Journal of Applied Research in Memory and Cognition 8 (2019) 481–493

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

journal homepage: www.elsevier.com/locate/jarmac

Knowing What Others Know: Younger and Older Adults' Perspective-Taking and Memory for Medication Information

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Health-related information can be important to communicate and remember, but we may not understand our own or others' memory abilities. In this study, younger and older adults estimated their performance before and after a cued-recall memory task in which they studied medication–side-effect pairs. Participants also estimated the performance of a peer their own age, a medical student, and a person in the other age group (i.e., younger adults estimated older adults' performance and vice versa). In Experiment 1, participants completed four study-test cycles, each with new pairs. In Experiment 2, the same pairs were presented throughout. Overall, participants initially overestimated their memory performance, but after the task, several judgments were closer to participants' actual performance and that of their peers. Thus, people may not initially have accurate representations of how they and others remember health-related information, but these misconceptions may be ameliorated by testing and task experience.

General Audience Summary

Many people, especially older adults, are prescribed complicated medication regimens. It can be important to remember potential medication side effects, but when taking multiple medications, this information can often be confusable. Communicating and learning this type of information often requires taking others' perspectives. People across the lifespan may rely not only on their own abilities to remember health-related information, but also the abilities of others, such as when bringing a friend or loved one along on a doctor's appointment. In the current study, younger and older adult participants estimated how much information they would remember before completing a memory task in which they learned pairs of medications and their side effects; after completing the task, they estimated how well they performed. We also asked participants to estimate the performance of a peer their own age, a person who belongs to the other age group (e.g., older adults estimated younger adults' performance), and a first-year medical student. In most cases, participants overestimated their memory performance before the task. After the task, their judgments were closer to actual

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This work was supported in part by the National Institutes of Health (National Institute on Aging), Award Number R01AG044335. This work was presented at the 2017 Annual Meeting of the Psychonomic Society (Vancouver, Canada) and the 17th Biennial Cognitive Aging Conference (Atlanta, GA).

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performance—participants had a more accurate perception of their own and others' memory abilities. This study presents an efficient, novel way to show younger and older people that their memory is fallible, and that they may not initially have accurate representations of how they and other people remember health-related information.

Keywords: Memory, Metacognition, Learning, Cognitive aging

Communicating effectively—especially when we seek to convey knowledge—often depends on taking others' perspectives. For example, if instructors do not know what their students know, learning can be detrimentally affected (Sadler, Sonnert, Coyle, Cook-Smith, & Miller, 2013). Health-related communication can also involve perspective-taking: a practitioner may wish to convey major side effects of a new medication to a patient, or a patient may wish to share information about a new diagnosis with a loved one—in each of these situations, understanding what others do and do not know requires taking their perspective. Many older adults take several medications at the same time (Qato et al., 2008), and these complex regimens may cause older patients or caregivers to confuse or misremember medication information (especially in light of associative memory deficits; Naveh-Benjamin, 2000), but it is unclear whether people across the adult lifespan understand how they and others learn health-related information. In the current study, we assess how younger and older adults take others' perspectives when learning medications and their side effects.

Memory and Metacognition for Health-Related Information

Information in healthcare settings can be particularly important to know, but patients often struggle to adhere to their doctors' recommendations (Gellad, Grenard, & Marcum, 2011; Hughes, 2004; Roebuck, Liberman, Gemmill-Toyama, & Brennan, 2011). It can be critical to remember, for example, the important side effects of a medication, as certain symptoms could indicate a serious condition. However, patients forget up to 80% of medical information almost immediately upon encountering it (Kessels, 2003), and forgetting this type of information can have serious consequences, especially if one is unaware of one's potential to forget. In the lab, schematic support can benefit older adults' performance in memory tasks (e.g., Castel, 2005; Friedman, McGillivray, Murayama, & Castel, 2015; cf. Morrow, Menard, Stine-Morrow, Teller, & Bryant, 2001), but this is not always the case when the to-be-learned information is in the medical domain (Rice & Okun, 1994).

Family members often accompany patients, especially older adults, to medical appointments (Schilling et al., 2002), and relying on another person to remember information (e.g., through collaborative remembering, Harris, Keil, Sutton, Barnier, & McIlwain, 2011) can be effective for the learner. However, many people may not be aware of how learning health-related information really works (e.g., see Metcalfe, 1998), potentially illustrating overconfidence. Unrealistic optimism about one's own abilities, performance, and susceptibility to adverse outcomes has been illustrated in several domains (see Dunning, Heath, & Suls, 2004, for a review). For example, people are unrealistically optimistic about their physical health (e.g., people overestimate the extent to which they engage in healthy behaviors like handwashing compared to others; Miller, Windschitl, Treat, & Scherer, 2019) and their learning (e.g., lower-performing students often overpredict their performance on exams; Hacker, Bol, Horgan & Rakow, 2000; see Andrade, 2019 for a review). In fact, assessments by peers can be more accurate indicators of performance than learners' assessments about themselves (e.g., among surgical residents; Risucci, Tortolani, & Ward, 1989). In the lab, extensive work has documented discrepancies between predicted performance and actual performance (e.g., Carroll, Nelson, & Kirwan, 1997; Castel, McCabe, & Roediger, 2007; Koriat & Bjork, 2005; Miller & Geraci, 2011a). Overconfidence in memory is fairly common (Metcalfe, 1998); Schraw and Roedel (1994) suggest that it is largely due to participants not taking test difficulty into account when making judgments.

There is evidence that older adults are as accurate in their metacognitive judgments as younger adults are (Halamish, McGillivray, & Castel, 2011; Hertzog & Hultsch, 2000; Rast & Zimprich, 2009), but other work suggests that older adults may be more overconfident in their judgments than younger adults (Bruce, Coyne, & Botwinick, 1982; Devolder, Brigham, & Pressley, 1990). This difference between estimated performance and actual performance can differ based on the difficulty of the memory task (e.g., Connor, Dunlosky, & Hertzog, 1997; see Price, Hertzog, & Dunlosky, 2008; Touron & Hertzog, 2004). In addition, Connor et al. (1997) demonstrated that younger and older adults become more accurate in their global predictions of performance after a memory task, and that they use the midpoint of the scale as an anchor under some circumstances (cf. Miller & Geraci, 2011b; Mueller, Dunlosky, & Tauber, 2015).

Beliefs about Others' Memory Abilities

In addition to estimating one's own performance, participants in the current study also make judgments about several other people who vary with respect to their age and experience. Taking others' perspectives can involve, interestingly, an egocentric judgment: we may use our own knowledge as a starting point when estimating what others know (Epley, Keysar, Van Boven, & Gilovich, 2004; Kelley & Jacoby, 1996; Nickerson, 1999). Perspective-taking has also been linked to executive functioning (Nilsen & Graham, 2009): adults under high working memory load are less accurate in taking another's perspective than those who are not (Maehara & Saito, 2011), which has important implications for older adults' learning and communication, as working memory often declines in older age (Hasher & Zacks, 1988; Insel, Morrow, Brewer, & Figueredo, 2006).

More recently, Tullis (2018) posited that when estimating others' knowledge, we use more than just an egocentric anchor: we also assess the stimuli, the conditions of the judgment, and the person whom we judge. We have less information about others' memory abilities than we do about our own, and if we do not have much information about the person being judged, we may fail to accurately take their perspective (Tullis & Fraundorf, 2017). Errors in perspective-taking could have serious consequences in the medical domain if the conveyer of knowledge overestimates what the learner already knows or has the capacity to remember. Participants in this study may lack two types of knowledge when making their initial metacognitive judgments: they may not know much about the task, and they may not know much about the memory abilities of the other people whose performance they are asked to estimate, both of which may contribute to incorrect pre-task estimates of performance.

In the memory domain more specifically, Nickerson, Baddeley, and Freeman (1987) found that estimates of others' abilities to answer general knowledge questions (e.g., "What is the name of the island on which Napoleon was born?", p. 248) depend on one's own ability to answer the questions. However, egocentrism in metacognitive judgments can also be influenced by task construction: when participants in Thomas and Jacoby (2012) answered general knowledge questions and estimated the extent to which other participants would know the answers, their judgments were influenced by their own knowledge, but were also affected if the answer had been "spoiled" (e.g., by presenting the answer alongside the question). That is, people adjusted their egocentric views once they realized that what they knew was not an accurate predictor of what others new.

Frequently held stereotypes of older adults as forgetful could affect not only estimates in the current task, but also how people across the lifespan share medical information in formal (e.g., doctor's office) and informal (e.g., family discussion) settings. People across the adult lifespan believe that memory declines in older adulthood (Lineweaver & Hertzog, 1998; Ryan, 1992). Whether this belief informs perspective-taking in the domain of memory for health-related information has not been extensively studied, but work by Tauber, Witherby, and Dunlosky (2019) does shed light on how beliefs about aging affect younger adults' metacognitive judgments. Younger adults expected memory to decline with age, but item-by-item judgments of learning (JOLs) were not always affected by these beliefs (e.g., there were not differences in JOLs given for "an average younger adult" and "an average older adult" (p. 5) when those questions were asked between-subjects, but there were differences when the questions were asked within-subjects). The accuracy of older adults estimates of younger adults' performance, for example, has not yet been determined.

The Current Study

Before they experience the memory task, we expect participants to overestimate their performance, particularly when there is the potential for interference in memory (i.e., Experiment 1). Participants often fail to appreciate how much interference can detrimentally affect performance (Diaz & Benjamin, 2011), but interference often occurs in real-world medical situations (e.g., when a new medication can cause headaches as a side effect, while a previous medication was associated with dizziness; see Hargis & Castel, 2018b).

Because participants do not have direct experience with this task upon which to base their pre-task judgments, we expect that those estimates about their own and others' performance will be primarily based on their overall beliefs about their cognitive abilities (Koriat, 2002), using one's own knowledge as a starting point when judging what others know (Epley et al., 2004). Additionally, in this task we vary the type of information participants are given about the other people they are judging, both in terms of the other's age (i.e., a peer and a member of the other age group) and medical training (i.e., a medical student). We expect judgments about other people to differ based on what information participants are given about those others. When estimating peers' performance, a judgment based on one's own knowledge that is not adjusted would reflect similar expectations for one's own and a peer's performance, while thinking that one performs better than others (potentially due to unrealistic optimism in one's abilities) would lead to more inflated judgments for oneself than one's peer (see the discussion of self and peer assessments in Dunning et al., 2004). When judging the opposite age group, we predict that age-related expectations and stereotypes will affect both younger and older adults' judgments. While a midpoint anchor may be the starting point for these judgments (Connor et al., 1997), we expect participants to adjust based on age information, such that younger adults estimate older adults will do worse than they themselves will and older adults estimate that younger adults will do better than they themselves will. When the "other" being judged has medical training, we expect participants to adjust their estimates in light of medical students' interest and/or experience in the medical field, such that expectations are higher for medical students than for oneself. After the task, we expect participants' judgments about themselves and others to be adjusted closer to actual performance as they learn more about the task, the stimuli, and their own memory abilities (Thomas & Jacoby, 2012; Tullis, 2018).

Experiment 1

Experiment 1 examines how a difficult task might differentially impact younger and older adults' metacognitive judgment about multiple types of people. Overall, we expect that both age groups' pre-task estimates of performance will be inflated, particularly when rating medical students' performance, and when rating younger adults as individuals and groups (i.e., the "self" and "peer" categories for younger adult participants, and the "other age group" category for older adults). We expect that both age groups will overestimate their own performance before the task as they will not take the difficulty of the task into account when making judgments, and we expect older adults' ratings of their own performance to be lower than their ratings of younger adults' performance.

We constructed the memory task to be difficult so that participants would have the opportunity to learn about their memory abilities and adjust their metacognitive ratings accordingly. Therefore, we expect cued recall performance to be relatively low on this task, and we expect older adults to perform worse than younger adults due to the associative nature of the task (Naveh-Benjamin, 2000) and the potential for memory interference (May, Hasher, & Kane, 1999). After the task, we expect a similar pattern of metacognitive judgments as were given before the task but lowered to be more reflective of participants' experiences.

Method

Participants. Younger adults ($n = 24$) were undergraduate students at University of California, Los Angeles (UCLA) and were recruited through the Psychology Department subject pool ($M_{age} = 20.38$, $SD = 1.56$), 22 were female, one other. Older adults ($n = 26$) were recruited from the Los Angeles community ($M_{age} = 71.42$, $SD = 6.36$), ten were female. This research was approved by the UCLA Institutional Review Board.

Materials and procedure. Participants were asked to imagine that they were learning information about medications, some of which had been on the market for a substantial amount of time, and others that were new to the market. (In reality, half of the medications were fictitious, and half were real medications.) Participants were told that they would learn and be tested on 18 pairs of medications and the side effects that may occur when consuming them (e.g., "headache"). Critically, participants were told that after they saw all 18 items, their memory would be tested, and then they would "see a different set of 18 items, and [their] memory will be tested again, and so on." They were asked to remember as much information as they could.

After reading the instructions, participants were asked to estimate, with the instructions in mind, "How do you think you will perform on this task?" and filled in the following blank: "I will remember ___% of the items presented in this task." On the same computer screen, participants were also asked to predict the performance (as a percentage) of the following people: an undergraduate student at UCLA, a first-year medical student, and a person between the ages of 60 and 85. Depending on the participants' age group, either the younger adult question or the older adult question was phrased as making a prediction about a "peer."

After making the pre-task judgments, participants began the memory task, in which they viewed each of 18 medication-side effect pairs (e.g., "Calamor: itching") for 5 s. The pairs were presented in random order for each participant. Then participants were cued with each medication, one at a time, in random order, and asked to recall the side effect that was associated with that medication. This was repeated for a total of four study-test cycles, with new medications paired with the same set of side effects on each list to create interference (e.g., if "Calamor: itching" appeared on list one, list two could include "Zelnorm: itching").

All medication stimuli and side effects were taken from a previously normed database. Medications were rated to be similarly familiar ($M = 3.21$, $SD = 0.74$) on a scale from 1 (*not familiar at all*) to 5 (*very familiar*). Half were chosen to be fictitious to reduce the possible advantage (or possible interference) that might occur if certain participants were particularly knowledgeable about medications (see Hargis & Castel, 2018b). Side effects were chosen from categories established by prior participants' ratings of how concerning they would find the experience of that side effect to be: six were rated by participants as mildly concerning ($M = 2.22$, $SD = 0.22$) on a scale from 1 (*not concerning at all*) to 5 (*very concerning*), six as moderately concerning (*very concerning*$M = 2.73$, $SD = 0.14$ on a scale from 1 to 5), and six as highly concerning ($M = 3.51$, $SD = 0.25$ on a scale from 1 to 5; see *Supplementary Materials* for analyses). These categories were not made explicit to the participants and were not a main variable of interest. The distinction between the categories, especially between "mild" and "moderate" side effects, was relatively small.

After completing the four study-test cycles, participants were reminded of the task instructions and asked to make metacognitive judgments about their performance across the task. These judgments were similar to the pre-task ratings, except that participants were asked "How do you think you performed on this task?" and filled in the following blank: "I remembered __% of the items presented in this task." Judgments were made for each category: oneself, a peer of the same age group, a first-year medical student, and a member of the opposite age group.

Results

Metacognitive judgments. Younger and older adults' metacognitive judgments are displayed in Figure 1. The metacognitive judgments were first submitted to a 2 (age group) × 2 (time of judgment: pre-task vs. post-task) × 4 (type of judgment: self, peer, medical student, other age group) mixed-factorial analysis of variance (ANOVA). This test revealed no three-way interaction, $F(3, 144) = 1.90$, $p = .13$, $\eta^2 = .002$. There were, however, three significant two-way interactions. There was a significant interaction between time of judgment and type of judgment, $F(3, 144) = 10.84$, $p < .001$, $\eta^2 = .01$, a significant interaction between type of judgment and age group, $F(3, 144) = 35.37$, $p < .001$, $\eta^2 = .06$, and a significant interaction between time of judgment and age group, $F(1, 48) = 12.63$, $p < .001$, $\eta^2 = .019$.

To decompose the interaction between time of judgment (pre-task vs. post-task) and type of judgment (self, peer, medical student, other age group), we conducted a series of pairwise comparisons using paired-samples *t*-tests, which suggest that though participants gave lower ratings overall after the task, their ratings of medical students' performance decreased less than the other judgments (all post hoc comparisons reported here were subject to Bonferroni correction). That is, there was a significant difference in participants' ratings of their own performance, such that they gave higher ratings before ($M = 53.50$, $SD = 18.25$) than after ($M = 14.78$, $SD = 15.51$) the memory task, $t(49) = 13.01$, $p < .001$, $d = 1.84$. Participants also rated their peers higher before ($M = 52.86$, $SD = 17.23$) than after ($M = 21.40$, $SD = 16.78$) the memory task, $t(49) = 12.50$,

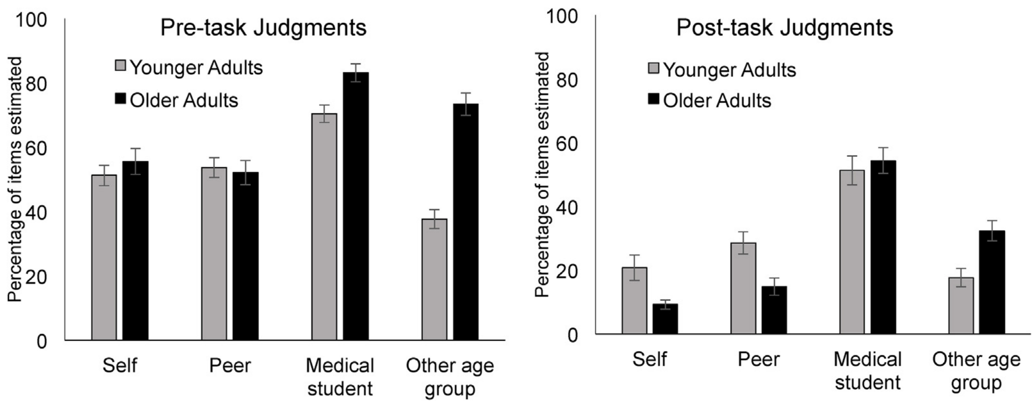

Figure 1. Metacognitive judgments given in Experiment 1 before (left panel) and after (right panel) the memory task. Participants estimated what percentage of items the following groups would recall: themselves, a peer of the same age group, a first-year medical student, and a member of the other age group. Error bars represent standard errors.

$p < .001$, $d = 1.77$. There was a significant (but smaller) difference in participants' ratings of medical students such that they gave higher ratings before ($M = 77.03$, $SD = 15.23$) than after ($M = 52.86$, $SD = 21.21$) the task, $t(49) = 8.89$, $p < .001$, $d = 1.26$, and participants also gave higher ratings to members of the opposite age group before ($M = 56.26$, $SD = 24.47$) than after ($M = 25.30$, $SD = 16.79$) the memory task, $t(49) = 10.78$, $p < .001$, $d = 1.52$.

To investigate the interaction between type of judgment and participants' age group, we conducted a series of pairwise comparisons using independent-samples t-tests. There was no significant difference in younger and older adults' ratings of their own memory accuracy across the task, $t(48) = .96$, $p = .34$, $d = .27$. There was also no significant difference in how younger and older adults rated their peers' accuracy across the task, $t(48) = 1.91$, $p = .06$, $d = .54$, nor was there a difference in how younger and older adults rated medical students' accuracy across the task $t(48) = 1.81$, $p = .08$, $d = .51$. However, there was a significant difference among younger and older adults' ratings of the opposite age group across the task, $t(48) = 6.74$, $p < .001$, $d = 1.91$, such that younger adults expected older adults to remember a significantly lower percentage of the information ($M = 27.69$, $SD = 11.97$) than older adults expected younger adults to remember ($M = 52.87$, $SD = 14.25$).

Finally, we investigated the interaction between time of judgment and age group by conducting independent samples t-tests. We compared younger adults' pre-task judgments to older adults' pre-task judgments and found that overall, younger adults' ratings ($M = 53.26$, $SD = 12.02$) were lower than older adults' ratings ($M = 66.05$, $SD = 16.36$) before the task, $t(48) = 3.13$, $p < .01$, $d = .89$, likely driven by the differences between younger adults' ratings of older adults and vice versa. We then compared younger adults' post-task judgments to older adults' post-task judgments and found no difference between younger ($M = 29.56$, $SD = 14.78$) and older adults' ratings ($M = 27.68$, $SD = 11.77$) after the task, $t(48) = 0.50$, $p = .62$, $d = .14$.

Accuracy. Younger and older adults' memory accuracy across the task is displayed in Figure 2. To investigate how younger and older adults' cued recall performance changed across the task, we conducted a 2 (age group) × 4 (test) ANOVA, which revealed a non-significant interaction between age and test, $F(3, 144) = 2.10$, $p = .102$, $\eta^2 = .008$. There was a significant main effect of age, $F(1, 48) = 15.50$, $p < .001$, $\eta^2 = .193$, such that younger adults ($M = 29.63$, $SD = 23.38$) recalled a higher percentage of the items than older adults did ($M = 12.45$, $SD = 9.75$) across the task. There was also, somewhat unexpectedly, a main effect of test, $F(3, 144) = 2.96$, $p = .035$, $\eta^2 = .0012$, such that participants' performance increased across the task. More specifically, participants' performance increased between Tests 1 ($M = 18.00$, $SD = 17.01$) and 2 ($M = 22.33$, $SD = 18.42$), $t(49) = 2.23$, $p = .03$, $d = .32$, but not significantly between Tests 2 and 3 ($M = 19.44$, $SD = 17.72$), $t(49) = 1.66$, $p = .10$, $d = .24$, or between Tests 3 and 4 ($M = 23.00$, $SD = 24.51$), $t(49) = 1.66$, $p = .10$, $d = .23$. Accuracy was higher on the final test than on the initial test, $t(49) = 2.20$, $p = .03$, $d = .31$, suggesting that some learning did take place across the task. This pattern was unexpected as there were new pairs presented on each study trial, but perhaps participants became better acquainted with the list of side effects (e.g., "itching" appeared in each learning phase, paired with a different medication each time) and were better able to learn the associations after being repeatedly exposed to the side effects. However, if a Bonferroni

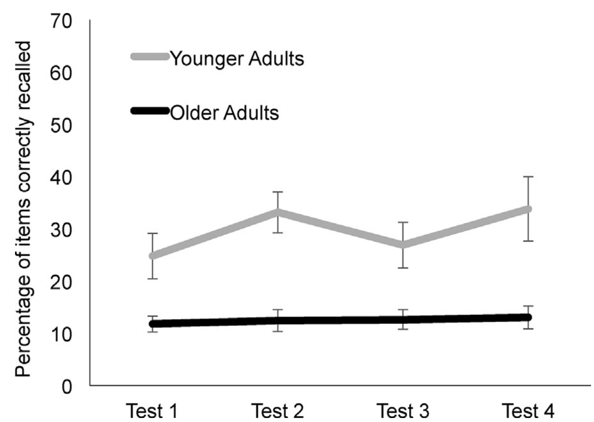

Figure 2. The percentage of side effects accurately recalled when presented with the associated medications in Experiment 1. Error bars represent standard errors.

Table 1
Pre-Task Judgments of Accuracy, Actual Performance, and Post-Task Judgments of Accuracy by Age Group in Experiment 1

	Younger Adults (*SD*)	Older Adults (*SD*)
Pre-task judgments		
Self	51.25 (15.62)	55.58 (20.46)
Peer	53.67 (15.11)	52.12 (19.24)
Medical student	70.42 (13.59)	83.13 (14.30)
Other age group	37.71 (14.59)	73.38 (17.98)
Actual performance	29.63 (23.05)	12.45 (9.79)
Post-task judgments		
Self	20.79 (19.57)	9.23 (7.30)
Peer	28.54 (17.16)	14.81 (13.66)
Medical student	51.25 (22.28)	54.35 (20.51)
Other age group	17.67 (14.90)	32.35 (16.19)

correction for multiple comparisons is applied, none of the above differences reach significance (corrected alpha = .0125).

Accuracy of metacognitive judgments. To compare metacognitive judgments with actual performance, we conducted a 2 (age group) × 3 (pre-task judgment of one's own performance, actual performance, post-task judgment of one's own performance) mixed ANOVA. (See Table 1 for younger and older adults' pre-task metacognitive judgments, actual performance, and post-task metacognitive judgments.) This test revealed a significant main effect of age group, $F(1, 48) = 5.65$, $p = .02$, $\eta^2 = .03$ and a significant main effect of pre-task judgment, actual performance, and post-task judgments, $F(2, 96) = 123.34$, $p < .001$, $\eta^2 = .50$; there was also a significant two-way interaction, $F(2, 96) = 8.99$, $p < .001$, $\eta^2 = .04$. Figures 1 and 2 suggest a greater overestimation of performance among older adults' judgments than younger adults'. To decompose the interaction, we conducted a one-way ANOVA for each age group. The ANOVA for younger adults' judgments revealed a significant difference between pre-task judgments, actual performance, and post-task judgments, $F(2, 46) = 30.40$, $p < .001$, $\eta^2 = .33$, as did the ANOVA for older adults', $F(2, 50) = 114.00$, $p < .001$, $\eta^2 = .72$. Post hoc paired-samples *t*-tests revealed that younger adults' pre-task judgments about themselves were higher than their actual performance, $t(23) = 4.37$, $p < .001$, $d = .89$ and higher than their post-task performance $t(23) = 6.92$, $p < .001$, $d = 1.41$. However, younger participants' post-task judgments were significantly lower than their actual performance, $t(23) = 4.08$, $p < .001$, $d = .83$. Taken together, these results reveal younger participants' overestimations before the task and underestimations after the task. Similar tests were conducted to examine older adults' judgments and accuracy, revealing that older adults' pre-task ratings of their own performance were also higher than their actual performance, $t(25) = 9.72$, $p < .001$, $d = 1.91$ and were higher than their post-task ratings, $t(25) = 13.32$, $p < .001$, $d = 2.61$. There was not a significant difference between older adults' actual performance and their post-task rating of that performance, $t(25) = 1.72$, $p = .10$, $d = .34$, suggesting that older adults give appropriate metacognitive judgments after the task.

We also conducted a series of independent-samples *t*-tests with Bonferroni corrections to determine how accurate each age group was in estimating the other age group's performance. Before the memory task began, younger adults overestimated older adults' performance, $t(48) = 7.74$, $p < .001$, $d = 2.19$ ($M_{\text{estimated}} = 37.71$, $SD_{\text{estimated}} = 14.59$, $M_{\text{actual}} = 12.45$, $SD_{\text{actual}} = 7.71$). After the memory task, however, younger adults accurately estimated older adults' performance, $t(48) = 1.64$, $p = .11$, $d = .46$. Older adults' ratings followed the same pattern: they overestimated younger adults' performance before the task, $t(48) = 7.98$, $p < .001$, $d = 2.26$ ($M_{\text{estimated}} = 73.38$, $SD_{\text{estimated}} = 17.98$, $M_{\text{actual}} = 29.63$, $SD_{\text{actual}} = 20.78$), but accurately estimated younger adults' performance after the task, $t(48) = 0.52$, $p = .61$, $d = .15$.

Discussion

In Experiment 1, younger and older adults studied new pairs of medications and their side effects during each of four study-test trials. We sought to assess participants' judgments of their own and others' performance, and how those judgments might change after task experience. After reading the instructions but before studying any words, both younger and older participants estimated that they and their peer would remember approximately 50% of the items presented (see Table 1), similarly to previous work investigating metacognitive anchoring near the midpoint of the scale (Connor et al., 1997; Scheck & Nelson, 2005) and basing judgments about others on judgments about ourselves (Epley et al., 2004; Nickerson, 1999). That the judgments of self and peer are so similar does not reflect unrealistic optimism in one's own abilities compared to peers (Dunning et al., 2004). Younger and older adults did not differ in their estimations of their own performance, their peers' performance, or medical students' performance, but their ratings of the other age group did differ as expected. Overall, older adults' ratings were lower than younger adults' before the task, but after the task, there were no age differences in performance estimates.

According to Tullis and Fraundorf (2017), lacking information about the to-be-judged person's memory may lead to inaccurate perspective-taking, which could at least partially explain the current results, particularly that participants in both age groups overestimate their peers' performance before the task as well as the performance of the participants in the other age group (e.g., younger adults overestimate older adults' performance). In contrast, post-task ratings by both age groups were in line with the other age group's actual performance. While people may use what they know as an anchor when assessing what others know (Epley et al., 2004), they may also keep in mind what they know about the to-be-learned information and the task requirements (Tullis, 2018), and participants could draw on their task experience to make the final judgments.

The pre-task bias toward overestimating was no longer present after the memory task; indeed, younger adults' post-task judgments were significantly lower than their actual performance, while older participants' post-task estimates were not different from their actual performance. This finding is in line with previous work suggesting that older adults' metacognitive judgments can be accurate (e.g., Halamish et al., 2011; Hertzog & Hultsch, 2000). Perhaps younger adults' underestimation of their own performance could be adaptive in this setting: expecting to remember less information than one actually could may lead that person to devote extra resources and attention toward learning it (Metcalfe, 2009; Metcalfe & Finn, 2008; Thiede, Anderson, & Therriault, 2003). Interestingly, both age groups still estimated medical students would perform fairly accurately compared to oneself, and these ratings decreased less than others from pre-task to post-task. Perhaps participants' estimates reflect a belief that medical students are particularly adept at memorizing and learning new information about their specialty, or that medical students have more interest in the content and would therefore devote more effort toward learning the pairs (see Johansson & Allwood, 2007; Kruger, 1999).

Participants in Experiment 1 were not given the opportunity to re-study (and thereby strengthen the memory trace of) pairs of medications and their side effects after they were tested on the pairs. Older participants in particular performed poorly in the memory task in Experiment 1, so we sought in Experiment 2 to ensure that performance would not be near the floor (similarly to Experiments 1 and 2 in Connor et al., 1997). Experiment 2 allows for re-study and better reflects real-life learning situations in which repeated exposure to material could occur.

Experiment 2

As discussed in Experiment 1, we may not accurately understand our own and others' memory abilities before learning. In the medical domain, patients may think they will remember what the physician is relaying (and therefore do not take effective notes, or do not take notes at all), only to find that, once they leave the doctor's office, much of the information is now forgotten (Kessels, 2003). Experiment 1 examined perspective-taking on an associative memory task, and how metacognitive judgments of self and others may change with task experience.

Instead of side effects that are randomly paired with new medications on each list (as in Experiment 1), Experiment 2 holds constant the medication–side-effect pairings throughout the task, such that each pair is studied and tested a total of four times. Prior work suggests that older adults benefit from successful prior task performance (Geraci & Miller, 2013); in the current Experiment, participants have the opportunity to learn across several lists (see Kilb & Naveh-Benjamin, 2011).

If younger and older adults are able to learn from task experience as in prior work examining associative memory for medical information (e.g., Hargis & Castel, 2018b), we predict that younger and older adults' cued recall performance will increase in accuracy across the task. Previous work suggests that older adults face deficits in associating unrelated items in memory (e.g., Naveh-Benjamin, 2000). Therefore, as in Experiment 1, we predict that younger adults will outperform older adults, as the task at hand does involve binding unrelated items.

If participants use an anchoring heuristic (Epley et al., 2004; Scheck & Nelson, 2005), they may estimate that they and others will remember "about half" of the items, regardless of the specific task requirements. Unrealistic optimism in one's own abilities compared to peers (e.g., Miller et al., 2019; see Dunning et al., 2004) would be reflected in judgments that are more inflated for oneself than one's peer. We expect that potential overestimations will be at least somewhat remedied after the memory task is complete, such that ratings will be adjusted downward to be closer to actual performance (that is, performance estimates will be more accurate after participants finish the memory task; Tullis, 2018).

Method

Participants. Younger adults ($n = 26$) were undergraduate students at UCLA and were recruited through the Psychology Department subject pool ($M_{age} = 20.31$, $SD = 2.00$), 19 were female. Older adults ($n = 26$) were recruited from the Los Angeles community ($M_{age} = 75.35$, $SD = 6.75$), 11 were female. Participants in Experiment 2 did not participate in Experiment 1. This research was approved by the UCLA Institutional Review Board.

Materials and procedure. The materials and procedure of this study were the same as Experiment 1, except that participants studied the same 18 pairs of medications and side effects on each list, and this same list repeated for a total of four study-test cycles. Participants were told this information before they answered the pre-task metacognitive questions, which were the same as in Experiment 1, as were the post-task metacognitive questions.

Results

Metacognitive judgments. Younger and older adults' metacognitive judgments are displayed in Figure 3. Similarly to Experiment 1, to analyze metacognitive judgments we conducted a 2 (age group) × 2 (time of judgment: pre-task vs. post-task) × 4 (type of judgment: self, peer, medical student, other age group) ANOVA. This test revealed a significant three-way interaction, $F(3, 150) = 5.61$, $p < .001$, $\eta^2 = .003$. To decompose this interaction, we conducted a 2 (time of judgment) × 4(type of judgment) within-subjects ANOVA on younger adults' judgments, which did not reveal a significant two-way interaction, $F(3, 75) = 1.31$, $p = .28$, $\eta^2 = .02$. There was a significant main effect of time of judgment, $F(1, 25) = 14.36$, $p < .001$, $\eta^2 = .23$, such that ratings given before the task ($M = 52.51$, $SD = 19.91$) were lower than ratings given after the task ($M = 70.17$, $SD = 29.03$). There was also a significant main effect of type of judgment, $F(3, 75) = 59.76$, $p < .001$, $\eta^2 = .19$. We further investigated this main effect using a series of paired-samples t-tests with Bonferroni corrections. The only comparison that failed to achieve significance after the correction was between younger adults' ratings of themselves ($M = 62.56$, $SD = 27.56$) and their peers ($M = 60.65$, $SD = 24.45$), $t(23) = 2.25$, $p = .03$, $d = .46$. Younger adults rated themselves as less accurate than medical students ($M = 77.25$, $SD = 19.96$), $t(23) = 6.91$, $p < .001$, $d = 1.41$ and more accurate than older adults ($M = 44.90$, $SD = 23.01$), $t(23) = 2.97$, $p = .007$, $d = .61$. Younger adults rated their peers to be less accurate than a medical student would be, $t(23) = 7.34$, $p < .001$, $d = 1.50$, but more

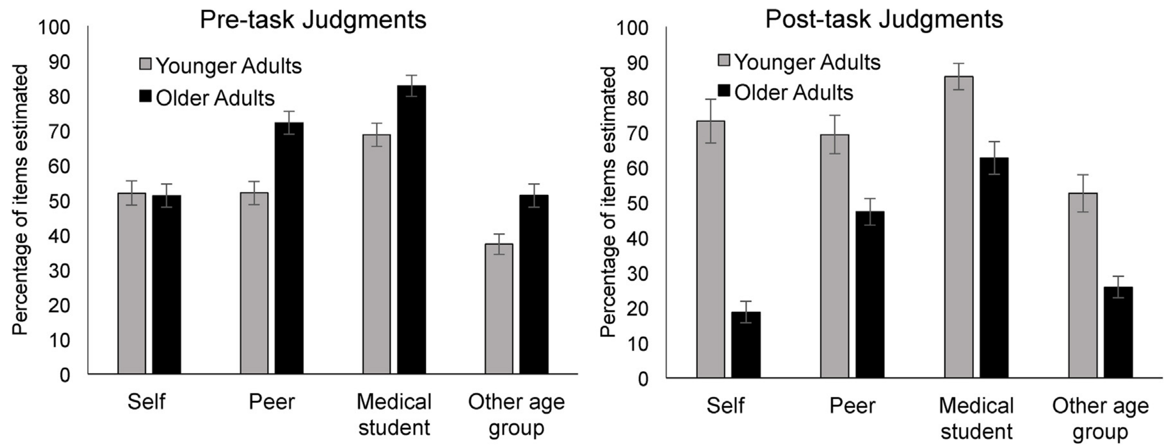

Figure 3. Metacognitive judgments given in Experiment 2 before (left panel) and after (right panel) the memory task. Participants estimated what percentage of items the following groups would recall: themselves, a peer of the same age group, a first-year medical student, and a member of the other age group. Error bars represent standard errors.

accurate than older adults, $t(23) = 5.40$, $p < .001$, $d = 1.10$. They also estimated that medical students would be more accurate than older adults, $t(23) = 10.36$, $p < .001$, $d = 2.12$.

To further decompose the significant three-way interaction, we conducted (at the older adult participant level) a 2 (time of judgment) × 4 (type of judgment) within-subjects ANOVA, which, unlike in younger adults, did reveal a significant two-way interaction $F(3, 75) = 5.89$, $p = .001$, $\eta^2 = .007$. There was a main effect of type of judgment, $F(3, 75) = 71.85$, $p < .001$, $\eta^2 = .34$, and a main effect of time of judgment, $F(1, 25) = 75.89$, $p < .001$, $\eta^2 = .23$. To decompose the interaction, we compared pre-task and post-task judgments at each level of the type of judgment variable (self, peer, medical student, and other age group). The pattern of results suggests differences in the magnitude of pre-task-to-post-task adjustments: older adults decreased their ratings of their own performance to a greater extent than their ratings of others' performance. Older adults gave significantly higher estimates of their own performance pre-task ($M = 51.23$, $SD = 17.04$) than post-task ($M = 18.69$, $SD = 15.59$), $t(25) = 9.16$, $p < .001$, $d = 1.80$. They also gave significantly higher estimates of their peers' performance pre-task ($M = 72.15$, $SD = 16.64$) than post-task ($M = 47.31$, $SD = 19.56$), $t(25) = 7.20$, $p < .001$, $d = 1.41$, and higher estimates of medical students' performance pre-task ($M = 82.77$, $SD = 15.41$) than post-task ($M = 62.65$, $SD = 23.64$), $t(25) = 6.41$, $p < .001$, $d = 1.26$, though these differences were smaller than the difference in ratings of one's own performance before and after the task. Older adults also gave higher ratings of the opposite age group's performance (i.e., younger adults' performance) pre-task ($M = 51.27$, $SD = 15.59$) than post-task ($M = 25.85$, $SD = 15.40$), $t(25) = 6.82$, $p < .001$, $d = 1.34$; this difference was also smaller than the difference in ratings of oneself before and after the task.

Accuracy. Younger and older adults' memory accuracy across the task is displayed in Figure 4. To investigate how younger and older adults' memory performance changed across the task, we conducted a 2 (age group) × 4 (test) ANOVA. This test revealed a significant two-way interaction between age and test, $F(3, 150) = 27.78$, $p < .001$, $\eta^2 = .23$. We then conducted pairwise comparisons using independent-samples t-tests,

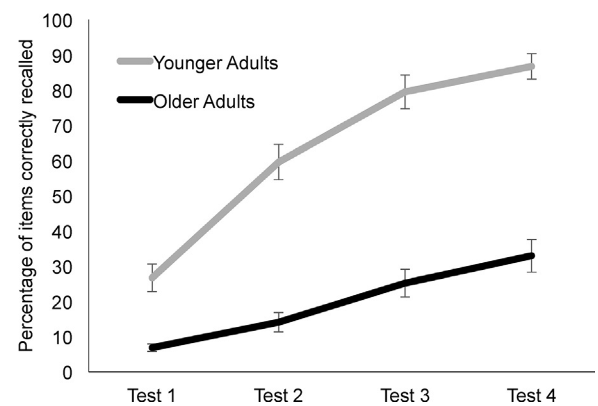

Figure 4. The percentage of side effects accurately recalled when presented with the associated medication in Experiment 2. Error bars represent standard errors.

which suggest that the extent to which younger adults outperform older adults increases across the task. That is, younger adults ($M = 26.71$, $SD = 20.06$) performed significantly better on Test 1 than older adults ($M = 6.84$, $SD = 5.28$) did, $t(50) = 4.88$, $p < .001$, $d = 1.36$, and younger adults ($M = 59.62$, $SD = 25.61$) outperformed older adults ($M = 14.10$, $SD = 13.90$) to a greater extent on Test 2, $t(50) = 7.96$, $p < .001$, $d = 2.21$. Further, younger adults ($M = 79.49$, $SD = 24.43$) significantly outperformed older adults ($M = 25.21$, $SD = 20.44$) on Test 3, $t(50) = 8.69$, $p < .001$, $d = 2.41$, and younger adults ($M = 86.75$, $SD = 18.53$) significantly outperformed older adults ($M = 32.91$, $SD = 23.77$) on Test 4, $t(50) = 9.11$, $p < .001$, $d = 2.53$ (that is, the size of the difference between younger and older adults was greatest on Test 4).

Accuracy of metacognitive judgments. As in Experiment 1, we conducted a 2 (age group) × 3 (pre-task judgments of one's own performance, actual performance, post-task judgments of one's own performance) mixed ANOVA to assess participants' relative overestimations or underestimations. (See Table 2 for younger and older adults' pre-task metacognitive judgments, actual performance, and post-task metacognitive judgments.) Similarly to Experiment 1, there was a significant main effect of

Table 2
Pre-Task Judgments of Accuracy, Actual Performance, and Post-Task Judgments of Accuracy by Age Group in Experiment 2

	Younger Adults (*SD*)	Older Adults (*SD*)
Pre-task judgments		
Self	52.00 (17.62)	51.23 (17.04)
Peer	52.04 (16.97)	72.15 (16.64)
Medical student	68.73 (17.10)	82.77 (15.41)
Other age group	37.27 (15.06)	51.27 (17.01)
Actual performance	63.14 (22.16)	22.16 (15.75)
Post-task judgments		
Self	73.11 (31.74)	18.69 (15.59)
Peer	69.27 (27.88)	47.31 (19.56)
Medical student	85.77 (19.22)	62.65 (23.64)
Other age group	52.54 (27.06)	25.85 (15.40)

age, $F(1, 50) = 55.80$, $p < .001$, $\eta^2 = .32$, and a significant main effect of pre-task judgment, actual performance, and post-task judgment, $F(2, 100) = 3.49$, $p = .03$, $\eta^2 = .02$. There was also a significant two-way interaction, $F(2, 100) = 37.25$, $p < .001$, $\eta^2 = .16$. The left panel of Figure 3 suggests that both age groups' initial judgments were anchored approximately at the midpoint of the 0–100% scale, and that younger adults' judgments about their own performance increased after the task, whereas older adults' judgements decreased. Paired-samples *t*-tests revealed that younger adults' pre-task ratings were significantly lower than their actual performance, $t(25) = 2.57$, $p = .02$, $d = .51$, and their post-task ratings were significantly higher than their actual performance, $t(25) = 2.76$, $p = .01$, $d = .53$. Younger adults' post-task ratings were significantly higher than their pre-task ratings, $t(25) = 3.53$, $p < .01$, $d = .69$. Older adults' pre-task ratings were higher than their actual performance, $t(25) = 5.73$, $p < .001$, $d = 1.12$, but their post-task ratings were not different than their actual performance, $t(25) = 1.09$, $p = .287$, $d = .21$. Unlike younger adults' post-task ratings, older adults' post-task ratings were significantly lower than their pre-task ratings, $t(25) = 9.16$, $p < .001$, $d = 1.80$.

We also conducted a series of independent-samples *t*-tests with Bonferroni corrections to assess the accuracy of younger adults' estimates about older adults and vice versa. Before the memory task began, younger adults overestimated older adults' performance, $t(50) = 3.35$, $p = .002$, $d = .93$ ($M_{\text{estimated}} = 37.27$, $SD_{\text{estimated}} = 15.06$; $M_{\text{actual}} = 23.50$, $SD_{\text{actual}} = 14.53$). After the memory task, younger adults also overestimated older adults' performance, $t(50) = 4.62$, $p < .001$, $d = 1.34$ ($M_{\text{estimated}} = 52.54$, $SD_{\text{estimated}} = 27.06$). Older adults' ratings did not follow the same pattern as younger adults': older adults were accurate in their estimates of younger adults' performance before the task, $t(50) = 2.30$, $p = .03$, $d = .64$ (did not survive Bonferroni correction; $M_{\text{estimated}} = 51.27$, $SD_{\text{estimated}} = 17.01$; $M_{\text{actual}} = 63.14$, $SD_{\text{actual}} = 20.14$), but they underestimated younger adults' performance after the task, $t(50) = 7.50$, $p < .001$, $d = 2.08$ ($M_{\text{estimated}} = 25.85$, $SD_{\text{estimated}} = 15.40$).

Discussion

Experiment 2 was similar to Experiment 1, except that it allowed for more learning to occur across the task as participants encoded the pairing between a medication and its side effect during four study-test cycles. If participants were to take the task requirements into account, we expected that pre-task ratings would be higher in Experiment 2 than in Experiment 1, as Experiment 1 presented the same pairs repeatedly. Alternatively, we expected that if participants were to base their pre-task judgments on a metacognitive anchor (Scheck & Nelson, 2005) rather than the specific task demands, then participants' pre-task judgments would not be different from those given in Experiment 1. Before the task, younger and older adults estimated that they would remember approximately 50% of the items correctly (see Table 2). The similarities in pre-task judgments from Experiments 1 and 2 may represent a general metacognitive anchor in that regardless of the specifics of the task, people expect to remember about half of the information presented (England & Serra, 2012; Scheck, Meeter, & Nelson, 2004; Scheck & Nelson, 2005). Participants also rated medical students (who are often younger adults; e.g., Dhalla et al., 2002) as more accurate than themselves and their peers.

We predicted a main effect of age on memory performance such that younger adults would outperform older adults, perhaps due to the difficulty of the associative component of this task (Naveh-Benjamin, 2000) and the interference that can be caused by the side effects, as interference can differentially affect older adults' performance (May et al., 1999). Younger adults did outperform older adults overall, and younger adults improved across the task to a greater extent than older adults did.

Older adults' pre-task ratings reflected overestimations of their own performance, as participants may not have fully understood the difficulty of remembering 18 pairs of items until they actually experienced the task. Post-task ratings were more in line with task performance; the overconfident pre-task ratings were at least affected by the task. Among younger adults, by the time the post-task judgment occurred, participants had just completed their fourth cued recall test, on which they scored relatively high after learning throughout the task. Having completed a test on which they scored fairly well might have led to a sense of fluency about the entire memory task (cf. Geraci & Miller, 2013), thus inflating their overall performance judgment to reflect overestimations rather than estimating how they did on the task overall.

Younger adults overestimated older adults' performance before and after the task, while older adults gave accurate pre-task estimates of younger adults' performance but underestimated their performance afterward. Younger people do often have the perception that memory declines with aging (Lineweaver & Hertzog, 1998; Ryan, 1992; see also Tauber et al., 2019), but they may not appreciate how much more difficult this task was for older adults than for themselves.

General Discussion

Taken together, the current experiments suggest that younger and older adults' initial metacognitive judgments about their own and others' abilities to remember medical information are not always accurate. Many patients take several medications simultaneously (Qato et al., 2008), and remembering the side effects of those medications can be important, especially if the presence of a side effect may indicate the presence of a dangerous reaction to that medication. However, remembering side effects from multiple medications requires those items to be bound together in memory, which can be difficult for older adults (Naveh-Benjamin, 2000), and could potentially cause memory interference. Highly confident memory errors could lead to harmful consequences, especially when relying on other people to help us remember important information, a process which often involves perspective-taking.

Our results demonstrate that participants become more accurate in several of their estimates of performance after the memory task (see Miller & Geraci, 2014). Younger and older adults updated their knowledge about their own and others' memory abilities after task experience; the testing experience can provide cues about learning that can then be used to better calibrate metacognition (Dunlosky & Hertzog, 2000; Touron & Hertzog, 2004; cf. Matvey, Dunlosky, Shaw, Parks, & Hertzog, 2002). The instructions and task construction differed between Experiments 1 and 2, but participants in both experiments estimated that they would remember approximately half of the items before they saw the memory task, perhaps relying on a metacognitive anchor at approximately the midpoint of the scale (Connor et al., 1997). When one is unsure about task difficulty or about the memory abilities of the person being judged (e.g., Tullis & Fraundorf, 2017), it might be reasonable to estimate 50% performance; indeed, anchoring is prevalent when a participant does not know much about the task (Scheck et al., 2004).

Perceptions of others depended upon what participants knew about them. For example, younger adults (and older adults in Experiment 1), rather than expecting better performance by themselves than by others (e.g., Dunning et al., 2004), predicted that their peers' performance would be very similar to their own, perhaps reflecting egocentrism (Epley et al., 2004; Kelley & Jacoby, 1996; Nickerson, 1999; Nickerson et al., 1987). In contrast, when additional age information was included about the "other," participants mostly predicted age-related memory deficits (in line with Lineweaver & Hertzog, 1998). When the to-be-rated person's experience with medical information was stated more explicitly—that is, when participants were asked to estimate the performance of first-year medical students—judgments were high before the task and remained fairly high after task experience, perhaps reflecting perceptions of medical students' interest or experience in health-related domains.

Overall, there is not substantial evidence for age-related deficits in metacognitive awareness across these tasks (Halamish et al., 2011; Hertzog & Hultsch, 2000; Rast & Zimprich, 2009), and older adults' post-task ratings were often in line with their performance. Though some work shows that older adults' metacognitive judgments are less accurate than younger adults' (Bruce et al., 1982; Devolder et al., 1990), the current work suggests that, under some circumstances, older adults' judgments can be more accurate than, or at least as accurate as, younger adults'. When younger adults in Tauber et al. (2019) were asked to estimate older adults' performance using judgments of learning, their responses differed depending on whether they estimated only older adults' performance or if they were also asked to estimate their own performance (i.e., Experiment 1 vs. Experiment 2); in the current study, participants made all four judgments before and after the task, and rating other people could have influenced participants' perceptions of themselves and others (see also Thomas & Jacoby, 2012).

Future work can incorporate repeated judgments after each study-test cycle to assess how learning about one's own and others' memory abilities may change across lists within a task, and whether this learning may differ with age. Additional work may investigate the role of older adults' stereotype threat and anxiety (e.g., Geraci & Miller, 2013; see also Hargis & Castel, 2018a) on memory for medical information, and whether these effects may be mediated by metacognition. Future work can also assess whether younger and older adults differ in how accurate they think their judgments were in this type of memory task (Tullis & Fraundorf, 2017) to investigate confidence in one's perspective-taking and, potentially, to improve participants' ability to take others' perspectives when learning and communicating important information.

In addition to theoretical implications for aging, memory, and metacognition, the current work also has practical implications for the medical field, both in patient care and medical student instruction (see Medina, Castleberry, & Persky, 2017). Individuals learning medication information may benefit greatly from a quick check of their memory: they can learn the content they do not know *and* learn that their expectations about their memory and others' is often overly optimistic. In the current study, a short task reduced or eliminated the extent to which younger and older adult participants overestimated their own and some others' performance. Further research is needed to determine how to implement cognitive principles to enhance learning and perspective-taking when people encounter large amounts of (potentially confusing) medical information, such as at a doctor's office or when reading medication dosage instructions (see Hargis & Castel, 2018a, for a review). Perhaps incorporating established techniques to improve memory and metacognitive accuracy into medical communication (e.g., testing; Larsen, Butler, Lawson, & Roediger, 2013; Roediger & Karpicke, 2006; making important information salient; Castel, 2008; Hargis & Castel, 2018a; Hargis, Siegel, & Castel, 2019; Middlebrooks, McGillivray, Murayama, & Castel, 2015; or understanding overconfidence; Koriat & Bjork, 2005; Metcalfe, 1998) can lead to less confusion, better remembering, and improved health outcomes. In summary, the present work suggests that younger and older adults' perspective-taking can be improved after task experience, a finding which has implications for communicating and learning health-related information across the lifespan.

Author Contributions

The ideas and method were jointly developed by MBH and ADC. MBH collected data and drafted the manuscript, including portions of this work in her doctoral dissertation. Both authors edited the manuscript extensively.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

We thank Bob Bjork, Ted Robles, Barbara Knowlton, Catherine Middlebrooks, Alex Siegel, and Adam Blake for their thoughtful comments.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jarmac.2019.09.004.

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Received 28 March 2019;
received in revised form 26 September 2019;
accepted 26 September 2019
Available online 07 November 2019