when participants are presented with unrelated words (Naveh-Benjamin, Craik, Guez, & Krueger, 2005). Craik suggested that while older adults might have more limited cognitive capacity, adding elements of environmental support may elevate older adults' performance by decreasing the required demands. Support for this prediction come from RM age differences. Although younger adults outperform older adults on some RM tasks, indicated by higher proportions of study items recalled during testing (e.g., Craik & McDowd, 1987; Schonfield & Robertson, 1966), age differences are ameliorated when memory is tested using a recognition procedure.

Schonfield and Robertson (1966) presented both younger and older adults with two lists of 24 words. Memory for presented items was tested using recall for one list and recognition for the other. In recall, participants were instructed to write down as many items from the list as they could remember. Results indicated that although older adults were significantly outperformed by younger adults on the recall task, no significant age differences were found on the recognition task.

In a similar study, Craik and McDowd (1987) tested memory for items presented while participants were performing a secondary task. The addition of the secondary task

disrupted older adults' recall performance significantly more than younger adults' performance, but recognition scores did not significantly differ between the age groups. Taken together, these findings suggest that the processes necessary for recognition tasks are less susceptible to age-related declines than are those required for recall. Further, these findings are consistent with Craik's theory of environmental support. When cognitive demands are high (recall task) older adults do not perform as well as younger adults. However, when the cognitive demands are lessened by environmental support (recognition task), age differences are no longer evident.

In terms of PM memory, the degree of environmental support present when the intended action is to be performed is considerably decreased. Although for RM the environment cues initiation the remembering process, PM requires self-initiation of the intended action. *Self-initiation* refers to the individual's process of initiating remembering in the absence of an external agent (Craik, 1986). This requirement is unique to PM because in RM a memory test is provided which acts to cue the process of remembering. Following older adult's relative difficulties on tasks with little environmental support, Craik (1986) predicted that older adults would show deficits in self-initiation and would consequently have a harder time on PM tasks. Not only must individuals remember the action they are to perform, they must also devote attention to performing the intended action at the appropriate time, free of an external cue.

In line with the self-initiation theory, some research has suggested that older adults struggle with PM tasks to a larger extent than younger adults (Cherry & LeCompte, 1999; Einstein, McDaniel, Richardson, Guynn, & Confer, 1995; Maylor,

1993; Rendell, Forbes, & Einstein, 2007; West & Craik, 2001). Cherry and LeCompte (1999) asked both younger and older participants to study word lists that would later be tested for recognition. While the words were presented, participants were instructed to respond by hitting the F9 key if a specific target word appeared as one of the words to be studied. Thus, participants were responsible for self-initiating memory for the appropriate action while distracted by the task of studying the presented words. In line with Craik's prediction, younger adults remembered to perform the PM action significantly more often than older adults. Similarly, West and Craik (2001) instructed older and younger adults to perform either immediate or delayed actions to pre-specified cues during an ongoing color classification task. This task also required participants to perform intended actions in the face of ongoing task distraction without an external prompt. Younger adults performed more instructed actions than older adults. Further support comes from a study by Einstein et al. (1997), who found that older adults showed PM task deficits compared to younger adults if they were required to detect PM cues within two simultaneous ongoing tasks: word rating and a dichotic listening task. Taken together, these studies suggest that older adults are outperformed by younger adults on tasks on which an external cue is not provided. This evidence suggests that older adults may find the process of self-initiation more difficult than younger adults.

However, there is also contrary evidence that older adults do not show age-related deficits in PM tasks (Einstein et al., 1997; Rendell et al., 2007). Rendell et al. (2007) found that by making the PM cue more focal to the ongoing task, or increasing the duration of item presentation, older adults performed at the same level as younger adults.

Einstein et al. (1997), who found age deficits with two simultaneous ongoing task demands, did not find significant differences in PM performance with a single ongoing task of word rating. These results indicate that there are circumstances in which the ongoing task demands are alleviated and older adults do not show deficits in the self-initiation process of PM.

Further exploring the requirements of self-initiation, Einstein et al. (1995) analyzed age differences in time-based as well as event-based PM tasks. In line with Craik's predictions, authors suggested that older adults should be especially impacted by task demands of time-based PM compared to event-based PM because no cue is present at the time of appropriate responding. Older and younger participants were given either event-based or time-based instructions prior to performing a general knowledge ongoing task. In the current study, the event-based instruction was to press the F8 key when presented with a question about presidents, while the time-based instruction was to press the F8 key every five minutes. Consistent with their predictions, there were no age differences in event-based performance, but older adults were outperformed by younger adults on the time-based task. These results led Einstein et al. to conclude that self-initiated retrieval processes, consistent with RM literature, might be an important component in explaining age-related memory deficits. Similarly, Maylor (1993) suggested that, rather than an overall age-related decline in PM relative to RM, it is likely the task's specific instructions require either a high or low demand for self-initiation. Taken together, I suggest that while older adults tend to perform as well as younger adults when self-initiation demands are reduced through environmental support, age

deficits may become evident when external cues are absent. Further, I suggest that the prevalence of external cues in most PM tasks to date may also allow participants to rely on the familiarity of cues for successful performance.

Familiarity

When discussing memory judgments, *familiarity* describes an increased ease of processing when presented with a stimulus (e.g., Jacoby, 1991; Yonelinas, 2002). This processing difference is judged relative to other items presented in the same set or situation. In real-life scenarios, familiarity in isolation (without remembering recollective details) can refer to instances such as having a feeling you have met someone before but not being able to remember why. In an early model of recognition judgments, Mandler (1980) described two processes that occur when determining whether an item or event had been encountered previously. The first process is an initial sense of knowing, which can be likened to the current definition of familiarity. This can often be context-free, particularly until the second process is initiated. The second process is a search process whereby an individual scans memory for contexts, attributes, or details that may eventually result in recovering the source of the sense of knowing. Many models have since emerged in attempt to further explain the specifics of these two processes (see Yonelinas, 2002 for a complete review).

Jacoby (1991) introduced a dual-process model similar to Mandler's (1980). Jacoby outlined two main processes that describe memory judgments: familiarity and recollection. While familiarity has been discussed above, *recollection* was the term used

to describe the second process of searching for relevant details. However, Jacoby attributed specific properties to the two processes. According to Jacoby, familiarity is an automatic process that occurs without effort and does not require cognitive resources. In contrast, recollection is described as a controlled process that requires processing capacity. As such, recollection may be disrupted when other tasks are occurring at the same time. In general, the notion of familiarity as automatic and recollection as controlled is widely consistent with other models (e.g., Mandler, 1980; Yonelinas, 2002). A second, and more controversial, assumption that was suggested by Jacoby is that the two processes are independent of one another. Evidence to support the independence notion comes from *process-dissociation procedures* (e.g., Jacoby, 1991; Jacoby, 1999; Jennings & Jacoby, 1997).

The process-dissociation procedure (PDP) uses tasks in a manner that allows for measurement of each process in isolation, instead of the typical procedure in which the influences of each process cannot be separated. For example, Jacoby (1991, Experiment 3) presented participants with either words in their normal form or in anagram form to be solved. In a second study phase, participants heard a list of words. During a final recognition test, participants were presented with items one at a time under either *inclusion* or *exclusion* conditions. In the *inclusion* condition, participants were instructed to respond *old* if items had been presented in either phase during study. In the *exclusion condition*, participants were instructed to respond *old* only if the presented item had been heard in the study phase. They were instructed to respond *new* not only to newly presented items, but also to all items from the first study phase. Contrary to the inclusion

condition, familiarity alone would not be sufficient for a correct response under exclusion conditions. If the item seemed familiar, but memory for having read the word or solved the word as an anagram was not recovered, the participant might erroneously respond *old*. However, if recollection were successful, the participant would correctly respond *new*. By using two different recognition conditions, Jacoby was able to separately estimate the contributions of recollection and familiarity. More specifically, both recollection and familiarity led to a correct response in the inclusion condition, but recollection was necessary for a correct response in the exclusion condition. Incorrect *old* responses items from the first study phase in the exclusion task condition suggested that the item seemed familiar, but recollection was not used to override the original familiarity.

Using a similar PDP, Jennings and Jacoby (1997) presented older and younger adults with a list of words for study. After study, participants were presented with a continuous recognition task in which newly presented words were repeated after varying lag intervals. For example, an item might be presented with one intervening item (short lag) while another item was repeated after 24 intervening items (long lag). Participants in the inclusion condition were instructed to respond *old* to all previously presented items (whether from the first list or in the recognition phase), but participants in the exclusion condition were instructed to respond *old* only if the item was presented in the original study list. Therefore, when a repeated new word was presented, recollection for the item's presentation was necessary to avoid making errors of responding based on familiarity alone. Although older and younger adults' performance did not significantly

differ on the inclusion task (up to a lag of 12), age deficits were apparent on the exclusion task. Jennings and Jacoby concluded that although familiarity might be intact for older adults, their ability to override their automatic responses by using recollective information is below that of younger adults.

In another study, Jacoby (1999) presented younger and older adults with items visually in a first study phase and auditorally in a second study phase. Importantly, items in the first study phase were presented either one, two, or three times. The same inclusion and exclusion conditions were assigned during recognition testing. Additionally, participants were assigned to varying deadline conditions which manipulated the amount of time they were allowed to make a response during the testing phase. Results indicated that repetition of items increased familiarity for both younger and older adults. Items that were repeated were more likely to be recognized in the inclusion task. The effects of repetition on exclusion performance, however, differed according to age group. Regardless of deadline condition, older adults were subject to *ironic effects of repetition*, in which repetition of items led to more errors (more first-phase study items were called *old*). In contrast, when younger adults were given a relatively longer deadline to respond, repetition of items helped them to make a correct judgment about the item in the exclusion task. However, when rushed for response time, younger adults were subject to ironic effects of repetition, in which repetition of items led to more errors (more first-phase study items were called *old*). These results suggest that recollection is a more controlled process that requires more time and resources. If time and resources are available, results showed that younger adults were successful at using

recollection to respond correctly. This finding has led researchers to suggest that although familiarity processes of memory remain intact, recollection abilities decline with age. This suggestion is also consistent with age differences in recall and recognition mentioned previously.

Although dual process models and the PDP procedure have provided useful research in understanding memory processes, they have also evoked a great deal of criticism (e.g., Dodson & Johnson, 1996; Gruppuso, Lindsay, & Kelly, 1997; Johnson, Hashtroudi, & Lindsay, 1993). Common issues with the PDP paradigm typically revolve around whether recollection and familiarity are independent processes. Although the PDP does show independence, it is argued that this independence might be an artifact of the specific task demands and instructions more than actually indicating that they are distinct processes (Dodson & Johnson, 1996; Gruppuso et al., 1997). In contrast, theories based on source monitoring (Johnson et al., 1993) focus less on the distinct processes and more on the types of details involved in the recollection process. Such theories would explain search processes in terms of the immediate availability of gist-based information, and a more controlled search for item specific details that would be necessary to successfully perform a PDP task (see Brainerd & Reyna, 1990, for more details on gist vs. verbatim traces).

For my purposes, it is not critical to determine whether the processes of familiarity and recollection are independent. Instead, what is important is that previous RM literature indicates that the process of familiarity appears to be relatively intact in older adults, particularly when compared to more controlled processes. This finding

particularly evident in PDP or other tasks on which familiarity without recollection can lead to errors on specific tasks (Gallo, Bell, Beier, & Schacter, 2006). The current study suggests that the same reliance on familiarity that enabled older adults to have success on RM tasks might be responsible for performances on PM tasks in which older adults have also shown success.

Current Study

Perhaps on most PM tasks participants might be able to rely on familiarity to *detect* the PM cue. When the PM cue is presented in the ongoing task, it may seem familiar relative to other items due to its recent presentation during instructions. When the item is displayed and identified as familiar, it is clear to participants what action to perform. Recall from RM findings that when recognition tests are used to assess memory, age deficits are absent when sufficient cognitive attention can be allocated to encoding memory items during study. Older adults are just as efficient as younger adults when they can rely on familiarity of the item (e.g., a recognition task).

The current study introduces a design on which familiarity alone is insufficient to generate the correct response. To my knowledge, this is the first study that examines the role, and possible reliance on, the process of familiarity in a PM task. The design for the experiment was derived in part from studies conducted on the *false fame effect* (Dywan & Jacoby, 1990; Jacoby, Kelly, Brown & Jesechko, 1989). Originally demonstrated by Jacoby et al. (1989), the false fame effect refers to the tendency to mistake previously read nonfamous names as famous after a time delay. In the original study, undergraduate

students were presented with lists of 120 nonfamous names and told to remember them for a later test. They were informed that all presented names were nonfamous.

Participants were then asked to indicate whether names on a subsequent list consisting of new nonfamous names, previously presented nonfamous names, and famous names were famous or nonfamous. This latter task was administered either immediately after reading the nonfamous name list, or after a 24 hours delay. In both conditions, participants were warned that names on the latter list might be from the previously presented list.

Participants in the 24-hour time delay condition were significantly more likely to incorrectly call previously read nonfamous names famous than those who were tested immediately. These results suggest that over time, the ability to retain the source of the information (the previously presented list) is reduced. Consequently, the name seems familiar, and instead of recalling that the name was presented on the list, participants misattribute such familiarity to fame. In a follow-up study conducted by Dywan and Jacoby (1990), older and younger adults were tested for the false fame effect. They found that even in the immediate condition, older adults were susceptible to false fame errors while younger adults were not. Although the results suggest that both younger and older adults make errors in source memory, older adults may be more susceptible. This finding is in further support of the aforementioned literature in suggesting younger adults more effectively use detailed context information about memories to override judgments based on familiarity alone.

The current study seeks to investigate performance of both younger and older adults by combining the methodological techniques used in both past PM tasks and false

fame tasks. In doing so, researchers are able to explore the role of familiarity in a PM task. Referring back to the aforementioned example about informing Ted about the change in dinner plans, when going through one's daily routine, it is not likely that Ted is the only familiar person one will run into tomorrow. This is arguably different from many PM tasks in which the PM cues presented during instruction seem more familiar than other items presented in the ongoing task. Further, in past PM research, the familiarity of the item may have acted as a cue to prompt the instructed PM response. It is unlikely that this same reliance on familiarity exists in the real world. Ted is likely going to be one of many familiar faces throughout the day, and familiarity alone is not thought to be sufficient to cue the desired action. By combining standard PM tasks with the false fame design, the current study attempts to decrease the degree to which familiarity alone cues the correct action.

The current study involved an ongoing task of making famous versus nonfamous judgments for a list of names. Prior to the ongoing task, participants were presented with one nonfamous name as a PM cue (e.g., Joe Jones). They were instructed to respond to the PM cue by pressing a special memory key if *Joe Jones* was presented during the ongoing task. They were instructed to perform this action instead of acting in accordance with the ongoing task by making a fame judgment. As such, three possible responses can be made to the nonfamous PM cue. The first option is that the cue is recognized and the participant correctly responds by pressing the special memory key. The second possibility is that the participant recognizes the nonfamous PM cue name, but incorrectly attributes the familiarity to fame and calls the cue *famous*. The third response possibility

is that the participant misses the PM cue altogether and responds by calling the name *nonfamous*.

The current study also manipulated the amount of time participants were allotted to make a response. Recall from the previous discussion that familiarity is thought to occur immediately and automatically, whereas recollection or detailed item memory is thought to involve controlled processes requiring more time. Similar to the methodology used by Jacoby (1999), some participants were required to respond quickly, making controlled recollective processes less likely to contribute to responses. By having two deadline conditions for both younger and older adults, I were able to examine whether responses might differ with the addition of controlled processes. Also similar to the design of Jacoby (1999), older and younger adults were given different deadline conditions allowing older adults more time to respond to account for any general slowing that accompanies healthy aging (Salthouse, 1996). As such, participants were assigned to one of three deadline conditions: short, medium, or long. Younger adults were assigned to either the short or medium deadline conditions. Older adults were assigned to either the medium or long deadline conditions.

I predicted that when participants were provided with sufficient time to respond (older adults in the long deadline; younger adults in the medium deadline), PM task accuracy would be relatively high. This result would be in line with Rendell et al. (2007), who found that when older adults were only given one PM cue focal to the ongoing task, their performance was equal to that of younger adults, with both groups performing well. I also predicted that both age groups would make significantly more

errors when assigned to a speeded deadline condition (short for younger adults; medium for older adults). Most critical to the current study was not the predicted number of overall errors, but the type of errors the different age groups were predicted to make. If participants miss the nonfamous PM cue altogether, it could be inferred that the cue was either not effectively encoded or it was simply not recognized when it appeared in the ongoing task. If participants mistakenly call a nonfamous PM cue *famous* instead of correctly pressing the special memory key, such a response would suggest that the nonfamous PM cue seemed familiar (due to presentation during the instruction screen), but the familiarity was mistaken for fame instead of correctly attributed to its original source. Recall from the previous literature (Jacoby, 1999) that when given a speeded deadline, participants tended to respond based on familiarity for RM tasks. This finding has since been replicated in studies demonstrating that younger adults under a speeded deadline were unable to use recollection to override familiarity-based responding (Light, Patterson, Chung, & Healy, 2004; Benjamin, 2001). Given these findings, I predicted that both age groups would demonstrate more familiarity-based errors in the speeded deadline conditions. Under the time pressure (shorter deadline), it is possible that participants would not have time to engage in the controlled process of remembering that the name was familiar because of the instruction screen. Additionally, these findings suggest that older adults are likely to show more familiarity-based errors than younger adults regardless of the deadline. Further support for the current predictions was derived from the finding that older adults demonstrated those tendencies more often than younger adults even without a short deadline (Jacoby, 1999; Benjamin, 2001). This prediction is

further supported by the finding that older adults show a false-fame effect even when tested immediately after reading a nonfamous name list (Dywan & Jacoby, 1990).

An alternative hypothesis for the current study might predict that older and younger adults would not differ significantly in the type of error made on the current task. This finding would support the notion that older adults are just as effective as younger adults at self-initiating the PM cue during the ongoing task. Further, this finding would suggest that older adults were not likely relying more heavily on familiarity than young adults in previous PM tasks that found no age differences.

EXPERIMENT

MethodParticipants

Younger adults were recruited from the subject pool at Montana State University. All younger adults participated for course credit. Older adults were recruited from newspaper articles and from local senior centers. Older adults were paid ten dollars for their participation. There were a total of 60 younger adults with a mean age of 19.8 years, a mean Shipley vocabulary score of 29.4 and mean education level of 13.1 years. A total of 60 older adult participants, with a mean age of 74.3 years, are represented in the reported analysis. Mean Mini Mental State Exams (MMSE) scores for older adults were 28.7, mean Shipley vocabulary scores were 35.9, and a mean education level of 16.5 years. Data was collected between June of 2008 and January of 2009. A total of six younger adults and 16 older adults were removed from analysis because they failed to respond to at least fifty percent of the presented items.

Materials

The presentation of stimuli was controlled by E-Prime. Stimuli were presented on 17-inch Dell monitors in 18-point Courier New font. The nonfamous names and practice trial names were identical for older and younger adults. These names were taken from a Bangor, Maine phone book. The same nonfamous names were used as critical PM cues for older and younger adults to control for item effects. Because different names are considered famous for older and younger adults, the famous names used in the current

experiment were normed in an attempt to equate level of fame. Thirty older adult community members of Belgrade and Manhattan, Montana, as well as 42 undergraduates at Montana State University were given lists of 270 famous names (authors, actors, athletes, politicians, etc., taken from the internet) and asked to rate the familiarity of the name on a 7-point scale. A score of one indicated that the individual had never seen the name before, and a score of seven indicated that the name was very familiar. None of the same individuals who filled out the fame questionnaire also participated in the current study. A mean rating of familiarity was then calculated for each name. The mean rating of 2.75 was chosen as the median for each age group (with ratings ranging from 2.08 to 3.86 and 1.85 to 4.84 for younger and older adults, respectively). This was done to keep the degree of familiarity constant between older and younger adults to assure an accurate comparison. However, although measures were taken to equate familiarity for older and younger adults in a study by Dywan and Jacoby (1990), older adults still identified fewer names as famous when compared to younger adults. To reduce potential bias, each target name was presented as a critical PM cue for half of the participants and a nonfamous control item for the other half of the participants.

Following a practice trial, participants were presented with 10 blocks during which they were presented with a target name to remember, and 5 *no-load* blocks where they were only required to make famous/nonfamous judgments. By having no-load blocks, I was able to examine the influence that a to-be-remembered item had on ongoing task reaction time, and understand whether participants could potentially rehearse the PM during the ongoing task, causing interference. Each target name block

contained one critical PM cue, one nonfamous control name, 9 other nonfamous names and 10 famous names. For the no-load trials, nine nonfamous and ten famous names were presented.

Procedure

Upon arriving to the experiment, participants were given a brief overview of the task to follow. They were then asked to sign a consent form and fill out demographic information. Then participants were seated at a computer and an experimenter gave them specific task instructions. Participants were instructed to undergo two tasks simultaneously; an ongoing famous/nonfamous judgment task, and a prospective memory (PM) task.

During the *ongoing task*, famous and nonfamous names were presented one at a time. While the name was presented, participants were instructed to indicate whether the name was famous or nonfamous by pressing the corresponding key on the keyboard. There was a key labeled “F” for famous and “NF” for nonfamous (S and K, respectively). After a response to the presented name was made, the next word appeared. On the five no-load blocks, the ongoing fame-judgment task was the participant’s only focus. During the 10 target blocks, the participants were instructed to perform the PM task as well as the fame judgment ongoing task.

The *PM task* took place simultaneously with the ongoing task. Prior to the presentation of the ongoing task names, participants were presented with one nonfamous name as a PM cue. Participants were instructed to carefully read the PM cue name. They were told that during the ongoing task, they were to respond to names by pressing either

the F for famous, or N for nonfamous keys. However, if the PM cue name was presented during the ongoing task, they were to instead instructed to press the memory key (the N key labeled “M” for memory). Therefore, participants instructed to not make a fame judgment for that item. Each PM cue was randomly presented once during the session. At the start of a new session, a new PM cue instruction screen was presented. Prior to the start of the first block, participants were given a practice session to familiarize themselves with the task and ask any questions that arose.

In total there were three response deadline conditions (short, medium, long). This manipulation was made between subjects such that participants were given the same deadline throughout the entire experiment. After each deadline, participants’ responses were not recorded and the name on the screen disappeared. In the *short deadline* condition, participants were given 750 ms to respond to each presented name. For those participants in the *medium deadline* condition, names were presented and responses were recorded for 1275 ms. In the *long deadline* condition, participants were given 3000 ms to respond. Younger adults were randomly assigned to either the short or medium deadline conditions, and older adults were randomly assigned to either the medium or long deadline conditions.

For each block, participants were presented with the nonfamous target name instruction screen to study for 6 seconds. Following the instructions screen, a blank screen was displayed for 300 ms, followed by fixation crosses for 300 ms. This was followed by a blank screen for 300 ms, a warning tone for 150 ms, and then a famous filler, nonfamous filler, PM cue, or nonfamous control item. Item presentation was

random throughout the experiment in all conditions. The item was presented for 750, 1275, or 3000ms, depending on the deadline condition. Once a response was made or the deadline was met, 1000 ms intervened before the next item was presented. Each block contained 20 to 22 names (no-load and PM blocks, respectively). All names were presented randomly. Additionally, lists were counterbalanced such that each filler item had an equal chance of being presented during a PM block and a no-load block. Once all of the names in the block were presented, a new instruction screen was presented. Finally, participants were thanked and debriefed.

Results

Both older and younger adults showed a significantly higher timeout rate in their respective speeded condition. Older adults in the long deadline condition failed to respond before the deadline 3.6 % of the time. Older adults in the medium deadline condition failed to respond 18.3 % of the time. The same pattern emerged for younger adults, who timed out on 3.9 % of trials in the medium deadline and 17.4 % of the trials in the short deadline condition. Further analyses focus on only the trials in which a response was made prior to the deadline. The percentages of each type of response for each condition are displayed in Table 1.

Table 1. Percentage of target, famous and nonfamous responses as a function of age group and response deadline.

Group	Response Type	Item Type			
		Critical	Control	Nonfamous	Famous
Younger 1275ms (N=30)					
	Target	74.11	0.01	0.00	0.00
	Famous	12.22	20.3	20.25	38.57
	Nonfamous	13.67	78.37	79.52	61.18
Younger 750ms (N=30)					
	Target	64.79	0.01	0.00	0.00
	Famous	13.50	21.35	21.55	39.16
	Nonfamous	21.71	77.37	77.37	60.4
Older 1275ms (N=30)					
	Target	45.3	0.01	0.00	0.00
	Famous	24.84	16.28	16.9	55.6
	Nonfamous	29.85	83.02	82.75	43.8
Older 3000ms (N=30)					
	Target	67.37	0.00	0.01	0.00
	Famous	14.44	18.37	17.45	58.78
	Nonfamous	18.19	81.3	82.29	40.78

Target Accuracy

An accurate target response in the current study occurred if a participant successfully performed the PM task (pressing the “M” key) when the PM cue was presented. The mean target accuracy for each group is displayed in Figure 1.

The main effect of group was significant [$F(3, 115) = 8.76, MSE = .45$]. Paired comparisons follow-up tests indicated that this effect was driven by the low accuracy of the older medium deadline condition ($M = .45$) when compared to older long deadline ($M = .67$), younger medium deadline ($M = .74$), and younger short deadline ($M = .65$). No other differences were significant. Importantly, these findings replicate previous literature (Jennings & Jacoby, 1997; Rendell et al., 2007) indicating that older adults, when given more time to complete a task, do not perform significantly lower than

younger adults. Additionally, although the speeded deadline manipulation lowered the accuracy of both age groups, it only reached significance for older adults.

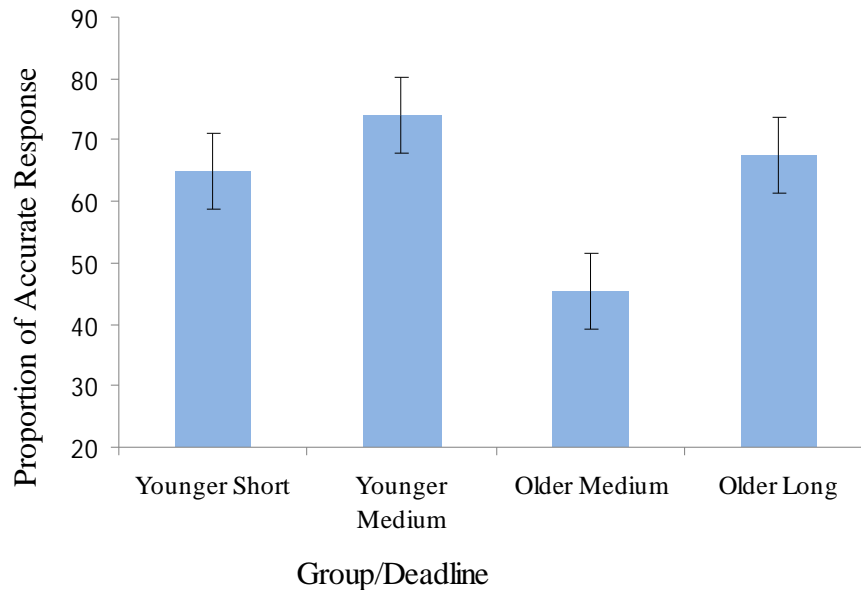


Figure 1. Mean proportion of accurate target responses for younger and older adults as a function of response deadline condition. (Errors bars indicate standard error)

Target and Control Comparisons

Of critical interest to the current study were the types of errors made by younger and older adults. As mentioned previously, each PM cue was presented to the other half of participants as a nonfamous control name during the ongoing task to control for item effects. This allowed for comparison in responses to the same name when it was a PM cue or critical item. First, I analyzed the proportion of famous responses made to the PM cue and control names as they were presented in the different groups. A mixed general linear model was conducted to compare the critical difference of famous responses to PM

cues and control items across the four groups. The results for *famous* responses to PM cue and control names are displayed in Figure 2.

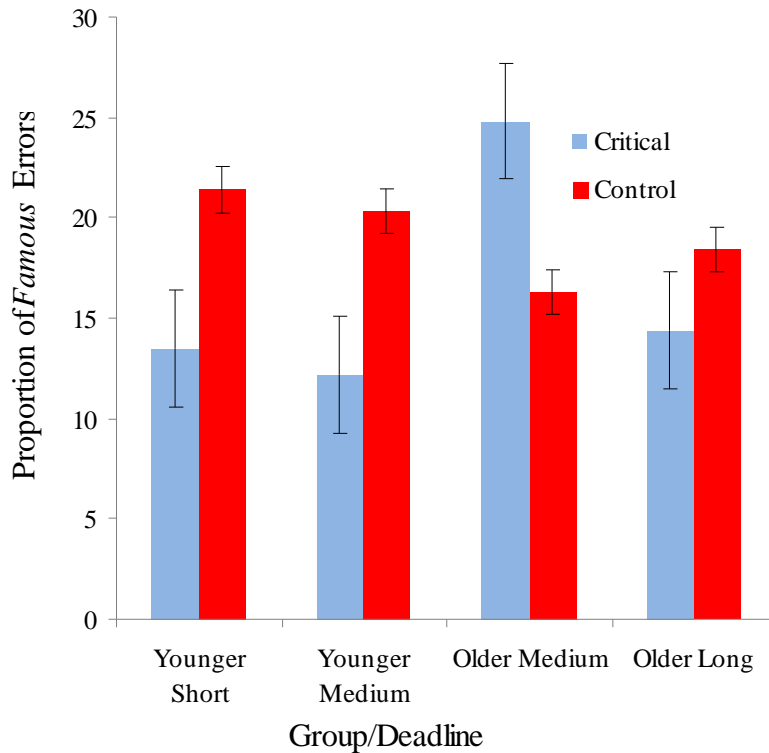


Figure 2. Mean proportion of famous responses for younger and older adults as a function of response deadline condition for target items presented as nonfamous PM cues (critical), and target items presented during the ongoing task (control). (Error bars indicate standard error)

Results showed a significant condition by group interaction [$F(3, 115) = 4.69$, $MSE = .09$], indicating that older and younger adults demonstrated different patterns of responding *famous* to the same name presented in different conditions. For younger adults in the medium deadline, participants made $8.1 \pm 7\%$ fewer *famous* responses to PM cues than control items (whereby in $X \pm Y$, X refers to mean difference and Y refers to the 95% confidence interval). This pattern was similar for younger adults in the fast

deadline condition, who responded famous to the PM cues $7.9 \pm .7\%$ more than to control items. These findings indicate that younger adults, even when pressed for time, did not show a tendency to mistakenly call the PM cue famous when they did make errors on the task. In fact, their responses were in the opposite direction indicating that even under a fast deadline their recollective abilities remained intact.

Older adults in the medium deadline condition showed the reverse pattern. They responded *famous* to the target name $8.5 \pm 7\%$ more when it was presented as a PM cue compared to when it was presented as a control item. Older adults in the long deadline condition did not demonstrate significantly different responding when responding to the two types of items. These results suggest that older adults' recollective abilities showed deficits in the long deadline, and this effect was exaggerated under speeded deadline conditions showing the ironic false fame effect.

A separate repeated-measures ANOVA was conducted to analyze the differences in *nonfamous* responses to PM cues and control items. No main effects of group or significant interactions were revealed, but a main effect of response was found [$F(3, 115) = 643.74, MSE = 20.8$]. While all groups were significantly more likely to respond *nonfamous* to control items, suggesting they were following task instructions, older adults in the medium deadline condition made the error of calling the PM cue *nonfamous* $14.7 \pm 6\%$ more than younger adults in the medium deadline condition. This result indicates that older adults missed the PM cue more often than younger adults when they were given the same response deadline. No other comparisons were significant, which

suggests that older adults, when allowed more time, were less susceptible to missing the PM cue.

Famous Versus Nonfamous Ongoing Task Responses

Although extensive measures were taken to equate famous name lists for older and younger adults, a repeated-measures ANOVA indicated a significant main effect of group [$F(3, 118) = 29.8, MSE = 1.17$]. Older adults correctly recognized more names from the famous list ($M = .56$ for medium deadline, $M = .59$ for long deadline) than did younger adults ($M = .38$ for the medium deadline, $M = .39$ in the short deadline condition). This result indicates that although both older and younger adults were more likely to call an item *nonfamous* than *famous*, younger adults were less likely to recognize famous names. The presence of this difference confirms the need for nonfamous control names in the current study to control for overall differences in *famous/nonfamous* responding across groups.

Increase in Errors Due to Deadline

However, for the current study to explain the past data in terms of a reliance on familiarity, older adults' errors in calling the PM cue *famous* should be what was driving the overall accuracy differences. In other words, if my predictions are correct, older and younger adults should not differ in their amount of *nonfamous* errors, suggesting that participants missed the cue altogether. Instead, older adults may have performed worse than younger adults due to incorrectly responding *famous* to the PM target name. Figure 3 displays the mean differences in accuracy for each group's longer deadline to shorter

deadline condition. Given that both *famous* and *nonfamous* responses to the PM cues were errors, Figure 3 also depicts the difference in each type of error as deadlines were speeded. All responses are reported in terms of a difference in responding to the PM cue and control items to control for overall response biases. Older and younger adults showed a similar increase in *nonfamous* responses to the control item as the deadline decreased, suggesting that both age groups missed the PM cue during the ongoing task more in the speeded versus non-speeded conditions. However, this pattern of results did not reach significance for either group. More importantly, although younger adults showed almost no cost in errors of responding *famous* to the PM target name, older adults showed a significant 12 % increase when their deadline was speeded, $p < .05$. It is evident from Figure 3 that, in line with my hypothesis, it was *famous* response errors that drove the differences in overall accuracy costs. This data supports the notion that older adults rely more on familiarity of the PM target during the ongoing task to trigger the appropriate PM action.

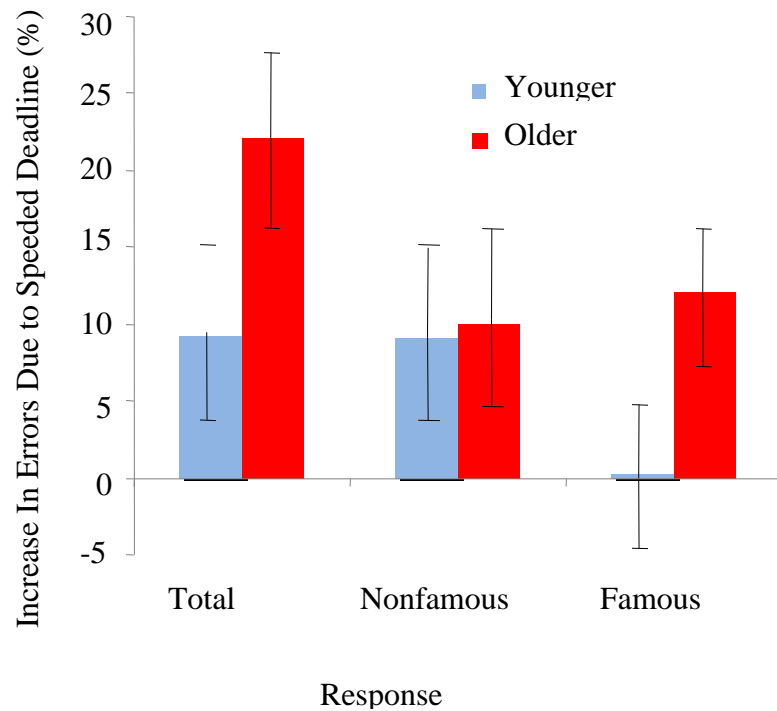


Figure 3. Mean percent of change in responses from when groups were placed under a speeded deadline condition (medium for older adults, short for younger adults). Reported proportions are the differences in responding to critical versus control items in the non-speeded deadline condition minus the differences in responding to critical versus control items in the speeded deadline condition. (Error bars indicate standard error)

Reaction Time Results

As response deadlines varied between groups, it was unnecessary to run between-group analyses on reaction time data. However, a repeated-measures ANOVA was conducted to test for within subject differences in fame judgment reaction times on trials in which participants had a PM cue to remember (load trials) and trials in which participants did not have PM cue to remember (no-load trials). If participants were slower to respond to the fame judgment task during trials in which there was a PM cue to remember compared to no-load trials, this would suggest that participants were

monitoring for the PM cue. If no reaction time cost was evident, participants may have instead been focusing on the ongoing task and relying on automatic processes to detect the PM cue when it was presented. Results indicated that the overall differences in response times between load and no load conditions reached significance [$F(3, 116) = 17.19, MSE = 1,564.40$]. Separate analyses were run for each deadline. Results indicated that while load compared to no load trials did not differ significantly for participants in the speeded deadline conditions [$F(1, 58) = .58, MSE = 299.39$], this difference was significant for participants in the longer deadline conditions [$F(1, 58) = 17.63, MSE = 46,070.52$]. This suggests that when participants were not in a speeded deadline condition, they were faster to make fame judgment responses in the no-load trials compared to when they had a PM cue to keep in memory. This result suggests that participants may have been rehearsing the cue during the ongoing trial. When there was no cue to remember, they were able to respond more quickly.

DISCUSSION

I predicted, in line with past literature (Rendell et al., 2007) that younger adults in the medium deadline condition, and older adults in the long deadline condition (both non-speeded) were likely to make few errors in detecting the nonfamous PM cue during the ongoing task. This prediction was supported. Both older and younger adults performed well when allotted sufficient time to respond. Additionally I predicted that both older and younger adults would perform significantly worse in their respective speeded deadline conditions. For older adults, this prediction was supported. Older adults in the medium deadline condition made significantly more errors than older adults in the long deadline condition. Although this pattern was replicated for younger adults, the difference did not reach significance. This finding is not entirely surprising given that there was only one PM cue to remember, and the PM cue was focal to the ongoing task. However, future research might shorten the response deadline for younger adults in an attempt to further prevent younger adults from using recollection in their responding.

Another prediction of the current study was that older adults were expected to make more errors overall than younger adults. This finding was supported with older adults in the medium deadline condition, who performed significantly worse than younger adults in short and medium deadline conditions. However, older adults in the long deadline condition were not significantly outperformed by younger adults. Of particular interest is that older adults, when given sufficient time to respond, did not perform significantly worse than younger adults under a speeded deadline. This finding is consistent with multiple studies in PM and RM literature (see Jennings & Jacoby,

1997; Rendell et al., 2007), providing support for the notion of a general slowing with age.

More important than the overall accuracy of older and younger adults, the current study was concerned with the patterns of responding that emerged when participants incorrectly responded to a nonfamous PM cue. Recall that that older adults' past success on PM tasks may have resulted from the ability to rely on familiarity to correctly perform the PM action. By designing a task in which the PM cue was not the only familiar item during the ongoing task, I were able to test this hypothesis. The current results support of my predictions. Although younger adults were more likely to make errors in the fast deadline condition, they rarely made the mistake of calling the PM cue *famous*. In fact, they were significantly more likely to call the same name *famous* when it was not the PM cue (when presented as a control item) than when it was the PM cue, and this occurred for both deadlines. This resulted for both the medium and short deadlines. This finding supports previous literature in which younger adults were not susceptible to false fame effects under immediate conditions (Dywan & Jacoby, 1990; Jacoby et al., 1989). Results of the current study are also consistent with the extensive literature suggesting that controlled recollective processes remain largely intact for younger adults (e.g., Jacoby, 1999; Yonelinas, 2002).

In contrast, older adults did not show strong recollective capabilities. Older adults in the long deadline did not show a difference in *famous* responses to names presented as PM cues and control items. This finding does not show that older adults are more susceptible to false fame effects, but it does indicate they may have lower level of

recollection. If participants were particularly skilled at remembering they saw the nonfamous name on the instruction screen, it would be expected that they would respond *famous* less compared to names which were being presented for the first time. This was the case with younger adults, but not older adults. This effect was exaggerated with older adults in the medium deadline condition. Not only did older adults in this condition show recollective deficits, these participants demonstrated a false fame effect. Participants made significantly more *famous* responses to nonfamous names presented as the PM cues compared to control items. This is to say that when the nonfamous name was recently presented to older adults on the instruction screen, the familiarity of that item was likely increased. Although the same was true for younger adults, they were able to use recollection to override a response based on familiarity. That is, it was familiar, but they remembered it was from the instruction screen, leading to a different response. Older adults in the medium deadline condition did not show this process. Instead, they demonstrated a tendency to call the PM cue *famous* more than if that name had not been presented on the instruction screen. As predicted, older adults' performance on PM tasks was not dissimilar from performance on RM when reliance on familiarity was decreased.

I suggested that previous research on PM tasks in which no age differences were found may have resulted from a reliance on familiarity. That is, when a PM cue seemed familiar during an ongoing trial, participants were externally guided towards the correct PM action. From what is known about memory and aging so far, there is every reason to believe that older adults would be capable of this task as automatic recognition processes seem to be intact. However, in the current study, when familiarity of an item led to a

confusion of responses, older adults showed a decline in performance. Although the result of a speeded deadline led to the typical finding that PM cues were missed by older adults, what is most important was the increase in *famous* responding to items presented as critical items as compared to the same item presented as a control item. This study suggests that familiarity remains intact for older adults, but their abilities to override original decisions based on familiarity with appropriate recollection processes appears to show age-related deficits. This hypothesis was further supported by the types of responses errors that emerged when the PM cue was presented in a speeded compared to non-speeded deadline. Younger adults' errors can be explained by increased errors in missing the PM cue altogether (*nonfamous* response). While older adults did not differ from younger adults on *nonfamous* response errors in the speeded deadline condition, they did make more errors overall than younger adults. The distinction between younger and older adults was explained almost entirely to the increased amount of *famous* responses made by older adults in the speeded condition. Younger adults did not make these same response errors (see Figure 3).

Understanding memory processes related to aging has widespread implications. While it is important to know which processes decline with age in terms of general awareness, it is equally important to understand which processes remain intact. Understanding these processes can allow for training of either reliance on those which remain intact, or training of those which do not. Liu and Park (2004), studied older adults trained on the use of blood-glucose devices. Participants were instructed to administer implementation intentions using those devices four times a day for three weeks on a time-

based schedule. One third of the older adult participants were told to form self-plans for using their devices based on where they would likely be at those times during the day. They were asked to visualize where they would be and try to focus on external cues that might trigger remembering. The idea behind this manipulation was to eliminate the challenge of self-initiation, as older adults tend to have difficulty with this component of memory. If older adults encounter a scenario or object during their day-to-day lives, the previous visualization of this event might trigger the correct action. Results indicated that older adults who visualized where they would be completed a higher proportion of the instructed tasks compared to participants who did not visualize. This finding is hopeful for teaching older adults strategies that may allow them to use the familiarity process that remains intact with aging.

There are also several studies which suggest that recollection may be strengthened through training in healthy older adults or individuals with early stages of Alzheimer's disease (Cherry, Simmons, & Camp, 1999; Jennings & Jacoby, 2003). Both studies involve beginning with short intervals to remember information, and gradually increasing time-intervals once the shorter has been mastered on an individual level. In both studies, participants using this method showed increased memory abilities when compared to participants that had spent the same amount of time in the training phase, but the intervals were not varied in the same manner. Although the real-life implications for such strategies may be more challenging to implement, these studies do provide hope that training recollection processes is possible.

It is possible that older adults might possess recollective process abilities, but they are not in the habit of using them without further instruction. Malthaup (1995) tested older adults in a false fame experiment similar to that of Jennings and Jacoby (1990). However, during the fame judgment task of this experiment, participants were instructed to write down the source of fame for any name they indicated as *famous*. Through this manipulation with older adults, the false fame effect was eliminated. This finding suggests that older adults can recollect source memory details, but perhaps they do not do so automatically or without provocation.

Conclusion

The current study sought to further examine the process of familiarity in older adults. Findings of the study suggest that automatic familiarity processes remain intact with aging. However, specifically on PM tasks, when the ability to rely on familiarity to assist with responding is removed, older adults were not able to perform as well as younger adults. Therefore, the current study contributes to the literature in that it is the first to demonstrate an age deficit in PM due to a reliance on familiarity. Further, similar to the way in which Jacoby's exclusion procedures called into question previous RM studies that did not show age deficits, the current study challenges the accuracy of methods used in previous PM literature. By providing more than one response that could be made based on familiarity, tasks similar to those that did not yield age differences in the past then demonstrated age-related decline in memory performance.

The current findings suggest that it may be adaptive for older adults to be conscious of their relative inabilities with controlled recollective processes, thereby incorporating more external cues into daily lives in order to compensate by using automatic memory processes that do tend to remain intact during aging. Implications of this study also suggest that older adults should use caution with their reliance on automatic processes, as they may occasionally lead to errors in everyday life such as following low credibility sources, forgetting to take medications, and so on.

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