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Context Affects Feeling-of-Knowing Accuracy in Younger and Older Adults

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In feeling of knowing (FOK) studies, participants predict subsequent recognition memory performance on items that were initially encoded but that cannot presently be recalled. Research suggests that FOK judgment magnitude may be influenced by the total amount, or quantity, of contextual information retrieved related to the unrecalled target (e.g., Koriat, 1993). The present study examined the contribution of quality of that information to episodic FOK judgments. In addition, we tested whether the episodic FOK deficit demonstrated by older adults could be reduced by encouraging retrieval of contextual information relevant to the target. Three experiments demonstrated that quality of the retrieved partial information influenced FOK judgments in both older and younger adults; however, the manifestation of that influence was age dependent. The results also indicated that older adults required explicit retrieval of contextual information before making FOK judgments in order to make accurate FOK predictions. The results suggest that FOK accuracy may be partially determined by search processes triggered when participants are queried for contextual information.

Keywords: feeling of knowing, metacognition, aging, episodic memory

A fundamental characteristic of episodic memory is the subjective experience of knowing what we can and cannot retrieve. Empirically, this *feeling of knowing* (FOK) has been examined by having participants predict subsequent recognition memory performance on items that were initially encoded but that cannot presently be recalled. Research has repeatedly shown that while imperfect, people's FOKs can predict memory performance (e.g., Blake, 1973; Freedman & Landauer, 1966; Gardiner, Craik, & Bleasdale, 1973; Gruneberg & Monks, 1974; Hart, 1965, 1967; Koriat, 1993; Koriat, Levy-Sadot, Edry, & de Marcas, 2003; T. O. Nelson & Narens, 1980). In this study, we examined the underlying processes that result in accurate episodic memory FOK predictions, as well as how those processes change as a function of normal aging. Following previous research (T. O. Nelson, Gerler, & Narens, 1984; T. O. Nelson & Narens, 1990), FOK accuracy, or resolution, was assessed with intraindividual Goodman–Kruskal gamma (γ) correlations that determined whether the rank order of FOKs was related to likelihood of recognition success (but see Masson & Rotello, 2009).

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The finding of accurate FOK judgments would suggest that individuals can either detect the presence of a target in memory (Hart, 1965, 1967; Nelson & Narens, 1990; Reder & Ritter, 1992) or, alternatively, infer the presence of a target in memory by using a variety of cues (Koriat, 1993; Koriat & Levy-Sadot, 2001; Schwartz & Metcalfe, 1992). There are numerous studies that support an inferential mechanism for the FOK. These studies suggest that FOKs may be inferred from cues such as familiarity with an associate of the target (Metcalfe, 1994; Metcalfe, Schwartz, & Joaquim, 1993; Miner & Reder, 1994; Reder, 1987; Reder & Ritter, 1992; Schwartz & Metcalfe, 1992), expertise in specific domains (Koriat & Lieblich, 1974), and social desirability (Gruneberg & Monks, 1974). For example, Schwartz and Metcalfe (1992) demonstrated that FOK judgments increased when participants were primed with the cues of cue–target pairs in a paired-associate task. Similarly, Schacter and Worling (1985) demonstrated that FOK judgments were higher when participants retrieved affective characteristics of to-be-remembered target words than when they could not retrieve those characteristics. The present study examined how both quality and quantity of attributes, or cues, associated with the nonrecalled targets influenced the FOK in younger and older adults.

The examination of quality and quantity has been conducted to resolve a conflict in the FOK literature. In particular, the accessibility model proposed by Koriat (1993) suggests that in early stages of analysis, FOKs are based on the shallow inspection of partial information. This partial information can range from a vague detail (e.g., visual or auditory) to concrete features, such as the connotation of a target word or perhaps the first letter of a word (e.g., Blake, 1973; Brown & McNeill, 1966; Eysenck, 1979;

Koriat, 1993; Koriat et al., 2003; Schacter & Worling, 1985; Yarmey, 1973). The inspection is nonanalytic and automatic. Thus, FOKs are dependent on the accessibility of such partial information, regardless of correctness. Within the accessibility model, two factors are proposed to influence FOK judgments: the amount of partial information and the ease of access to that information. An important assumption of this model is that quality of retrieved partial information is irrelevant. In support of this assumption, Koriat (1993) found that mean FOK ratings increased as a function of amount of partial information recalled (in this case, number of letters of a nonword), regardless of whether letters recalled were correctly or incorrectly associated with the target.

More recent research suggests that quality of retrieved partial information may influence FOKs (Dunlosky, Rawson, & Middleton, 2005). When participants read expository texts and predicted later recall of definitions from the text, prediction accuracy was constrained by the quality (i.e., correctness) of retrieved partial information. These results suggested that the content of retrieved information influenced the accuracy of the subjective assessment. However, quality of partial information may impact prediction accuracy only when to-be-remembered material is meaningful. FOK judgments typically involve predicting the likelihood of remembering small units of information, such as letter strings or concrete nouns. In this case, correct and incorrect information may be similarly accessible. In Dunlosky et al. (2005), participants made predictions for concepts and ideas embedded in text. In this case, where units of information carried more meaning, correct conceptual units might have been accessed more quickly than incorrect units. If this was the case, FOK judgments may have been influenced by ease of access to partial information and not directly by quality of partial information. Dunlosky et al. did not examine ease of access to partial information. In the present study, we examined the relationship between access to partial information and partial information quality in order to understand exactly how partial information influenced FOK judgments. Speed of access to partial information was measured by recording response latencies (Benjamin, Bjork, & Schwartz, 1998). If the accessibility model proposed by Koriat (1993) is correct, FOK magnitude differences will be accounted for by recall latencies and not by quality of what is recalled.

Aging and Metacognition

The present study also examined whether the often-reported age deficits in FOK accuracy could be reduced if older adults were explicitly directed to examine partial information. Older adults have been shown to be less accurate than younger adults when making episodic FOK predictions (Perrotin, Isingrini, Souchay, Clarys, & Taconnat, 2006; Souchay, Isingrini, & Espagnet, 2000). We investigated whether age deficits in FOK accuracy could be reduced if older adults were explicitly directed to examine accessible information associated with a target. Numerous studies have demonstrated age-related deficits in self-initiated processes. These deficits have been posited to account for age effects in recall (Light & Singh, 1987), divided attention tasks (Naveh-Benjamin, Craik, Guez, & Kreuger, 2005), and frequency judgments (Hasher & Zacks, 1988). However, when older adults were explicitly given some sort of support or additional instruction, age deficits disappeared (Alba, Chromiak, Hasher, & Attig, 1980; Naveh-Benjamin et al., 2005). For example, Thomas and Bulevich (2006) found that age deficits in false memories were reduced when older adults were instructed in how to make accurate source monitoring decisions.

In the present study we compared conditions in which partial information was queried before and after making FOK judgments. We tested whether explicit retrieval of partial information before the FOK judgment would influence accuracy of FOK judgments. We hypothesized that explicit retrieval of partial information would highlight the value of that information and, if done before FOK judgments, would positively influence the accuracy of those judgments. Further, given the well-established deficit in self-initiated processing in older adults, we hypothesized that, in the absence of a specific prompt or instructions, older adults would be less likely to effectively use partial information when making FOK judgments.

In three experiments, we examined the contribution of quantity and quality of partial information to FOK judgment magnitude and FOK predictive accuracy as measured by Goodman–Kruskal gamma correlations. We also examined speed of access to partial information, as well as the placement of the partial information question within the context of a given trial. The present study consisted of three experiments. Experiment 1 examined whether retrieved partial information influenced FOK judgments in both older and younger adults. The methodology employed mimicked that used by Koriat (1993) in which partial information was queried after FOK judgments were made. Participants studied paired associates that consisted of a neutral cue paired with a valenced target (positive or negative). Following study, participants took a cued recall test. If participants could not produce the target, they were asked to make an FOK judgment and then to provide the valence of the to-be-remembered word. This valence judgment served as an index of partial information. Participants then took a final six-alternative forced choice recognition test. Experiment 2 compared conditions where partial information was retrieved before and after making FOK judgments. We hypothesized that older adults would demonstrate improvements in prediction accuracy when partial information was retrieved before making FOK decisions. Latencies associated with retrieved partial information and FOK judgments were also examined to ascertain whether speed of access influenced FOK accuracy. Finally, Experiment 3 required participants to make FOK judgments and partial information responses under the constraints of a deadline. This manipulation was designed to force quick and shallow (unevaluated) access to the associated partial information.

Experiment 1

Method

Participants. Participants were 44 younger adults (29 women and 15 men; age range 18–24; $M = 22.1$ years, $SD = 1.9$) and 46 older adults (27 women and 19 men; age range 61–82; $M = 72.1$ years, $SD = 5.1$). Younger adults were recruited from the participant pool maintained by the Department of Psychology at Colby College and the participant pool maintained by the Department of Psychology at Tufts University. Older participants were community dwelling and were recruited through the participant pool maintained by the Department of Psychology at Colby College and the participant pool maintained by the Department of Psychology at Tufts University. Mean years of education were 13.2 ($SD = 1.1$) and 15.1 ($SD = 2.2$) for the younger and older adults, respectively ($t < 1$). Older adult participants were prescreened for cognitive impairment (Mini-Mental State Exam; Folstein, Folstein, & McHugh, 1975) and answered a questionnaire regarding general health and medication. Older participants were those that presented as cognitively healthy, not suffering from mood disorders, and not presently taking medication that might interfere with cognitive functioning. Individuals received either course credit (younger adults) or $10 per hr (older adults) for participating.

Stimulus materials. A list of 36 English words was compiled, 18 having a positive valence and 18 having a negative valence. The 36 words with a positive or negative connotation served as the targets of the cue–target pairs and were selected from the Affective Norms for English Words word list (Bradley & Lang, 1999). The 36 cue words were selected from the University of South Florida Free Association Norms (D. L. Nelson, McEvoy, & Schreiber, 2004). These words were chosen to have low forward and backward association strength to the paired targets and to have similar frequency in the English language as the paired targets. Additionally, target words that served as distractors in recognition trials were picked to have low forward and backward associative strength to the cue and target on a given trial. The frequency of the cue and target words ranged from 32 to 87, with a mean of 54.

Procedure. The experiment was conducted with E-Prime software on Windows-based personal computers. Younger adults were tested in groups of four, and all responses were entered via keyboard by the participants. An experimenter was present during younger adult group testing. Older adults were tested individually. Older adults' responses were made verbally and entered via keyboard by an experimenter. The experiment consisted of four phases: study, criterion retrieval, FOK, and recognition. In the first block of the study phase, the 36 cue–target pairs were presented. The presentation rates for older and younger adults differed in order to reduce floor effects in the second phase in older adults (and reduce ceiling effects in younger adults). Pilot testing revealed that a presentation rate of 500 ms per pair for younger adults and 5 s per pair for older adults yielded the desired performance levels. A 500-ms interstimulus interval followed each presentation. In the retrieval phase, only the cue words were presented and participants had to type (younger) or verbally indicate (older) the target associated. Eight seconds were allowed. The corresponding target word was then presented for 2.5 s, either 1 s after the participant responded or after 8 s if no response was supplied. If participants reached the performance criterion of 33% correct, they moved to the next phase. If not, the procedure for phase 2 was repeated. If participants did not reach criterion after three repetitions, they were thanked for their participation and the testing ended (for criterion procedure, see Koriat, 1993). Four older adults and two younger adults failed to reach criterion after three presentations. These participants did not complete the next two phases of the study and were not included in analysis. Thirty-seven younger adults and 26 older adults reached criterion after one blocked presentation. Five younger adults and 10 older adults reached criterion after two presentations. Six older adults reached criterion after three presentations.

The FOK phase directly followed the criterion phase. As in the criterion retrieval phase, only the cue words were presented. In the FOK phase, if participants failed to supply an answer within the 8-s time limit, they were asked the FOK question, "What are your chances of recognizing the correct target? (17%–100%)." The instructions given at the beginning of the experiment specified the nature of the recognition test and indicated that 17% represented chance performance (for FOK procedure, see Koriat, 1993). Following the FOK question, participants were asked to rate the meaning of the target words as having a good connotation or a bad connotation and to abstain from responding when they had no articulate feeling about the connotation. The words *good, abstain,* and *bad* appeared on the screen, and participants typed 1, 2, or 3 (young) or said their response aloud (old). Thus, the FOK question preceded the partial information/valence question in Experiment 1.

The final block was the recognition test. On each trial, one cue word appeared on the screen, and beneath it appeared six valenced choices. Presentation order was random for each participant and block. The distractors were chosen randomly from the study list targets, except that across the entire test, each target word appeared equally often as a distractor and was not repeated on two successive trials. Also, the six alternative answers (including the target) included three positively valenced words and three negatively valenced words.

Results

Cued recall and recognition. Unless otherwise stated, all statistical comparisons declared as significant had $p < .05$. Cued recall performance averaged 0.48 correct for older adults and 0.52 correct for younger adults. A 2 (valence: positive, negative) × 2 (age: younger, older) mixed analysis of variance (ANOVA) with valence as a within-participants factor and age as a between-participants factor was performed to examine cued recall performance. The effects of age and valence were not significant (Fs $<$ 1). Recognition performance was examined with a 2 (valence: positive, negative) × 2 (age: younger, older) mixed ANOVA. There was no effect of age or of valence (Fs $<$ 1).

FOK magnitude. Because participants made FOK judgments only when cued recall was incorrect, older adults made judgments on 52% of the trials and younger adults made FOK judgments on 48% of the trials. The number of FOK judgments made did not differ between older and younger adults (see Table 1).[1] The following analyses were confined to the items for which FOK

[1] Gamma correlations can be unstable when there are few observations. We computed gamma correlations as a function of partial information correctness; however, there were different numbers of observations for each partial information group. We have chosen to provide an analysis of the number of observations for each experiment in this footnote. In addition, Table 1 includes a breakdown of the number of observations used to compute gamma correlations. In Experiment 1, participants provided, on average, more FOK judgments in association with correct than incorrect partial information, $t(83) = 5.07$, $d = 0.97$. Participants also provided more FOK judgments in association with correct partial information than when they abstained from the partial information decision, $t(83) = 3.38$, $d = 0.80$. There was no difference in the number of FOK judgments in association with incorrect partial information and abstain responses.

In Experiment 2, older adults in the FOK-before group provided FOK judgments for an average of 18.25 incorrectly retrieved items, and those in the FOK-after group provided FOK judgments for an average of 17.17 incorrectly retrieved items. Younger adults in the FOK-before group

Table 1
Mean No. Incorrect Cued-Recall Responses During the Feeling of Knowing (FOK) Phases as a Function of Quality of Partial Information

Variable and age group	Abstained	Correct valence	Incorrect valence
	Experiment 1		
Old	6.16 (4.66)	7.14 (3.58)	5.45 (2.78)
Young	4.76 (3.38)	8.07 (3.87)	4.67 (2.23)
	Experiment 2		
FOK before			
Old	5.15 (1.72)	8.30 (2.37)	4.80 (1.76)
Young	4.42 (2.97)	8.67 (4.67)	4.08 (2.84)
FOK after			
Old	5.23 (2.48)	6.27 (3.34)	4.21 (2.52)
Young	6.13 (2.43)	8.09 (3.12)	5.41 (2.10)
	Experiment 3		
FOK deadline			
Old	5.21 (1.67)	8.08 (2.45)	4.67 (2.14)
Young	4.95 (2.58)	7.63 (4.33)	4.38 (2.54)
Partial information deadline			
Old	5.55 (2.79)	7.65 (3.19)	4.95 (2.45)
Young	5.45 (2.68)	6.00 (3.36)	4.31 (2.25)

Note. Standard deviation in parentheses.

judgments were made. As we were interested in the relationship between correctness of partial information and average FOK judgments, we conducted a 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) mixed ANOVA with partial information as a within-participants factor and age as a between-participants factor. A main effect of partial information was found, $F(2, 96) = 28.51$, $MSE = 160$. As illustrated in Table 2, FOK judgments were higher when correct partial information ($M = 0.65$) was provided than when either incorrect information, $M = 0.57$, $t(75) = 2.94$, $d = 0.36$, or no partial information was provided, $t(57) = 6.68$, $d = 1.01$. In addition, FOK judgments were higher when incorrect partial information was provided than when no partial information was provided, $M = 0.43$, $t(49) = 5.93$, $d = 0.47$. The interaction between age and partial information was also significant, $F(2, 96) = 6.91$, $MSE = 160$. Younger adults produced significantly higher FOK judgments when correct than incorrect partial information was retrieved, $t(40) = 4.20$, $d = 1.26$. The difference in FOK judgments as a function of partial information quality was not significant in older adults ($t < 1$).

Accuracy of FOK predictions. Goodman–Kruskal gamma correlations between FOK judgments and recognition were computed to examine FOK predictive accuracy, or resolution. These correlations reflect the degree to which individual differences in predictions accurately reflect individual differences in recognition performance. Participants' knowledge of the relative effectiveness of specific cues can be assessed by examining the changes across trials. For the gamma correlation index, large positive values correspond to a strong association between memory performance and judgments, values close to 0 correspond to no association, and negative values correspond to an inverse relationship. Our interest was in determining whether accessibility of partial information (correct or incorrect) influenced the accuracy of metacognitive predictions. In addition, we examined whether younger adults would be more accurate than older adults in their FOK judgments. As such, gamma correlations were computed for each age group and for each partial information category. A 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) mixed-

provided FOK judgments for an average of 15.71 incorrectly retrieved items, and those in the FOK-after group provided FOK judgments for an average of 19.64 incorrectly retrieved items. A 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK before, FOK after) mixed ANOVA performed on the average number of items recalled incorrectly during the FOK phase found a main effect of partial information, $F(2, 120) = 31.33$, $MSE = 6.74$. More FOK judgments accompanied correct than incorrect partial information, $t(72) = 8.03$, $d = 1.27$. Similarly, more FOK judgments accompanied correct partial information than no partial information, $t(68) = 4.85$, $d = 1.06$. There was no difference in the number of FOK judgments made when participants provided incorrect partial information and when they did not provide any partial information ($t < 1$). The effects of age and group were not significant ($Fs < 1$).

Finally, in Experiment 3, older adults in the FOK-deadline group provided FOK judgments for an average of 17.96 incorrectly retrieved items, and those in the PI-deadline group provided FOK judgments for an average 16.95 of these items. Younger adults in the FOK-deadline provided FOK judgments for an average of 18.15 incorrectly retrieved items, and those in the PI-deadline group provided FOK judgments for an average of 15.76 of these items. A 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK deadline, PI deadline) mixed ANOVA performed on the average number of items for which participants made FOK judgments found a main effect of partial information, $F(2, 138) = 27.16$, $MSE = 6.72$. More FOK judgments accompanied correct than incorrect partial information, $t(85) = 8.13$, $d = 1.18$. Similarly, more FOK judgments accompanied correct partial information than no partial information, $t(79) = 4.35$, $d = 0.54$. There was no difference in the number of FOK judgments made when participants provided incorrect partial information and when they did not provide any partial information, $t(75) = 1.75$, $p = .12$. The effects of age and group were not significant ($Fs < 1$).

Table 2
Mean Feeling of Knowing (FOK) Judgments (0.17–1.0) as a Function of Quality of Partial Information

Variable and age group	Abstained	Correct valence	Incorrect valence
	Experiment 1		
Old	0.47 (0.21)	0.60 (0.17)	0.58 (0.22)
Young	0.38 (0.18)	0.70 (0.17)	0.56 (0.19)
	Experiment 2		
FOK before			
Old	0.32 (0.14)	0.53 (0.19)	0.54 (0.22)
Young	0.30 (0.21)	0.71 (0.18)	0.50 (0.24)
FOK after			
Old	0.32 (0.17)	0.81 (0.18)	0.66 (0.13)
Young	0.25 (0.13)	0.75 (0.22)	0.59 (0.32)
	Experiment 3		
FOK deadline			
Old	0.32 (0.13)	0.61 (0.22)	0.52 (0.23)
Young	0.32 (0.18)	0.72 (0.17)	0.50 (0.13)
Partial information deadline			
Old	0.33 (0.21)	0.80 (0.19)	0.58 (0.24)
Young	0.25 (0.13)	0.69 (0.26)	0.59 (0.32)

Note. Standard deviation in parentheses.

design ANOVA was performed on mean FOK accuracy as measured by gamma correlations. A main effect of partial information was found, $F(2, 164) = 3.14$, $MSE = 0.18$. Planned comparisons revealed that FOK accuracy was higher when some partial information (incorrect or correct) was provided than when no partial information was provided, $t(83) = 1.68$, $p = .09$, $d = 0.22$; $t(83) = 2.33$, $d = 0.31$. (See Table 3 for illustration.) A main effect of age was also found, $F(1, 82) = 28.23$, $MSE = 0.30$. In this experiment, when collapsed over partial information, older adults ($M = -0.04$) were significantly worse than younger adults at predicting future performance ($M = 0.32$). The interaction between partial information and age was not significant ($F < 1$).

Discussion of Experiment 1

Experiment 1 examined mean FOK judgments and gamma correlations as a function of quality of retrieved partial information in younger and older adults. Our primary goal was to examine

Table 3
Mean Gamma Correlations Between Feeling of Knowing (FOK) Judgments and Recognition as a Function of Partial Information

Variable and age group	Overall	Abstained	Correct	Incorrect
		Experiment 1		
Old	.03 (.51)	−.09 (.52)	.04 (.42)	−.07 (.42)
Young	.40 (.46)	.19 (.44)	.37 (.50)	.39 (.49)
		Experiment 2		
FOK before				
Old	.09 (.52)	.02 (.53)	−.24 (.53)	−.13 (.64)
Young	.62 (.31)	−.20 (.44)	.59 (.44)	.52 (.33)
FOK after				
Old	.38 (.42)	.11 (.44)	.48 (.33)	.02 (.44)
Young	.61 (.30)	−.02 (.34)	.54 (.27)	.64 (.29)
		Experiment 3		
FOK deadline				
Old	.22 (.40)	−.09 (.38)	.27 (.42)	−.08 (.58)
Young	.32 (.27)	−.07 (.29)	.58 (.42)	−.03 (.30)
Partial information deadline				
Old	.29 (.32)	−.04 (.39)	.37 (.35)	−.10 (.35)
Young	.56 (.25)	−.02 (.20)	.43 (.32)	.47 (.27)

Note. Standard deviation in parentheses.

whether quality of retrieved partial information would play a role in FOK judgments. For younger adults, quality did affect the magnitude of FOK judgments but had no effect on gamma correlations. That is, the magnitude of FOK judgments was higher when correct than incorrect partial information was retrieved; however, younger adults produced above-chance gamma correlations in cases where both incorrect and correct partial information was retrieved. Older adults were no better than chance in their predictions of future recognition. Additionally, older adults did not demonstrate differences in the magnitude of FOK judgments as a function of quality of partial information.

Experiment 2 examined whether older adults would be more likely to effectively use accessible partial information if explicitly prompted to retrieve that information before making FOK judgments. In Experiment 2, the partial information question preceded the FOK judgment. We predicted that older adults would show improvements in prediction accuracy when partial information was queried before they made FOK predictions. In addition, Experiment 2 examined the processes that may have led to the counterintuitive finding of above-chance prediction accuracy in younger adults when incorrect partial information was retrieved. This finding suggests that younger adults may have engaged in additional processing after valence associated with the target was retrieved. Therefore, Experiment 2 investigated whether younger adults evaluated the quality of queried partial information. Latencies associated with the FOK prediction were collected to examine this process. In addition, latencies associated with the partial information judgment were collected to rule out the alternative explanation that correct partial information may have been accessed more quickly.

Experiment 2

Method

Participants. Participants were 47 younger adults (32 women and 15 men; age range = 18–24; M = 18.7 years, SD = 1.1) and 37 older adults (29 women and 8 men; age range = 65–82; M = 70.1 years, SD = 5.8). Younger adults were recruited from the participant pool maintained by the Department of Psychology at Colby College. Older participants were community dwelling and were recruited through the participant pool maintained by the Department of Psychology at Tufts University. The same screening procedures used for older participants in Experiment 1 were used in Experiment 2. Individuals received either course credit (younger adults) or $10 per hr (older adults) for participating.

Stimulus materials. The stimuli used in the previous experiment were again used in Experiment 2.

Procedure. A 2 (valence: positive, negative) × 2 (age: younger, older) × 2 (partial information access: FOK before, FOK after) mixed factorial design was used, with valence as a within-subjects factor and age and partial information access manipulated as between-subjects factors. Twenty older adults and 22 younger adults in the FOK-before group and 15 older adults and 24 younger adults in the FOK-after group completed the entire experiment. As in Experiment 1, younger adults were tested in groups of four, and older adults were tested individually. This experiment consisted of four phases: study, criterion retrieval, FOK, and recognition. One younger adult and two older adults did not achieve criterion learning and thus did not complete the experiment.

The phases in Experiment 2 were identical to those used in Experiment 1, with three exceptions. First, the FOK phase differed as a function of group. In the FOK-before group, after participants supplied an answer or after the 8-s time limit, they were given the FOK question, “What are your chances of recognizing the correct target? (17%–100%).” Following the FOK question, participants were asked to rate the meaning of the target words as having a good connotation or a bad connotation but to abstain from responding when they had no articulate feeling about the connotation. In the FOK-before group, the FOK question preceded the partial information/valence question. In the FOK-after group, the FOK question followed the partial information assessment. Second, latency data associated with FOK judgments and the retrieval of partial information were collected. This necessitated a slight modification to the task instructions. Participants were told to make FOK judgments and partial information assessments as quickly as possible. Younger and older adult latency data were collected via keypress. In the case of younger adults, keypresses were made by the participants. In the case of older adults, keypresses were made by the experimenter entering data for the participant as the information was verbally produced. Third, participants were asked to make FOK judgments and partial information assessments for all 36 items, including items retrieved during the FOK phase. No feedback was given to participants as to the correctness of items retrieved. The recognition phase was the same as in Experiment 1.

Results

Cued recall and recognition. In the FOK phase, older adults’ cued recall performance averaged 0.52 correct and younger adults’ cued recall performance averaged 0.56 correct. A 2 (age: younger, older) × 2 (group: FOK before, FOK after) × 2 (valence: positive, negative) mixed ANOVA did not find a significant difference between age or between group (Fs < 1). However, a significant effect of valence was found, $F(1, 77) = 6.53$, MSE = .01. Participants were more accurate at recalling positive words (M = 0.56) than negative words (M = 0.51). Further, statistical analyses examining FOK magnitude, FOK prediction accuracy, and latencies were confined to trials where cued recall was incorrect (M = 0.48 for older adults and M = 0.44 for younger adults). Final recognition was analyzed with a 2 (valence: positive, negative) × 2 (age: younger, older) × 2 (group: FOK before, FOK after) ANOVA. No significant effects were found (Fs < 1).

FOK magnitude. Although FOK judgments were provided on all items, we confined the analyses to items for which participants provided incorrect cued recall responses, either by error of commission or by error of omission. This was done because when participants accurately retrieved the item, the FOK provided was always 100%. Thus, FOK analysis would have been artificially inflated by accurate retrieval, and comparisons to previous experiments would have been difficult. A 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK before, FOK after) mixed-design ANOVA was performed on mean FOK judgments. A main effect of partial information was found, $F(2, 126) = 74.25$, MSE = 373.61. Planned comparisons revealed that FOK judgments were significantly greater (M = 0.70) when participants provided the correct partial information than when they provided incorrect partial information, $M = 0.57$, $t(80) = 3.60$, $d = 1.10$. Table 2 illustrates this pattern. In addition, FOK judgments were significantly greater when participants gave incorrect partial information than when they did not provide partial information, $M = 0.30$, $t(66) = 8.38$, $d = 1.37$. A main effect of group was also found, $F(1, 63) = 5.04$, $MSE = 439.91$. FOK judgments were higher in the FOK-after group than the FOK-before group. An interaction was found between partial information and group, $F(2, 126) = 5.96$, $MSE = 373.61$. Mean FOK judgments were higher in the FOK-after group but only when partial information was retrieved: correct, $t(79) = 3.23$, $d = 0.75$; incorrect, $t(79) = 1.95$, $d = 0.69$. Finally, a significant interaction between group and age was found, $F(1, 63) = 5.04$, $MSE = 439.91$. Older adults' average FOK judgments were higher in the FOK-after group than the FOK-before group, $t(26) = 3.20$, $d = 0.78$. There was no difference in younger adult FOK judgments as a function of group.

Accuracy of FOK predictions. To investigate relative prediction accuracy as a function of age and group, we performed a 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK before, FOK after) mixed-design ANOVA on mean gamma correlations. A main effect of partial information was found, $F(2, 122) = 12.93$, $MSE = 0.18$. As illustrated in Table 3, prediction accuracy was greater when correct ($M = 0.34$) and incorrect ($M = 0.26$) partial information was retrieved than when no partial information was retrieved ($M = -0.02$): correct-abstain, $t(69) = 4.01$, $d = 1.12$; incorrect-abstain, $t(72) = 3.81$, $d = 1.10$. There was no difference in prediction accuracy as a function of correctness of partial information retrieved ($t < 1$). A main effect of age was also found, $F(1, 61) = 18.45$, $MSE = 0.23$. Older adults ($M = 0.09$) were significantly less accurate than younger adults ($M = 0.36$), collapsing across partial information. Finally, a main effect of group was found, $F(1, 61) = 5.92$, $MSE = 0.23$. Again, collapsing across partial information, accuracy of FOK predictions was higher in the FOK-after group ($M = 0.30$) than the FOK-before group ($M = 0.14$).

Our primary goal in this experiment was to investigate whether FOK accuracy was affected by the time course of partial information access. A significant three-way interaction among age, group, and partial information suggested that FOK accuracy was indeed affected by the placement of retrieval but only in older adults and only when the partial information accessed was correct, $F(2, 122) = 4.69$, $MSE = 0.18$. To examine this interaction further, we conducted a 3 (partial information: correct, incorrect, not given) × 2 (group: FOK before, FOK after) ANOVA for each age group. For older adults we found a significant interaction between group and partial information, $F(2, 64) = 16.80$, $MSE = 0.26$. This interaction was driven by the significant group difference in average gamma correlations when correct partial information was retrieved, $t(32) = 4.45$, $d = 1.79$. Gamma correlations were statistically identical between the FOK-before and FOK-after groups when incorrect partial information was retrieved and when older adults chose not to provide partial information (ts < 1). That is, prediction accuracy was significantly higher for older adults when they retrieved correct partial information before making FOK judgments than when they retrieved correct partial information after making FOK judgments. A similar interaction was not found in younger adults ($F < 1$).

Latencies associated with FOK judgments and partial information access. As with the previous set of analyses, if participants were correct in retrieving items during the FOK phase, those items were removed from the analysis. In order to ensure that the latency analyses were not unduly influenced by extreme scores, we used the following screening procedures. An overall mean and standard deviation were calculated for each participant's FOK judgment latency and partial information judgment latency. Any observation that was greater than 2.5 *SD*s above the mean or 2.5 *SD*s below the mean was treated as an outlier and removed. In addition, we conducted separate analyses for each age group, because the response format differed between older and younger adults. A 3 (partial information: correct, incorrect, not given) × 2 (group: FOK before, FOK after) mixed ANOVA was performed on mean response latencies associated with the partial information answer in younger adults. A main effect of partial information was found, $F(2, 76) = 18.37$, $p < .001$. Planned comparisons revealed that younger adults were faster when they retrieved correct partial information (M = 2337 ms) and incorrect partial information (M = 2,532 ms) than when they chose not to provide partial information (M = 3,898 ms): correct vs. abstain, $t(39) = 5.64$, $d = 0.53$; incorrect vs. abstain, $t(39) = 3.98$, $d = 0.40$. Response latencies were unaffected by quality of partial information in younger adults. That is, response latencies were statistically identical when those associated with correct partial information were compared with those associated with incorrect partial information ($t < 1$). No other effects were significant (Fs < 1). A similar analysis performed in older adults also found a main effect of partial information, $F(2, 52) = 19.04$, $p < .001$. Planned comparisons revealed that older adults responded more quickly when they provided correct (M = 3,360 ms) and incorrect (M = 3,629 ms) partial information than when they did not provide partial information (M = 5,851 ms): correct vs. abstain, $t(27) = 5.25$, $d = 0.49$; incorrect vs. abstain, $t(27) = 4.39$, $d = 0.51$. As with younger adults, response latencies were unaffected by quality of partial information in older adults. No other effects were significant (Fs < 1).

We also examined response latencies associated with FOK predictions. A 3 (partial information: correct, incorrect, not given) × 2 (group: FOK before, FOK after) mixed ANOVA was performed on mean reaction times in younger adults. As with the previous set of analyses, if participants were correct in retrieving items during the FOK phase, those items were removed from the analysis. A main effect of partial information was found, $F(2, 74) = 34.86$, $p < .001$. As Figure 1a illustrates, FOK judgments were made more quickly when correct partial information (M = 2,989 ms) rather than incorrect partial information (M = 5,546 ms) was retrieved, $t(45) = 7.42$, $d = 0.46$. FOK judgments were also made more quickly when correct partial information was retrieved than when no partial information (M = 4,252 ms) was retrieved, $t(66) = 3.48$, $d = 0.39$. Finally, FOK judgments were made more quickly when no partial information was retrieved than when incorrect partial information was retrieved (M = 5,546 ms), $t(38)=3.87$, $d = 0.91$. No other effects were significant (Fs < 1).

For older adults, we also found a main effect of partial information, $F(2, 52) = 5.85$, $p < .005$. As Figure 1b illustrates, FOK decisions were made more quickly when correct partial informa-

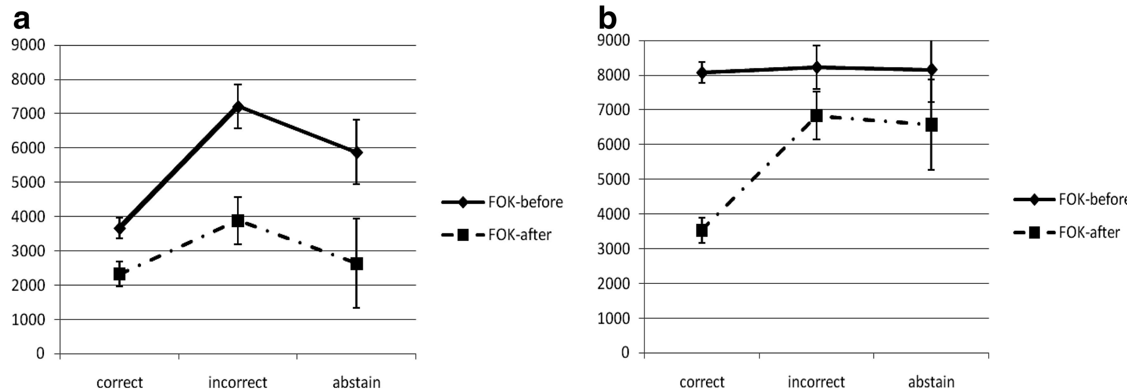

Figure 1. Response latencies in (a) younger adults and (b) older adults as a function of quality of partial information and feeling of knowledge (FOK) judgment time condition in Experiment 2.

tion ($M = 5{,}798$ ms) than incorrect partial information ($M = 7{,}526$ ms) was retrieved, $t(34) = 2.72$, $d = 0.60$, and than when older adults chose not to provide partial information, $M = 7{,}363$ ms, $t(27) = 1.97$, $p = .06$. The difference between FOK response latencies associated with the retrieval of correct and incorrect partial information was not statistically different ($t < 1$). Finally, the interaction between partial information and condition was significant, $F(2, 52) = 3.54$, $p < .05$. For older adults in the FOK-before condition, FOK response latencies did not vary as a function of quality of partial information (mean correct = 8,068 ms; mean incorrect = 8,219 ms; mean abstain = 8,157 ms). However, quality of partial information did influence FOK response latencies in the FOK-after condition. FOK response latencies were faster when participants retrieved correct partial information than incorrect partial information or did not provide partial information: correct-incorrect, $t(34) = 2.72$, $d = 0.55$; correct-abstain, $t(27) = 1.97$, $d = 0.47$.

Discussion of Experiment 2

The findings from Experiment 2 are significant for two reasons. First, the results demonstrate that quality of retrieved partial information influenced the episodic feeling of knowing in older and younger adults. Both older and younger adults gave higher FOK judgments and older adults demonstrated greater prediction accuracy when correct rather than incorrect partial information was retrieved. Second, findings from Experiment 2 demonstrated that partial information influenced FOK judgments in older adults, but only when they were explicitly directed to access partial information before making FOK predictions. However, it is important to note that even though the age deficit in FOK accuracy was reduced, it was not eliminated. Younger adults demonstrated greater prediction accuracy than did older adults. Further, when prediction accuracy was examined as a function of quality of partial information, older adults demonstrated above-chance predictions only when correct partial information was retrieved. Younger adults demonstrated above-chance predictions when both correct and incorrect partial information was retrieved. Finally, the analysis of latency data associated with partial information access indicated that correct partial information was not accessed more quickly than incorrect partial information.

We can draw two important conclusions from these findings. The first is that older adults may not benefit from partial information without explicit direction. This is not entirely surprising when considered in the context of research that suggests that older adults may suffer contextual cue-utilization deficits. Research has suggested that older adults may not effectively use context in episodic memory tasks (e.g., Glisky, Polster, & Routhieaux, 1995; Park, Puglisi, & Sovacool, 1983; Trahan, Larrabee, & Levin, 1986). However, when attention was directed to the context, older adults demonstrated memory performance that was comparable to that of younger adults (Naveh-Benjamin & Craik, 1995; Thomas & Bulevich, 2006; Thomas & Sommers, 2005). The second is that quality of partial information affects FOKs. Correct partial information was not accessed more quickly than incorrect partial information; however, average FOKs were higher when correct rather than incorrect partial information was retrieved.

Experiment 3

Experiment 3 was designed to further explore the hypothesis that younger adults may be more likely than older adults to engage in additional evaluative processing of contextual information. In both Experiments 1 and 2, we found that younger adults demonstrated above-chance levels of prediction accuracy even when incorrect partial information was retrieved. When response latencies associated with FOK judgments were examined, we found that younger adults spent the most time making these decisions when incorrect partial information was retrieved. This was not the case for older adults. Paired with prediction accuracy when incorrect partial information was retrieved, the response latency data suggest that younger adults may engage in additional search processes to support FOK judgments. In order to provide additional support for this explanation, Experiment 3 utilized a response deadline procedure. W examined mean FOK judgments and FOK prediction accuracy in two groups in conditions where participants were required to access partial information or make FOK judgments under a response deadline. We hypothesized that under an FOK deadline, younger adults would not be able to engage in additional search processes and that prediction accuracy would suffer.

Method

Participants. Participants were 51 younger adults (29 women and 22 men; age range = 18–24; M = 19.1 years, SD = 1.5) and 50 older adults (32 women and 18 men; age range = 66–85; M = 72.3 years, SD = 4.5). Recruitment and screening procedures used in the previous experiments were used again in Experiment 3. Individuals received either course credit (younger adults) or $10 per hr (older adults) for participating.

Stimulus materials. The stimuli used in the previous experiments were used in Experiment 3.

Procedure. The previously used procedure was employed for Experiment 3 with some minor alterations. A response deadline manipulation was introduced, and participants were divided into two groups. In the partial information (PI) deadline group, participants responded to the partial information question under a deadline in order to rule out the possibility that participants might differentially access correct and incorrect partial information. In the FOK deadline group, participants responded to the FOK question under a deadline. In both deadline groups, FOK judgments were made after the partial information question was answered. Thus, a 2 (valence: positive, negative) × 2 (age: younger, older) × 2 (response deadline: FOK deadline, PI deadline) mixed factorial design was used, where valence was a within-subjects factor and age and deadline were between-subjects factors. Twenty-four participants in each group completed all phases of the experiment. Three younger adults and two older adults did not achieve criterial performance during the cued recall phase and, thus, did not complete the experiment. As in the previous experiments, younger adults were tested in groups of four, and older adults were tested individually. This experiment consisted of the four previously described phases: study, criterion retrieval, FOK, and recognition. During the FOK phase, the partial information question came before the FOK question. A response deadline of 2,500 ms was chosen for older adults and of 1,500 ms was chosen for younger adults. The same deadline was used for the FOK and partial information deadline procedures. The deadlines were established by examining recorded latencies from Experiment 2. We wanted to give participants enough time to assess the question without allowing careful evaluation of accessible information. Participants were again instructed to make FOK judgments and partial information assessments as quickly as possible. As in Experiment 2, latency data was collected via keypress, which was made by the participant or an experimenter. Participants were informed that they would be required to respond within the confines of 2,500 ms or 1,500 ms (depending on age). The word *RESPOND* appeared on the screen 100 ms before the deadline. A red *X* then appeared if participants did not respond before the deadline. Participants were asked to make FOK judgments and partial information assessments for all 36 items, including items retrieved during the FOK phase. No feedback was given to participants as to the correctness of items retrieved. The recognition phase was the same as in the previous experiments.

Results

Cued recall and recognition. In the FOK phase, older adults' cued recall performance averaged 0.50 correct and that of younger adults averaged 0.59 correct. A 2 (age: younger, older) × 2 (group: FOK deadline, PI deadline) × 2 (valence: positive, negative) ANOVA did not find a significant difference between groups ($F < 1$). However, a significant effect of valence was found, $F(1, 81) = 7.35$, $MSE = .01$. Participants were more accurate at recalling positive words ($M = 0.57$) than negative words ($M = 0.52$). In addition, a significant main effect of age was found, $F(1, 81) = 5.39$, $MSE = 0.06$. Younger adults correctly recalled more items during this phase than older adults. No other effects were significant. A 2 (valence: positive, negative) × 2 (age: younger, older) × 2 (group: FOK deadline, PI deadline) mixed ANOVA on final recognition performance did not yield any significant findings (Fs < 1).

FOK magnitude. As in the first two experiments, statistical analyses were confined to trials for which cued recall was incorrect ($M = 0.48$ trials for older adults and $M = 0.41$ trials for younger adults). A 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK deadline, PI deadline) mixed ANOVA was performed on mean FOK judgments. A main effect of partial information was found, $F(2, 152) = 95.21$, $MSE = 353.94$. Planned comparisons revealed that mean FOK judgments were significantly higher when participants provided correct partial information than when they provided incorrect partial information, $t(95) = 4.99$, $d = 1.15$. In addition, FOK judgments were significantly higher when participants provided incorrect partial information than when they did not provide partial information, $t(79) = 8.41$, $d = 1.27$. No other main effects or interactions were found.

FOK prediction accuracy. To investigate prediction accuracy as a function of age and group, we performed a 3 (partial information: correct, incorrect, not given) × 2 (age: younger, older) × 2 (group: FOK deadline, PI deadline) mixed-design ANOVA on mean gamma correlations. A main effect of partial information was found, $F(2, 114) = 23.93$, $MSE = 0.14$. Prediction accuracy was best when correct partial information was retrieved ($M = 0.41$) compared to when incorrect ($M = 0.06$) and no partial information ($M = -0.04$) was retrieved, $t(71) = 4.59$, $d = 0.09$; $t(68) = 7.79$, $d = 0.99$. Prediction accuracy was also greater when incorrect partial information was retrieved than when no partial information was retrieved, $t(68) = 2.6$, $d = 1.24$. A main effect of age was also found, $F(1, 57) = 10.35$, $MSE = 0.14$. Older adults' FOK judgments were significantly less accurate than younger adults' FOK judgments. Finally, the three-way interaction among partial information, group, and age was significant, $F(2, 114) = 4.20$, $MSE = 0.14$.

To explore this interaction further we conducted separate 2 (partial information: correct, incorrect) × 2 (group: FOK deadline, PI deadline) mixed ANOVAs for each age group. We chose not to include gamma correlations associated with trials for which participants withheld partial information, because under all conditions, both groups of participants were no better than chance at predicting future performance. For older adults, a main effect of partial information was found, $F(1, 34) = 14.82$, $MSE = 0.22$. Prediction accuracy was greater when correct than incorrect partial information was retrieved. No other effects were significant (Fs $<$ 1). A main effect of partial information was also found in younger adults, $F(1, 34) = 12.71$, $MSE = 0.09$. As with older adults, prediction accuracy was greater when younger adults retrieved correct than incorrect partial information. Unlike with older adults, the interaction between partial information and group was significant, $F(1, 34) = 22.96$, $MSE = 0.09$. There was no difference in average gamma correlations when correct partial information was retrieved, $t(38) = 1.41$, $p = .17$; however, average gamma correlations were higher when incorrect partial information was retrieved in the PI deadline group ($M = 0.47$) than in the FOK-deadline group, $M = -0.03$, $t(41) = 5.34$, $d = 0.99$.

Latencies associated with FOK judgments and partial information access. As in Experiment 2, we examined the latencies associated with FOK judgments and partial information access. Due to the design of this experiment, we performed two separate analyses of latency data. First, an overall mean and standard deviation were calculated for each participant's FOK judgment latency and partial information judgment latency. Any observation that was greater than 2.5 *SD*s above the mean or 2.5 *SD*s below the mean was treated as an outlier and removed. Participants rarely responded past the deadline ($M = 0.03$ for younger; $M = 0.04$ for older). Responses that were made after the deadline were eliminated from analysis.

For the FOK-deadline group, a repeated-measures ANOVA was performed with mean partial information response latencies as the dependent variable. This analysis examined three levels of partial information for each age group. For younger adults, a main effect of partial information was found, $F(2, 36) = 3.59$, $p = .03$. As in Experiment 2, responses were more rapid when participants retrieved correct and incorrect partial information than when they did not provide partial information: correct-abstain, $t(20) = 2.32$, $d = 0.81$; incorrect-abstain, $t(18) = 2.32$, $d = 0.62$ (for similar results, see Singer & Tiede, 2008). Incorrect (3,093 ms) and correct (2,899 ms) partial information was accessed similarly ($t < 1$). For older adults, average response latencies appeared faster when correct (4,067 ms) and incorrect (4,132 ms) partial information was accessed than when no partial information was accessed (4,561 ms); however, the repeated-measures ANOVA did not reach statistical significant ($F < 1$).

For the PI-deadline group, a repeated-measures ANOVA was performed with mean FOK response latencies as the dependent variable. This analysis examined three levels of partial information for each age group. For younger adults, a main effect of partial information was found, $F(2, 46) = 35.47$, $p < .001$. FOK judgments were made more quickly when participants retrieved correct (2,497 ms) than incorrect (4,391 ms) partial information, $t(23) = 6.94$, $d = 1.90$, and than when they retrieved no partial information (3,071 ms), $t(23) = 3.32$, $d = 0.81$. In addition, FOK decisions were made more slowly when incorrect partial information was retrieved than when partial information was not retrieved, $t(23) = 5.69$, $d = 1.19$. For older adults, a main effect of partial information was also found, $F(2, 46) = 4.99$, $p = .01$. FOK decisions were made more quickly when correct (3,745 ms) than incorrect (5,058 ms) partial information was retrieved, $t(23) = 4.29$, $d = 1.05$, and than when no partial information (5,290 ms) was retrieved, $t(23) = 2.29$, $d = 1.23$. There was no difference in response latencies when comparisons were made between incorrect partial information retrieval and no partial information retrieval ($t < 1$).

Discussion of Experiment 3

In Experiment 3, FOK prediction accuracy was disrupted in the FOK-deadline group. Both older and younger adults demonstrated a reduced ability to predict future performance. However, both older and younger adults demonstrated above-chance prediction accuracy under PI-deadline constraints. Once partial information was accessed (in this case, valence information), both older and younger adults engaged in additional processes that yielded improvements in prediction accuracy. However, age differences in prediction accuracy remained. Younger adults were able to make more accurate predictions than older adults in cases where incorrect valence information was retrieved. These results suggest two important possibilities: (a) additional search processes may be engaged when participants retrieve some partial information related to the unrecalled target and (b) these processes differ between older and younger adults.

General Discussion

Our primary goal was to examine the conditions under which quality of partial or contextual information influenced FOK judgments in episodic memory. Additionally, we investigated whether older adults would show improvements in FOK prediction accuracy if their attention was directed toward partial information. We found that the quality of partial information influenced mean FOKs and FOK prediction accuracy. This was observed in younger adults, regardless of when partial information was retrieved, and in older adults only when partial information was retrieved before FOK judgments were made.

The Importance of Quality

According to the accessibility model, FOK judgments are determined by the amount of partial contextual information accessed, regardless of its correctness (Koriat, 1993). In the present study, we defined partial information as the affective connotation of the target word. Our definition is similar to that of Koriat (1993, Experiment 3). However, in three experiments we demonstrated, contrary to Koriat's findings, that the quality of partial information did influence FOKs. Further, correct partial information was not accessed more quickly than incorrect partial information. Our findings do not necessarily contradict the assumptions made by the accessibility model. Rather, they suggest that FOKs might be sensitive to the type of materials used and the time allotted for judgments to be made.

The quality of partial information seems to have more of an impact when target items are meaningfully related to the cues. For example, Dunlosky et al. (2005) found that delayed judgments of learning were influenced by quality of partial information when the partial information was conceptual units related to expository texts. Similarly, Koriat (1995) found that FOK judgments were influenced by the quality of partial information when general knowledge questions were used. However, when Koriat (1993, Experiment 3) paired pronounceable nonword strings with words that carried a positive or negative connotation, quality of partial information was less important to FOK judgments. In the present study, we used paired associates. Cues and targets were chosen so that a given pair was low on both forward and backward associative strength; however, a meaningful semantic relationship could still be generated for each pair.

Combined with previous research, the present study suggests that whether the quality of partial information affects FOK judgments may be dependent on the degree to which conceptual meaning can be extracted from the materials. More analytic FOK judgments may arise when conceptual relationships are apparent. Thus, FOK judgments encompass both early inspection of partial information and a more analytic evaluation of candidate responses. Further, the present study demonstrated that above-chance prediction was more likely to result when older and younger adults were given sufficient time to make FOK decisions. In the present study, we found that younger and older adults demonstrated above-chance prediction accuracy when time to make FOK decisions was unlimited. However, when FOK judgments were made under the constraints of a deadline, both groups demonstrated decrements in performance. These results suggest that older and younger adults may engage in additional search processes before generating their FOK judgments.

This proposed search process led to above-chance prediction accuracy even when younger adults initially retrieved incorrect valence information. Under these conditions, as compared to when correct information was retrieved, younger adults also took significantly longer to make FOK decisions. These findings support the conclusion that younger adults engaged in the evaluation of the incorrect partial information, an additional search for relevant information, or evaluation of the FOK decision itself. As one example of how additional time taken has been shown to influence FOKs, in situations in which the use of controlled processes was manipulated (e.g., the time spent retrieving a piece of information, the amount of time studying to-be-learned material), output from that process informed monitoring decisions. As Koriat, Ma'ayan, and Nussinson (2006) suggested, retrieval latencies (how much time one takes to recall an item) can influence the confidence assigned to that item. Similar ideas can be found in work examining the contribution of fluency in recognition memory (Jacoby, Lindsay, & Toth, 1992; Jacoby, Ste-Marie, & Toth, 1993). Finally, the additional processing that likely occurred when younger adults retrieved incorrect valence information either did not occur or was less efficient in older adults. This was evidenced by poor prediction accuracy in older adults.

Directing Attention to Accessible Partial Information

Consistent with previous findings, older adults were significantly less accurate than younger adults in making item-by-item FOK predictions. Even when some partial contextual information was retrieved, older adults were not better than chance at predicting what they would later remember. However, this metacognitive deficit was reduced in Experiments 2 and 3 when partial information was retrieved before FOK predictions were made. Under conditions in which accurate partial information was retrieved, older adults were better able to make accurate memory predictions. This finding demonstrates that older adults may not effectively use accessible partial information as a guide to the feeling of knowing unless explicitly reminded to do so. These findings also suggest that older adult episodic FOK performance is directly related to the accessibility of contextual information. Consistent with previous findings (i.e., Thomas & Bulevich, 2006), the value of that information had to be made apparent to older adults. The results suggest that older adults have to be directed to access that information in order for that information to positively influence the accuracy of FOK predictions.

One of the defining characteristics of episodic memory is the inclusion of contextual information. Memory deficits for contextual information have been posited to account for poor performance in older adults on episodic FOK tasks (Souchay, Moulin, Clarys, Taconnat, & Isingrini, 2007). For example, Souchay et al.demonstrated that older adults made less accurate FOK predictions than did younger adults, unless those predictions corresponded to items for which people had a conscious recollective experience at final retrieval (i.e., those that were given "remember" responses; Souchay et al., 2007). Souchay et al. suggested that older adult were less likely than younger adults to retrieve relevant and accurate contextual information when making FOK decisions. MacLaverty and Hertzog (2009) also demonstrated age equivalence when FOKs were restricted to "remember" responses as opposed to overall recognition performance. These findings suggest that even when cued recall fails, older adults can access relevant cues that can be used to later predict conscious recollective states. The present set of experiments adds to this body of research by demonstrating that older adults can improve FOK prediction accuracy when given specific direction to inspect those relevant cues.

This finding may also shed light on why, when compared to younger adults, older adults typically do not show a deficit in semantic FOK tasks (Allen-Burge & Storandt, 2000; Bäckman & Karlsson, 1985; Butterfield, Nelson, & Peck, 1988; Lachman, Lachman, & Thronesbery, 1979; Marquié & Huet, 2000; for a similar argument, see Souchay et al., 2007). Episodes can be conceptualized as semantic information that is bound with temporal, sensory, and emotional contextual information. Semantic memory is frequently thought of as context free (for a discussion of the differences between semantic and episodic memory, see Tulving, 1985). If contextual information is less important for semantic memory in general, it is plausible that semantic FOK judgments and prediction accuracy for semantic tasks may not be dependent on contextual information.

Conclusion

In conclusion, the present research demonstrated that the quality, or correctness, of retrieved contextual information was an important variable in determining the magnitude and accuracy of FOK judgments. The present study also demonstrated that older adults could make accurate episodic FOK predictions, contrary to previous findings. However, their ability to accurately predict future retrievability was contingent on when in the procedure partial contextual information was retrieved. In contrast, younger adults spontaneously accessed and effectively used this information. This failure in older adults to effectively use the associated contextual information is consistent with research indicating a generalized episodic retrieval deficit in older adults. Finally, the present research demonstrated the counterintuitive finding that younger adults could make accurate FOK predictions after retrieving incorrect contextual information. This finding, paired with the disruption in FOK prediction accuracy under FOK-deadline conditions, suggested that the assessment of partial information may have led to additional evaluation and search processes that triggered more accurate FOKs. Additional search processes may have resulted in retrieval of relevant contextual information not directly queried within the context of this study. We believe these findings are not only important for developing a comprehensive model of the episodic feeling of knowing but are also important for understanding the relationship between metacognition and episodic memory deficits.

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