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Using the phenomenology of memory for recent events to bridge the gap between episodic and semantic memory

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Abstract

Public events such as celebrity news, tragedies, and political events are widely experienced. Initially at least, memories of these events are "episodic" in nature; however, these events are also stored in associative networks similar to the semantic organization of knowledge (N. R. Brown, 1990, *Journal of Experimental Psychology: General, 119*[3], 297–314). Thus, these memories provide a novel way of examining how episodically experienced events might become semanticized and integrated into the knowledge base. Younger and older adults rated their subjective memory strength for and answered questions about details of events occurring over the previous 12 years. Participants also rated their phenomenological experience using a modified remember/know paradigm, in which no instructions about usage of the terms were provided. Interestingly, *remembered* and *known* items were equal in terms of subjective strength. *Know* responses were highly accurate, and more so than *remember* responses. Older and younger adults performed similarly. Participants' own definitions of *remember*, *know*, and *just familiar* revealed that *knowing* is associated with retrieval from semantic memory, whereas *remembering* and *just familiarity* are more associated with event/episodic memory. These results suggest that memory for public events shares phenomenological features with both episodic/event memory and semantic memory. Public events thus allow researchers to examine the complex ways in which storage of novel information can be jointly maintained in both episodic and semantic memory.

Keywords Episodic memory · Semantic memory · Phenomenology · Remember-to-know shift

Since Tulving's (1972) distinction between episodic and semantic memory, numerous lines of research have explored the complex relationship between these supposedly separate but obviously interrelated memory systems (see Renoult et al., 2019). Interestingly, Tulving himself stated that "I will refer to both kinds of memory as two stores, or as two systems, but I do this primarily for the convenience of communication, rather than as an expression of any profound belief about structural or functional separation of the two" (p. 384). He further referred to it as "an orienting attitude or a pretheoretical position" (p. 384). However, in subsequent theorizing, the distinction became more and more marked with efforts to design "process pure" measures that would tap only one or the other proposed memory system.

Although Tulving noted that episodic and semantic memory differed along a number of dimensions (Tulving, 1972, 1983, 1984, 1985, 2002), such as their units, organization, veridicality, and means of access among several others, one particularly useful and utilized distinction lies in the phenomenology associated with retrieval from the different stores. As Tulving (1985) suggested, retrieval from episodic memory is associated with autonoetic consciousness (clearly involving the self in the retrieved event, which is situated at a single point in time and space) and the experience of *remembering*, whereas retrieval from semantic memory is associated with noetic consciousness and the experience of *knowing*. Decades later, the face validity of this claim has now been corroborated empirically: From lay participants to memory experts, there is remarkable consensus around the terms' meanings, aligned with natural language use (Umanath & Coane, 2020). Critically, laypeople did not spontaneously associate *remember* with recollection and *know* with familiarity, in direct contrast to the vast majority of the literature that uses this paradigm to try and capture those

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constructs. Instead, *remembering* was defined in association with event memory whereas *knowing* was defined as related to retrieval from the knowledge base. Thus, in the present work, we rely on phenomenological experiences of retrieval success, primarily *remembering* and *knowing*, to begin to explore how recently acquired information may become integrated into semantic memory. In a novel way of examining this question, we used naturally occurring stimuli: recent events covered in the media. In particular, we identified events that were highly pervasive and short-lived. In the current era of "viral" media events and a rapidly changing news cycle, such events provide a unique window into naturalistic memory processes. The use of such stimuli allows us to study retrieval processes in the absence of a controlled episodic encoding phase and to observe how encoding "in the wild" results in the formation of memories and perhaps knowledge.

Episodic and semantic memory: A brief overview

The concept of episodic memory (and the associated notion of *remembering*) has evolved immensely from Tulving's original proposal: "I did such and such, in such and such a place, at such and such a time" (Tulving, 1972, p. 389; see Renoult et al., 2019; Renoult & Rugg, 2020, for reviews). These developments have been well documented elsewhere (see Rubin & Umanath, 2015; Umanath & Coane, 2020, for reviews). Over time and with a great deal of research, the definition of this kind of memory has become increasingly specific. Simply put, episodic memories are considered to be of singular, self-relevant, voluntarily retrieved events and are accompanied by a sense of mental time travel or reliving (Tulving, 2002). We will be using this strict definition and terminology, in contrast to discussing the broader concept of event memory (Rubin & Umanath, 2015) for the sake of consistency and clarity, because our stimuli are events.

Similarly, the concept of semantic memory has changed over the years. From Tulving's (1972) initial definition focusing primarily on abstract, decontextualized memory of verbal materials and the abstract relations between lexical units, the concept has grown to include important elements such as modality-specific representations and embodied knowledge as well as categorical and conceptual knowledge. Much of the research in semantic memory focuses on the nature and organization of the representations, be they amodal or grounded, feature-based or network-based (for a review, see Balota & Coane, 2008).

Many approaches to examining episodic and semantic memory have attempted to isolate these forms of memory using "process pure" methods (e.g., Jacoby, 1991). Ebbinghaus (1885/1913), in his ground-breaking study on forgetting, used nonsense syllables to avoid contamination from prior knowledge, which he assumed would affect estimates of performance. A large body of subsequent work similarly employed nonsense syllables (e.g., Jenkins & Dallenbach, 1924; Underwood, 1953; but see Hull, 1933) to try to isolate episodic performance. Similarly, traditional approaches to studying semantic memory do so by asking participants to retrieve information from the knowledge base in the absence of an episodic encoding task, either through general knowledge tasks (e.g., Morson et al., 2015), vocabulary tasks (see Verhaeghen, 2003, for a review), or speeded tasks such as lexical decision or pronunciation (e.g., Meyer & Schvaneveldt, 1971). Thus, researchers have attempted to compartmentalize the contributions of each form of memory to qualify and quantify the processes and mechanisms involved. Yet, as suggested by Tulving (1972) and confirmed by a substantial body of research, these two forms of memory may be less independent than such approaches assume or hope (e.g., Greenberg & Verfaellie, 2010; Renoult et al., 2019; Rosenbaum et al., 2017; Versace et al., 2014).

Semantic memory acquisition

One area that has revealed itself to be particularly challenging to study concerns the processes involved in the acquisition of semantic memory and the extent to which it depends on episodic memory. In a recent review of Tulving's work, Renoult and Rugg (2020) underscore this and note that "Tulving's (1972) observation that inputs to semantic memory are generally unknown still appears valid" (p. 2). Whereas research has greatly expanded our understanding of the systems and processes involved in learning and encoding processes in episodic memory, much less is understood about encoding into semantic memory, in part because of the inherent difficulties in researching a system that encompasses so many components (e.g., mental lexicon, conceptual knowledge, general knowledge, autobiographical semantic memory). Schemata, or organized representations of repeated events, actions, or situations, are a fundamental aspect of knowledge construction. Many approaches to examining how information is acquired into semantic memory emphasize the importance of the process of "semanticization" or schematization, whereby knowledge and schemata are an emergent property of episodic memory (Renoult et al., 2019).

It is assumed that these representations emerge as a result of repetition over time; however, there is limited research in how the learning and abstraction process occurs (Zacks et al., 2021). For example, Baddeley (1988) suggests that semantic memory is the result of the abstraction of multiple episodic traces that have lost their specificity and contextual information. A number of computational models (e.g., Howard et al., 2011), neuroscientific approaches (Mack et al., 2016), or a combination thereof (McClelland et al., 1995; Nelson & Shiffrin, 2013) corroborate that episodic traces might give rise

to semantic knowledge. For example, Nelson and Shiffrin's (2013) computational model proposes that individual events (episodes) result in the creation of a trace. Repetition of that event or a similar event will create a new trace or augment the existing one; the event trace will store featural elements (e.g., context) of the specific occurrence as well as the retrieved knowledge. Through repeated exposure, the developed knowledge comes to include all prior contexts; because none of the contexts are particularly salient, the knowledge is perceived as being context-free (i.e., "known"). Schank and Abelson (1995) similarly suggested that knowledge emerges from episodes, and Hintzman's (1986, 1988) MINERVA model likewise assumed that individual traces stored as vectors of primitive features could give rise to categorical knowledge and mimic prototype effects. Even Tulving (1993) noted that episodic memory may influence encoding into semantic memory, although he claimed it is not necessary. As Renoult and Rugg (2020) further note, it is generally difficult to control the acquisition of semantic knowledge, other than in isolated cases, such as children's naturalistic conceptual learning or learning of novel, often artificial, concepts in adults.

We acknowledge that the accumulation of traces in episodic memory is just one established route for the acquisition of semantic memory. Research on fast-mapping suggests that learning can occur in a single trial or after relatively few trials (e.g., Coutanche & Thompson-Schill, 2015). Furthermore, evidence from patient populations, such as individuals with developmental amnesia (e.g., Brandt et al., 2006; Vargha-Khadem et al., 1997) indicates semantic memory can emerge under conditions of severely impaired episodic memory. However, there is consensus that non–hippocampally mediated learning that is dependent on neocortical regions is slower and less efficient (see Greenberg & Verfaellie, 2010 for a review). The patients show that episodic and semantic memory can, under certain circumstances, function independently of one another. However, in depth discussion of this work is beyond the scope of our effort (see Kim, 2016; Maguire, 2014, for reviews). Furthermore, such approaches, while valid and informative, are often limited to word pairs or other relatively simple materials, and thus fail to provide insight into the integration of more complex events into knowledge systems.

In sum, several theoretical approaches suggest that facts are initially represented in memory with links to contextual details such as source, but that over time these episodic details are lost, resulting in "purely" semantic memories (Tulving, 1985). Although the idea that memories transition across forms of memory is a popular one, there is surprisingly little behavioral data in healthy adults on this type of relationship, primarily because it is very difficult to study, given the challenges involved in simulating learning experiences that are comparable to the rich, repeated, contextually variable, and multimodal exposure to information that occurs in naturalistic contexts. This leaves open the question of how newly or recently acquired information might transition from being episodic in nature to being integrated into the knowledge base and semanticized.

Classroom studies have broached the practical implications of the transition from episodic to semantic stores by examining transitions in phenomenology from remembering to knowing. For example, Conway et al. (1997) suggested that some episodic memories may transition into semantic knowledge through decontextualization. Across an entire school year, high achievers in the classroom were less likely to *remember* where they had learned information (e.g., in a textbook vs. in a lecture) and more likely to identify the information as *known* than *remembered*. The authors argued that these students had developed extensive frameworks of background knowledge that facilitated integration of new information with preexisting knowledge (also see Barber et al., 2008). Furthermore, when students were given review opportunities in different formats (e.g., multiple choice vs. recall), they were more likely to manifest the *remember*-to-*know* shift and had greater schematization of knowledge than students with fewer review opportunities (Herbert & Burt, 2004). Under more carefully controlled experimental conditions, Dewhurst et al. (2009) obtained a similar *remember*-to-*know* shift for the definitions of obscure words. This shift is assumed to reflect the transition from primarily episodic representations to semantic representations.

Memory for recent events

Behavioral work involving naturalistic presentation of information over extensive periods of time, either in formal educational contexts or informal situations "in the wild," is consistent with the theoretical approaches outlined above: Repetition of episodically acquired traces can result in semantic or semantic-like knowledge. In the present work, instead of relying on classroom instructional approaches, we capitalized on the widespread availability of information in the digital age by examining memory for relatively recent news events. Because events encountered in the media are likely encountered in different formats, distributed over time, and experienced in multiple modalities, such events are good candidates for becoming schematized into the knowledge base. Thus, they provide a strong test case for the models reviewed above, which propose that repetition of episodically encountered events can give rise to decontextualized and abstracted knowledge.

In early work examining memory for events, N. R. Brown (1990) examined what he termed "historical memory" or memory for recent events acquired in the news or media, which, he argued, is integrated into the knowledge base and is critical for supporting functions such as discourse comprehension, decision-making, and opinion formation. Historical

memory, which is assumed to be tied to specific time periods (e.g., a presidential administration) is often acquired secondhand and in a multimodal manner, through news reports, television or radio, and discussions. This knowledge is generally organized in a narrative-like structure, where related elements of a story are connected in long-term memory. In this sense, memory for events learned in the news shares characteristics with semantic memory, as these events are integrated within the knowledge base. However, the personal context in which such knowledge is acquired also forms part of a complex memory trace (cf. flashbulb memories; R. Brown & Kulik, 1977).

The use of public events as experimental stimuli offers two distinct advantages over more traditional approaches, such as word lists studied and tested in a laboratory. First, such stimuli are rich, detailed, and complex. Naturally occurring events, unlike words or even more complex prose passages or movie clips, unfold over extended periods of time, are composed of multiple elements, and likely involve different levels of analysis, from coarse-grained to fine-grained (Zacks et al., 2001). Second, these events allow us to assess memory performance over delays that are much longer than those typically observed in laboratory settings. As argued by Bahrick et al. (2013), much of our understanding about long-term memory is constrained by the relatively short retention intervals used in the majority of studies. This is exactly why studies like Conway et al. (1997) are so few and far between, but so fundamental in addressing these questions. Clearly, using naturally occurring stimuli comes at a cost—namely, controlling the exposure rate and consequent encoding, not knowing whether all participants were exposed to information in the first place, and variable levels of interest and delays. Thus, we want to be explicit in saying that our approach here is not examining memory for specific events in any attempt to achieve process purity in an experimental task. Instead, we strive to examine episodic and semantic memory as they naturally unfold, using participants' experiential reports to provide insight into memorial situations in which the distinction between the two might be particularly blurry, as we would expect if memories are "transitioning" from one store to the other. In the Discussion, we connect our use of events as stimuli to other bodies of literature examining memory for recent and remote events.

The present work

Our basic goal was to extend upon the use of phenomenological experiences of retrieval (i.e., *remember* and *know* responses) to examine whether they can effectively distinguish between retrieval from episodic or semantic stores. Although the long-term goal of this research agenda is to examine factors that promote the formation and accessibility of long-term knowledge, this work provides an initial assessment of the validity of the measures.

Shifted away from Tulving's (1985) original discussion of *remembering* and *knowing*, the distinction between these phenomenological experiences has been primarily used to explore different retrieval processes within episodic retrieval, namely, recollection and familiarity (Mandler, 1980; Rajaram, 1993, 1996). Recently, however, as mentioned above, Umanath and Coane (2020) provided evidence that both lay participants and experts in psychology associate *remembering* with the retrieval of specific events or episodes and *knowing* with retrieval from the knowledge base, in line with Tulving's original distinction. Here, consistent with that work, we capitalized on and examined intuitive use of the terms in the context of thinking back on recent events. That is, we asked participants to provide their own definitions of these terms in addition to using the terms, to explore whether recent events, when retrieved, are associated with the same phenomenological experiences typically ascribed to episodic versus semantic memory. Furthermore, in typical episodic recognition tasks, *remember* responses are more accurate than *know* responses (which reflect familiarity in that context); however, if *knowing* is associated with retrieval from the knowledge base and not with familiarity, then we might find equivalent or higher accuracy for *known* than *remembered* events.

We included a sample of older adults (OAs) to verify the generalizability of any effects across populations known to differ along a number of dimensions. OAs typically have a larger and richer knowledge base and show a greater reliance on this base than do younger adults (YAs; Umanath & Marsh, 2014); however, most of the research supporting this difference has examined general knowledge that is relatively stable or crystallized (e.g., Verhaeghen, 2003). Whether OAs would also outperform YAs regarding recent news, if this even "counts" as a form of general knowledge, was unclear. OAs also tend to perform worse than YAs on traditional episodic tasks (Balota et al., 2000). Thus, there might be differences in how well they are able to retrieve information about these specific events, if these events are more episodic in nature in memory. However, if the events have been strongly encoded—which is possible, given the way many events are covered in the media—or if they have become integrated into the knowledge base, age differences might be minimized. Thus, OAs' performance, both on the retrieval task and in terms of phenomenological assessments, provide potentially converging evidence with the experiences of YAs in support of how events might transition from episodic to semantic in nature.

We combined ratings of subjective memory strength for an event with retrieval attempts in a multiple-choice recognition test of specific details concerning the event and the phenomenology associated with successful retrieval. We acknowledge that recognition, especially in a multiple-choice task, can

reflect multiple processes, from recollection to familiarity to implicit memory and guessing. The phenomenological responses (*remember*, *know*, *just familiar*, and *guess*) were included to partition the underlying processes as much as subjective ratings allow, consistent with prior work. In addition, the subjective memory strength ratings can provide converging evidence concerning the validity of our modified use of the R/K paradigm. In typical R/K studies involving episodic recognition tasks, *remember* responses are associated with stronger and more detailed memory than *know* responses (e.g., Wixted & Mickes, 2010); thus, the subjective memory strength ratings can provide insight into whether the naturalistic use of the same terms is also characterized by differences in perceived strength or whether, when used to reflect retrieval from episodic vs. semantic memory, subjective strength is similar across response options.

We hypothesize that if memories for recent events are episodic in nature, and preserve the key characteristics of being contextualized in time and space and autonoetic consciousness, more *remember* responses following correct recognition are expected. Conversely, if recent events have become integrated into the knowledge base, and are devoid of contextual information and associated with noetic consciousness, more *know* responses following correct recognition are expected. As N. R. Brown (1990) noted, both episodic and semantic characteristics are likely to be involved, suggesting that memories for events might not neatly fit into one or the other category. However, the phenomenological experiences surrounding these current events still provide some insight into the degree to which these events are transitioning into being part of the knowledge base.

Method

Participants

Target sample size was based on our earlier work examining the phenomenology of retrieval failures (Coane et al., 2018; Coane & Umanath, 2019). We increased the target sample size to account for the fact that our phenomenological responses included four instead of two options, and we wanted to ensure we had sufficient responses in each cell; constraints on participant pool sizes, especially for OAs, prevented us from doubling our sample size. A sensitivity analysis using G*Power (Faul et al., 2007) indicated sufficient power to detect an effect size *f* of .17. Forty-six OAs, all over the age of 60 years, from the Waterville, Maine, area, participated. Sixty-five younger adults from Colby College (n = 26) and Claremont McKenna College (n = 39) participated in exchange for course credit or $5; older adults were compensated with $5. Data from one participant from Colby College were lost due to computer issues, leaving 64 complete data sets. YAs were oversampled because data collection was conducted in parallel at both sites.

All participants completed the Shipley (1940) Vocabulary Scale, in order to assess general cognitive ability. Vocabulary serves as a proxy for general knowledge, which increases over the life span (e.g., Salthouse, 2004). More generally, performance on vocabulary tasks provides a snapshot of verbal abilities and language knowledge. Furthermore, general knowledge and word knowledge are related to performance on news events questionnaires (Howes & Katz, 1988). As is typically found, OAs outperformed YAs in the vocabulary task, $t(94.22) = 9.24$, $p < .001$. OAs were also administered the Mini-Mental State Examination (MMSE; Folstein et al., 1975). All participants scored at or above 27, indicating no significant cognitive impairment.

Materials and procedure

We initially selected a large set of events spanning the years from 2006 to 2016. These events, pertaining to politics, international affairs, and pop culture, were selected from a variety of sources (e.g., news websites, social media sites, websites like Buzzfeed and Wikipedia). Initial selection was conducted by looking for the "top 10" or "most popular stories" of the year on a variety of sites. Many popular sites generate such lists at the end of each year (e.g., NBC lists the "most read stories," *USA Today* lists the "news year in review"). Sample items included the mass shooting at Virginia Tech in 2007, the death of Steve Jobs in 2011, and the legalization of same-sex marriage by the U.S. Supreme court in 2015. This was done to try to isolate single events, instead of ongoing events represented in the media over extended periods of time. Once a potential item had been identified, key terms were entered into Google Trends to examine search history patterns. Items were selected if there was a well-defined peak that could be isolated within a month, after constraining the search dates to the period between 2006 and 2016 (when the original stimuli were selected). Data in Google Trends are normalized to correct for relative popularity and are filtered to remove very uncommon searches, repeated searches by the same individual over a brief time span, and special characters (for more information on how Google Trends manages data, see: https://support.google.com/trends/answer/4365533?hl=en). This process yielded a total of 178 events, with approximately 16 (range: 6–27) items from each calendar year.

The items were tested in an online pilot study, conducted in the summer of 2016, to verify that the items spanned a range of difficulty and familiarity. In the pilot test, different groups of participants rated the familiarity of brief event descriptions (e.g., *Malaysia Airlines Flight 17 shot down*) or answered open-ended questions about the same events (e.g., *Over what country was Malaysia Airlines Flight 17 shot down in 2014?* [correct answer: Ukraine]). From the original set, we initially

selected 87 to span a range of difficulty. These events were rated as moderately familiar ($M = 4.49$, $SD = 1.0$, on a 7-point scale ranging from *not at all familiar* to *very familiar*) and as having a broad range of difficulty ($M_{correct} = .48$, $SD = .21$, range: 0–1). An additional 13 items, from 2017 and 2018, were not pretested but were selected using the same parameters as the original items. The final stimulus set included an average of 7.69 items from each year between 2006 and 2018 (range: 4–15). The selection of items spanning several years was intended to guarantee a range of familiarity and difficulty, not to examine specific decay functions, given likely differences in salience or memorability of the different events.

Participants were tested on computers running E-Prime (Schneider et al., 2012). Participants were tested individually or in small groups (older adults were only tested individually). The experiment consisted of two phases: subjective memory strength ratings and recognition followed by phenomenological rating. After providing consent and demographic information, participants rated the 100 experimental items, presented in random order, in terms of the quality and quantity of information they could retrieve (i.e., 1 = "I have no memory of this event"; 3 = "I have some memory of this event"; and 5 = "I have a very clear and detailed memory of this event"). Thus, higher ratings reflect a stronger and more detailed memory. In this task, participants were presented with a brief, general description of each event that did not include any of the details that would be tested in the recognition test (e.g., *Eric Garner's death*). We opted not to use the term familiar/unfamiliar because the phenomenological assessment portion of the memory test (described below) included the option *just familiar*, and we wanted to avoid biasing participants' responses one way or another.

After the subjective memory strength rating task, participants answered three questions in a random order in which they indicated what they meant when they say "I remember something," "I know something," or "something is just familiar." Of course, the validity of the paradigm hinges on participants' understanding and self-report of their phenomenological experiences as well as researchers' subsequent ability to infer cognitive processes and states from those introspective judgments. These questions were asked before the final test because (1) we wanted participants to use the terms in a manner consistent with their own interpretation of their meanings, and (2) we wanted to examine the degree to which participants' responses reflected discrimination between the different phenomenological states and potentially aligned with the findings reported in Umanath and Coane (2020) when participants answered, "When I say I remember, I mean that . . . ." and "When I say I know, I mean that . . . ." without any context whatsoever. In addition, we wanted participants to consider the different experiences associated with retrieval success prior to making their responses on the recognition test. Qualitative analyses of the answers to these questions are reported below. We followed Umanath and Coane's (2020) procedure and used open-ended questions, which we then coded for references to several underlying theoretical constructs including recollection, familiarity, event memory, and semantic memory, among others that are linked to distinct phenomenological experiences of retrieval (see Table 2). Importantly, participants were given no instructions in how to use the terms or define them, in marked contrast to the standard use of the R/K paradigm.

On the multiple-choice recognition test, which was our measure of objective memory performance, participants responded to questions about specific details of the events, presented in a new random order. The correct response and three incorrect options were included. For example, one question asking how Eric Garner died included, in addition to the actual cause of death (*choking* or *asphyxiation*), the alternatives *shot*, *tasered*, or *run over*. Foils were developed by the researchers and selected so as to be plausible. The order of the response options varied across questions and participants made their response by pressing the number key corresponding to the digit presented next to each response. After selecting their response, a new screen appeared in which participants indicated whether their response was made on the basis of remembering, knowing, familiarity, or guessing. *Just familiar* and *guess* response options were included, as in Conway et al. (1997), where *knowing* was defined for participants as reflecting certainty that an item was correct in the absence of information about the learning context, whereas familiarity was defined as a relative assessment, where an item was judged as more familiar than others. Performance differed for responses based on *knowing* and those based on familiarity; over time, correct *know* responses increased, whereas *just familiar* responses were stable. Providing distinct response options avoids conflating the two experiential states in a single response, and results in increased accuracy and confidence of *know* responses (Dewhurst et al., 2009). No time limits were imposed in either task.

The task took approximately 30 minutes to complete and participants were thanked, debriefed, and compensated upon completion.

Results

In all analyses, where relevant, degrees of freedom are corrected for violations of the assumptions of the test (Greenhouse–Geisser for analyses of variance [ANOVAs]). Partial η^2 is reported as a measure of effect size for ANOVAs, and Cohen's d is reported for t tests. Pairwise comparisons reflect a Bonferroni correction. In the analyses reported below, we adopted a conservative screening process for removing participants whose answers to the questions about use of *remember*, *know*, and *just familiar* were missing or

could not be meaningfully coded (e.g., "I am very familiar with the subject," "I remember that"). Most participants whose data were excluded had one such response of the three definitions; we excluded all trials for those participants. It is worth noting that all the ambiguous responses were to *remember* and *just familiar*. This resulted in removing the data from three YA and nine OA participants, leaving 61 YAs and 37 OAs in the analyses. Analyses including the full data set yielded identical results. Demographic information about the participants whose data were included in the analyses can be found in Table 1.

We first present the analyses of the phenomenological definition task, because it serves to orient the reader to how our participants considered and used the terms *remember*, *know*, and *just familiar*. We then report the results of the multiple-choice test. We present the analyses on subjective memory strength last (even though chronologically participants completed it first) because these ratings were examined as a function of the phenomenological response given following recognition.

To preview our main findings, the usage of *remember* and *know* was highly consistent with our earlier findings (Umanath & Coane, 2020): *Remembering* is associated with retrieval of details and of specific events; *knowing* is associated with retrieval from the knowledge base; and interestingly, *just familiar* is defined as reflecting prior experience in the absence of specific details, thus confirming a dissociation between *knowing* and *familiarity*. Performance on the multiple-choice test revealed that recent events, when retrieved, preserve characteristics of both episodic and semantic traces, as defined by an analysis of phenomenological responses. Accuracy was high for *remembered* and *known* items, with the latter more accurate than the former. Finally, subjective memory strength ratings were equally high for details subsequently *remembered* and *known* and lower for items recognized on the basis of familiarity and guessing.

Phenomenological definitions

All valid responses were independently scored by the two lead authors (JHC and SU) authors using the coding scheme provided in Table 2. For a full explanation of the development of this theory-based coding scheme, please see Umanath and Coane (2020). Note that the responses to all three questions were coded together with the coders blind to which question each response was associated. For each dimension, a score of 1 indicated the criterion was present, and 0 indicated it was not. Each participant's response for each question was given a score of 1 or 0 for every dimension. The proportions reported refer to the proportion of participants who referenced a particular dimension or to the proportion of responses that included that dimension. Note that each response was coded for all dimensions such that it could earn a score of 1 or 0 on multiple dimensions. For example, the response to a *remember* prompt, "I can recall the main idea or motivation behind an event and some details," was coded as Recollection and Event, and the response to a *know* prompt, "I can access retrieve [sic] information from either my short-term or long-term memory. Information that I can easily access without much thought" was coded as Semantic and Fluency. For more examples, please see Table 2. Correlations between the two coders ranged from .98 to 1. Discrepancies were then resolved through discussion.

Several 3 (term: *remember*, *know*, *just familiar*) × 2 (age group: younger adult, older adult) mixed ANOVAs were conducted to examine the relative inclusion of different dimensions in answering what these terms meant across the participant groups. These dimensions were applied to capture participants' references to well-established underlying theoretical constructs such as recollection versus familiarity, event versus semantic memory, accuracy, confidence, and others. Definitions of *remember* and *know* generated without specific contexts in mind from laypeople and psychology and memory experts indicated that in natural language use, *remembering* is most associated with recollection and event memory whereas *knowing* is associated with retrieval from the knowledge base, accuracy, confidence, mastery, and experience (having learned something before; Umanath & Coane, 2020). Here, we sought to examine how participants would experience and use *remembering* and *knowing* with our particular stimuli that seemingly exist in the murky space between event memory and the knowledge base. The inclusion of *just familiar* as a response option allowed us to directly compare *knowing* and familiarity and to isolate the usage of each. We discuss each dimension in turn to provide a full picture of how participants defined each term in comparison to the other two. To preview, regardless of age group, participants' definitions for *remember*, *know*, and *just familiar* diverged for most of the dimensions considered with very few interactions. The results

Table 1 Demographic information for participants (standard deviation and range in parentheses)

	Mean age	Mean years of education	Shipley Vocabulary	MMSE
Younger adults	19.41 (1.15; 18–22)	12.89 (1.07; 11–16)	31.08 (4.16; 21–37)	N/A
Older adults	69.34 (5.76; 60–87)	16.27 (2.26; 12–20)	36.65 (2.73; 28–40)	29.43 (.90; 27–30)

Note. *MMSE* Mini-Mental State Examination (Folstein et al., 1975)

Table 2 Dimensions used in coding participant definitions of "remember," "know," and "just familiar" with sample responses (adapted from Umanath & Coane, 2020)

Dimension	Definition	Sample answers
Recollection	Response included reference to the process of recollection of specific details, experience of reliving, or used the word "recollect" explicitly	I have a vague mental image pop up in my mind; I can definitely conjure up a vivid description of something; I can remember the moment I learned about it and the details well enough to explain the event
Familiarity	Response included information such as "feels familiar" or the response indicated a lack of detail combined with a sense of prior experience	I can sort of recall an event, but not vividly; I have a vague memory; I can somewhat retrieve it from my memory, but it is difficult and not all details are present
Event	Response indicated retrieval of an event from the past	I can think about some event from the past; I can recall the event; I remember the event occurring
Semantic	Response referenced retrieval from the knowledge base	I have some information about the subject or it's workings; I know most of the details on it and can explain them well; I know facts, details, and descriptions of the event if asked
Accuracy	Response included reference to the perceived accuracy or to the factual or evidence-based nature of the retrieved information (high or low)	I am sure of the facts because I have studied the subject or lived through it; I know it as a fact; I am certain of a set of facts and I can state and expound on the facts
Confidence	Response included reference to confidence or certainty of answer (high or low confidence)	I am able to respond without hesitation that I am correct in providing details; I distinctly remember enough about it that I feel I won't be disputed if I speak up; I feel I may know something about the topic but am not sure about it
Fluency	Response included statements that reflected the ease of retrieval or the speed and automaticity with which information came to mind	…without too much prompting; I am able to respond without hesitation; I am able to recall the event off the top of my head immediately
Mastery	Response indicated depth of knowledge and comprehension of the material	I am fully able to recall every detail possible from memory; I have the appropriate knowledge to speak about a certain topic; I can recall enough information to have a solid understanding about an event
Experience	Response included a reference to the fact that the information was learned or encoded at some point, that the individual had been exposed to the information at some point, or had gathered the information through experience	I have a lot of experience with it or am greatly familiar with it with substantial information and experience to discuss; I can remember the moment I learned about it; I can recall either hearing or reading something about an event

of the statistical tests are reported in Table 3, and all the means are depicted in Fig. 1.

Recollection

Regardless of age group, participants referenced recollection significantly more often when defining *remembering* (M = .74) than *knowing* (M = .29) or *just familiar* (M = .11), which also significantly differed from one another. The interaction did not reach significance. Other than event memory, which we will discuss in detail below, recollection was the dimension that was referenced most to explain participants' use of *remember*.

Familiarity

Regardless of age group, participants referenced familiarity significantly more often when explaining how they defined *just familiar* (M = .77) than *remember* (M =.12) or *know* (M =.01). Note that references to familiarity were essentially at floor regarding *knowing*, significantly less referenced than for *remembering* as well. The interaction was not significant.

Event

Event memory was the only dimension for which all effects showed statistical significance. For the sake of clarity, we focus on the Term × Age Group interaction. Both age groups showed differences across their uses of the three terms, YAs: $F(2, 118) = 3.38$, $MSE = .16$, $\eta_p^2 = .42$, $p < .001$; OAs: $F(2, 72) = 10.44$, $MSE = .16$, $\eta_p^2 = .23$, $p < .001$, but these usages are different. Both OAs and YAs referenced event most often for *remembering,* though OAs do reference it less (M = .54) than YAs do (M = .82), $t(95) = 3.02$, $SED = .09$, $d = .61$, $p = .003$. OAs and YAs also similarly reference event-related content least frequently for *knowing* (Ms = .19 and .17,

Table 3 Inferential statistics for the qualitative coding of remember (R), know (K), and just familiar (JF) as a function of dimension and participant age group

	Term $F(2, 190)$	R versus K $t(96)$	R versus JF $t(96)$	K versus JF $t(96)$	Age group $F(1, 95)$	Interaction $F(2, 190)$
Recollection	62.11, $MSE = .15$, $\eta_p^2 = .40$ ***	7.50, $SEM = .06$, $d = 1.01$ ***	12.23, $SEM = .05$, $d = 1.64$ ***	−3.20, $SEM = .06$, $d = .45$ **	2.09, $p = .15$	1.57, $p = .21$
Familiarity	164.62, $MSE = .09$, $\eta_p^2 = .63$ ***	3.50, $SEM = .03$, $d = .46$ ***	−12.27, $SEM = .05$, $d = 1.72$ ***	−17.58, $SEM = .04$, $d = 2.49$ ***	<1	<1
Event	40.94, $MSE = .16$, $\eta_p^2 = .30$ ***	—	—	—	7.99, $MSE = .23$, $\eta_p^2 = .08$ **	3.87, $MSE = .16$, $\eta_p^2 = .04$ *
Semantic	54.40, $MSE = .14$, $\eta_p^2 = .36$ ***	−8.24, $SEM = .06$, $d = 1.16$ ***	<1	8.76, $SEM = .06$, $d = 1.28$ ***	<1	<1
Accuracy	31.04, $MSE = .08$, $\eta_p^2 = .25$ ***	−5.64, $SEM = .05$, $d = .77$ ***	<1	5.80, $SEM = .05$, $d = .82$ ***	<1	1.02, $p = .33$
Confidence	16.10, $MSE = .17$, $\eta_p^2 = .15$ ***	−5.36, $SEM = .06$, $d = .79$ ***	1.82, $p = .07$	3.60, $SEM = .06$, $d = .51$ ***	<1	$F < 1$
Fluency	1.86, $p = .159$	–	–	–	<1	4.17, $MSE = .06$, $\eta_p^2 = .04$ *
Mastery	60.25, $MSE = .10$, $\eta_p^2 = .39$ ***	−7.54, $SEM = .05$, $d = .91$ ***	3.68, $SEM = .03$, $d = .49$ ***	10.11, $SEM = .05$, $d = 1.42$ ***	2.90, $p = .09$	<1
Experience	56.44, $MSE = .19$, $\eta_p^2 = .06$	2.68, $SEM = .06$, $d = .36$ **	<1	−3.79, $SEM = .06$, $d = .47$ ***	<1	<1

*$p < .05$, **$p < .01$, ***$p < .001$

respectively) and to an equivalent degree ($t < 1$). However, YAs reference event for *just familiar* ($M = .40$) far more than OAs do ($M = .16$), $t(95) = 2.52$, $SED = .10$, $d = .54$, $p = .01$. Thus, YAs seem to define both *remembering* and *just familiar* in relation to event memory compared with *knowing*, whereas OAs reference event memory for *remembering* and much less for the other two terms.

Semantic

Both older and younger adults referenced retrieval from the knowledge base significantly more for defining how they used *know* ($M = .61$) than *remember* ($M = .12$) or *just familiar* ($M = .09$) with no difference between the latter.

Accuracy

Following the same pattern as semantic references, for both age groups, accuracy was referenced significantly more for *know* ($M = .30$) than for *remember* ($M = .03$) or *just familiar* ($M = .02$), with no difference between those two. The interaction did not reach significance.

Confidence

Similarly, confidence was also referenced significantly more for *know* ($M = .41$) than for *remember* ($M = .09$), or *just familiar* ($M = .19$), with the difference between the latter not reaching significance. This was true for both age groups, and the interaction was not significant.

Fluency

Neither main effect was significant for references to fluency, but there was a significant interaction between term and age group. Though both age groups seem to show differences across their uses of the three terms, significantly so for YAs: $F(2, 118) = 3.38$, $MSE = .06$, $\eta_p^2 = .05$, $p = .037$, and marginally so for OAs: $F(2, 72) = 2.85$, $MSE = .06$, $\eta_p^2 = .07$, $p = .06$, these usages are different. For younger adults, fluency is referenced for *remembering* ($M = .10$) and *knowing* ($M = .13$, $t < 1$), but not for *just familiar* ($M = .02$). For *just familiar*, fluency was referenced at floor, marginally less than for *remembering*, $t(59) = 1.93$, $SEM = .04$, $d = .36$, $p = .06$, and significantly less than for *knowing*, $t(59) = 2.79$, $SEM = .04$, $d = .45$, $p = .007$. In contrast, older adults mentioned fluency-related attributes for *remembering* ($M = .13$) and *just familiar* ($M = .08$, $t < 1$) but not for *knowing* ($M < .001$) which was essentially never referenced, significantly less than for *remembering*, $t(36) = 2.37$, $SEM = .06$, $d = .55$, $p = .02$, and marginally less than for *just familiar*, $t(36) = 1.78$, $SEM = .05$, $d = .41$, $p = .08$. Note, however, that fluency was not mentioned much, as seen by the low percentages across the board, which is consistent with Umanath and Coane (2020).

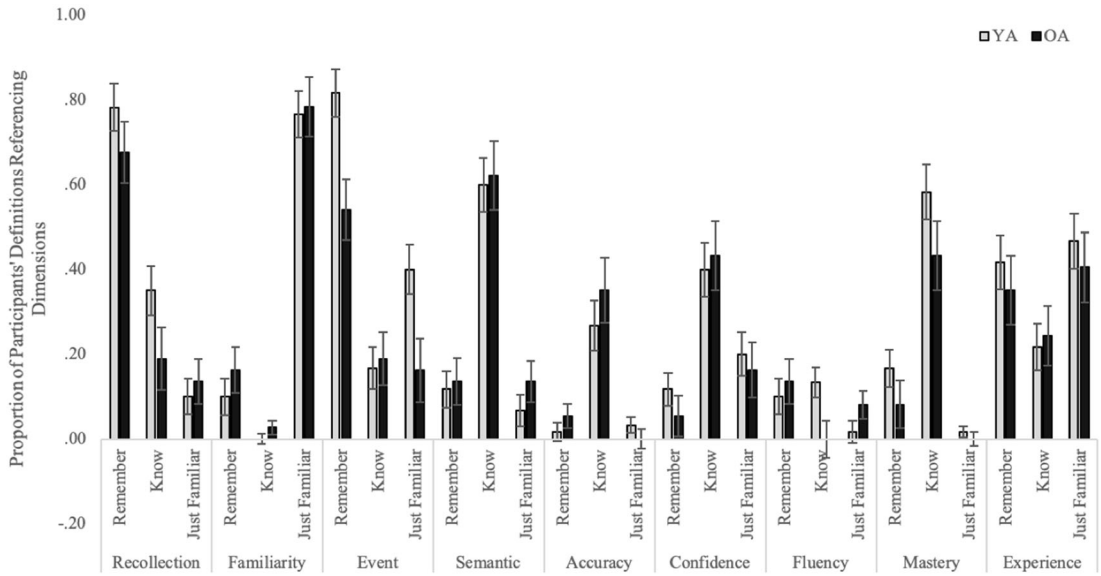

Fig. 1 Proportion of younger adult (YA) and older adult (OA) participants endorsing each qualitative dimension for remember (R), know (K), and just familiar (JF). Because each response was coded for all dimensions, proportions do not add to 1. (Error bars represent standard error of the mean)

Mastery

Regardless of Age Group, Mastery was referenced significantly more for *know* (M = .53) than for *remember* (M = .13), or *just familiar* (M = .01), with mastery referenced more frequently for *remembering* than *just familiar*. The interaction was not significant.

Experience

Interestingly, OAs and YAs both referenced Experience for both *remembering* (M = .39) and *just familiar* (M = .44), but significantly less so for *knowing* (M = .23). The interaction was not significant.

Summary

In sum, participants' explanations of their usage of the terms *remember*, *know*, and *just familiar* confirm that participants can and do discriminate between these phenomenological experiences associated with retrieval. *Remembering* is strongly defined in terms of recollection, retrieval from event memory, and experience-based acquisition. *Knowing* is most often associated with retrieval from semantic memory, accuracy, confidence, and perceived mastery or expertise. Finally, *just familiar* is primarily based on assessments of familiarity and experience-based learning. The marked distinction between *knowing* and *just familiar* underscores the importance of providing both options to capture the experiential nature of retrieval. Notably, these definitions are generally aligned with the natural language definitions of *remember* and *know* provided in Umanath and Coane (2020), extending the face validity of these terms to capture retrieval from event memory versus semantic memory among other underlying constructs of interest. Overall, few differences as a function of age were noted, suggesting stability over the life span in the usage of these expressions. Across the majority of the analyses, effect sizes ranged from moderate to large; in particular for both recollection and semantic, the effect sizes of the comparisons between *remember* and *know* are very robust (over 1.0).

Multiple-choice test

We first examined overall accuracy as a function of age. OAs (M = .59, SEM = .01) and YAs (M = .60, SEM = .01) correctly responded to more than half the items, $t(96)$ = .19, p = .85. Thus, overall, both age groups performed similarly. Next, accuracy analyses were conducted on the proportion of *remember*, *know*, *just familiar*, and *guess* responses that were correctly answered. These were submitted to a 2 (age) × 4 (phenomenological response) mixed ANOVA to examine whether the experiential states associated with retrieval success resulted in different levels of accuracy (see Fig. 2). This analysis reveals whether different phenomenological states are associated with different levels of accuracy (what Murdock, 1974, referred to as posterior probabilities; see Conway et al., 1997). Data from 35 OAs are included; some participants did not use one or more of the phenomenological state options.

A high proportion of questions given *remember* and *know* responses were accurate, whereas questions given *just familiar* and *guess* responses were less likely to be accurate,

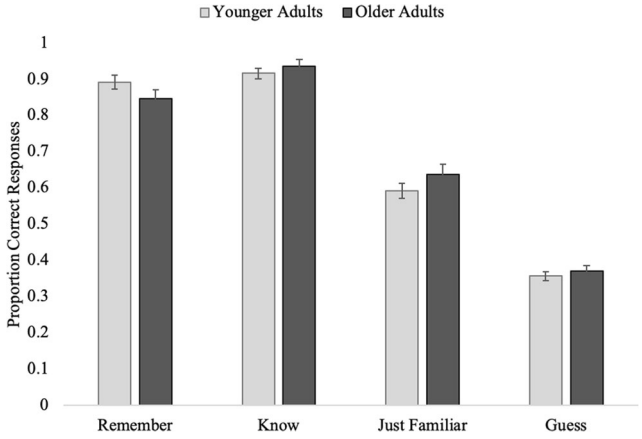

Fig. 2 Accuracy on the multiple-choice test as a function of age group and response (error bars represent standard error of the mean)

$F(2.81, 263.80) = 435.89$, $MSE = .014$, $p < .001$, $\eta_p^2 = .82$. *Know* responses were most often accurate ($M = .92$, $SEM = .01$), followed by *remember* responses ($M = .87$, $SEM = .01$), *just familiar* responses ($M = .61$, $SEM = .02$), and *guess* responses ($M = .36$, $SEM = .01$). All pairwise comparisons were significant ($ps \leq .02$). Neither the effect of age nor the interaction was significant, both $Fs \leq 2.4$, $ps > .07$. In sum, when OAs and YAs claimed to *know* or *remember* details surrounding an event, they were highly accurate. Accuracy dropped significantly when it was based on familiarity or guessing.[1] These results are consistent with our hypothesis that *knowing* and *remembering* might be associated with equivalent performance under the present conditions, when participants used *knowing* to reflect retrieval from the knowledge base and *remembering* to reflect retrieval from episodic memory. This is in contrast to the standard usage of the R/K task in purely episodic conditions, where *remember* responses are generally more accurate than *know* responses and are supposed to be associated with recollection versus familiarity, respectively. Furthermore, the size of the effect was quite large, indicating that the experiential responses did differ markedly in associated accuracy.

[1] We examined whether the recency of the events affected performance, in particular in younger adults who might have been too young to encode some of the earlier events. Events were divided into quartiles based on the date of occurrence. The only significant effect to emerge was that subjective memory strength was lower for the oldest events (from 2006–2009). However, there were no systematic effects of recency and phenomenology in multiple-choice performance; importantly, recency had no effect on the accuracy of items identified as *remembered* or *known*. Two limitations of these analyses are that relatively few participants' data were available in each cell of the design, and, more importantly, the type of items and their salience were not controlled across recency quartiles. Thus, any conclusions remain somewhat speculative and require further examination with more carefully matched materials across date ranges.

Subjective memory strength ratings

To make best use of the subjective memory strength ratings, we conditionalized the data based on participants' subsequent correct recognition of the multiple-choice test. The average initial subjective rating of items subsequently correctly identified on the multiple-choice test was examined as a function of age and phenomenological responses given on the multiple-choice test. This analysis allowed us to examine whether subsequently *remembered* and *known* items differed, not only in accuracy, but also in subjective strength (see Fig. 3). Analyses on errors are not reported because of empty cells (very few participants provided a *know* response for errors).

Only the effect of response was significant, $F(3, 279) = 218.76$, $MSE = .29$, $p < .001$, $\eta_p^2 = .70$. Subjective memory strength ratings were highest when participants subsequently claimed to *remember* ($M = 3.59$, $SEM = .06$) or *know* ($M = 3.73$, $SEM = .08$) an answer compared with when they judged it as *just familiar* ($M = 2.75$, $SEM = .07$) or indicated they had guessed ($M = 2.0$, $SEM = .06$). Notably, there was no difference between *remember* and *know* responses ($p \geq .40$), but all other pairwise comparisons were significant (all $ps \leq .001$). Neither the effect of age nor the interaction were significant, both $Fs \leq 1.12$, $ps \geq .34$. In sum, the subjective memory strength ratings aligned with the objective memory performance, in that items that were subjectively rated as strongest were also associated with *remember* and *know* responses. Again, the effect size indicated a large effect. However, the small advantage in terms of subjective strength for *known* over *remembered* items was not reliable, unlike in the objective memory test. Again, *just familiar* and *know* were clearly distinguishable in the subjective ratings as in the qualitative definitions and objective performance in the multiple-choice test.

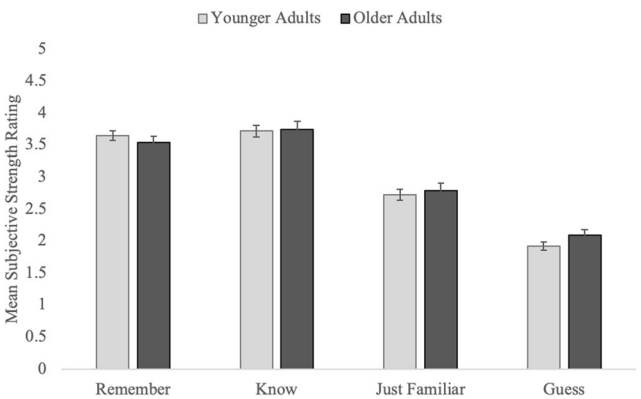

Fig. 3 Mean subjective memory strength ratings as a function of age group and response (error bars represent standard error of the mean)

Discussion

In the present study, we examined memory for recent public events as a potential tool for examining the transition of memories from episodic to semantic. These memories illustrated the range of episodic and semantic qualities in memories via participants' subjective assessment of their memory for the event, recognition of specific details, and phenomenological reports associated with correct retrieval. The underlying assumption—supported by qualitative analyses of how participants defined *remember*, *know,* and *just familiar*—is that *remembering* is associated with retrieval of episodic details contextualized in time and space and that *knowing* is associated with retrieval from the knowledge base (cf. Conway et al., 1997).

On the multiple-choice test, which required retrieval of a specific detail for each event, accuracy for *remembered* and *known* details was high and, importantly, higher for *known* than for *remembered* items. However, the initial subjective memory strength ratings with an event occurring in the previous 10–12 years did *not* discriminate between *remember* and *know* judgments, suggesting that self-rated subjective memory strength is not uniquely associated with episodic or semantic retrieval. Furthermore, the qualitative analyses indicated that confidence was higher for *know* than for *remember* in participants' own definitions. These findings are consistent with other work wherein the operational definitions of *remember* and *know* were applied as they were here—to capture retrieval from episodic memory versus the knowledge base (e.g., Conway et al., 1997).

As discussed in the Introduction, in standard applications of the R/K paradigm, extensive instructions are provided for participants to distinguish between *remembering* and *knowing* in the context of episodic tasks in attempts to separate recollection and familiarity-based responding. Notably, however, we did not instruct participants on how to use the terms; instead, we asked participants to define the terms for themselves before using them. As we have argued elsewhere (Umanath & Coane, 2020), the use of *know* to reflect familiarity runs fundamentally counter to how lay participants (and many psychology experts) use and understand the term in common parlance; and indeed, references to familiarity in definitions of *knowing* were at floor. Thus, it is not surprising that allowing participants to use these terms in ways that are consistent with their own prior understanding results in very different outcomes than that of the typical episodic recognition paradigm in which R/K has been used most frequently. That is, we are not assessing recollection and familiarity but episodic and semantic memory, as originally conceptualized by Tulving (1985), and this usage reveals stark differences in many dimensions of *remembering* and *knowing*.

In fact, analyses on the qualitative definitions of *remember*, *know*, and *just familiar* clearly indicate that participants associate *knowing* with retrieval from the knowledge base and *remembering* with retrieval of specific events, replicating Umanath and Coane's (2020) findings. Here, as in our previous work, *knowing* definitionally was associated with high levels of confidence and with the perceived accuracy of information, whereas *remembering* was associated with recollective experiences of specific events, but not with confidence or accuracy. Again, this is in marked contrast to standard use of the R/K paradigm, where *remember* responses are typically more accurate and more confident than *know* responses, though *know* responses have been known to reflect various levels of confidence (e.g., McCabe & Geraci, 2009; see Yonelinas, 2002, for a discussion). Here, low confidence was captured by the *just familiar* responses. Critically, these patterns were maintained even though the task of defining these terms followed the subjective memory strength rating task, which could have systematically biased participants towards thinking about the phenomenological experiences associated with these terms in the context of specific events, whereas in Umanath and Coane, no contextual information was provided.

Although participants clearly discriminated between the phenomenological experiences of *remembering* and *knowing*, the accuracy of retrieval of specific details was high in both cases. The overall similarity in performance on the multiple-choice test for *remember* and *know* items suggests that recent events learned in the context of media exposure might be dually stored in episodic and semantic systems and have characteristics traditionally associated with one system or the other. Such findings are consistent with N. R. Brown (1990), who found that information acquired through media is integrated into the knowledge base while also preserving some episodic details associated with the event. As noted by Lucchelli et al. (2018), "public memories are endowed with a dual nature, being actually a blend of facts of public knowledge, extracted from the media, and information pertaining to the personal context. Whenever a public event has become exceptionally famous (and therefore widely covered by the media), it could be processed to the point that it becomes a fact embodied into the "general knowledge of the world" (p. 1084).

Moreover, the same pattern of responses was observed in YAs and OAs, thereby increasing the generalizability of the effect. To our knowledge, the present results are the first to demonstrate that integration of new information into the knowledge base occurs in older adults using this approach. The lack of age effects for correct recognition is consistent with research showing that, when environmental support is high, as seen here in the multiple-choice test, age differences are minimized (Craik, 1986). More importantly, this indicates that OAs can and do acquire new information in naturalistic contexts and integrate it into the knowledge base. Although it has been repeatedly demonstrated that knowledge and semantic memory increase well into old age and can compensate for

declines in episodic memory performance (see Umanath & Marsh, 2014, for a review), there has been limited work on how this continued accrual of knowledge occurs. These results are exciting because they provide evidence that this growth does continue over the life span even in the absence of intentional and goal-driven information acquisition. Exposure to information that is multi-modal, meaningful, and relevant to one's life can result in the long-term integration of such information into the knowledge base. Longitudinal studies could more directly assess the preservation of knowledge. Additional work might examine whether the effects would persist in a task such as free recall, which is more dependent on active retrieval and effortful search strategies.

The present study extends earlier findings (Barber et al., 2008; Conway et al., 1997; Dewhurst et al., 2009) on the semanticization of knowledge and use of the remember/know paradigm to examine that process. For example, Herbert and Burt (2004) found that *know* responses were associated with greater schematization of knowledge and, as was found here, high levels of accuracy. They also found that participants could retrieve episodic details for *know* responses when prompted, suggesting that the *remember*-to-*know* shift is not an all-or-none phenomenon. In other words, at least in some circumstances, semantic knowledge can preserve traces of episodic content. To our knowledge, the present study is the first to have examined this process under conditions in which participants were not instructed on how to use *remember* and *know*, thereby extending the validity of this approach to a situation capitalizing on natural language use.

As discussed in the Introduction, a number of models hypothesize that storage of repeated traces over time can give rise to decontextualized knowledge (e.g., semanticization). Ross and colleagues (1984; Ross et al., 1990) further suggested that similar processes are involved in the formation of categorical knowledge, where encounters with specific episodes or exemplars serve as reminders and guide attention to similarities. Global matching models (e.g., MINERVA; Hintzman, 1986, 1988) similarly illustrate computationally how episodic traces can give rise to generalizations and decontextualized memory. Extending this logic further, Versace et al. (2009) propose a single-system model in which episodic and semantic memory (which they refer to as knowledge or conceptual memory) are not distinct systems; rather, the latter is an emergent property of the former.

A novel contribution of the present work was to examine the semanticization of knowledge using naturally occurring events outside of the laboratory context. Experiences with naturally occurring stimuli likely resulted in the formation and storage of many traces associated with the selected events. Due to the interrelated nature of many news stories, it is likely that explicit "reminders" were part of the encoding experience. For example, when tragedies such as mass shootings occur, it is typical for news media to review prior, similar events, thus serving to refresh the earlier knowledge. The repetition across different contexts likely results in a larger number of stored traces, with connections to multiple episodic details (cf. Hintzman, 1986, 1988).

A body of research has previously used news events as stimuli to examine basic and applied memory processes and phenomena. One focus has been on using news events to explore general memory and cognitive capacity in elderly or memory-impaired populations (e.g., Botwinick & Storandt, 1980) because such materials allow researchers to assess remote memory for events that are verifiable, unlike personal autobiographical memory. In many cases, public events have served as stimuli in studies examining reminiscence bumps (e.g., Koppel, 2013), flashbulb memories (e.g., Hirst et al., 2015), temporal memory (e.g., Friedman & Janssen, 2010), historically defined autobiographical periods (i.e., historical periods that serve to organize autobiographical memory; N. R. Brown & Lee, 2010), and long-term forgetting (e.g., Kogure et al., 2001). For example, Tekcan et al. (2017) found a reminiscence bump for public events for high-impact events that were central to a country's collective memory; in addition, they found robust recency effects for important public events. Research using "transient news events" (O'Connor et al., 2000), which are similar to the types of stimuli used here, suggests that conceptual information that is integrated into networks of knowledge is more resistant to forgetting than discrete units, such as names or facts associated with events that had a relatively brief exposure in the media. Consistent with this idea, when information is repeatedly learned under more variable conditions, memory for specific details, such as source information, is negatively affected compared with learning that occurs under more constant conditions (Sievers et al., 2019). Variable encoding increases an item's familiarity, and, potentially, its integration into semantic memory.

In the present study, some of the events occurred when the YAs were probably quite young; however, as indicated by the analyses examining performance as a function of event recency, age of the event did not systematically affect memory performance. Other work suggests that salient events can be well remembered, even when they occurred when participants were quite young. Janssen et al. (2008) found a reminiscence bump for public events, such that participants recalled and recognized events more accurately when the events had occurred when they were between the ages of 10 and 25. Events, even those defined as transient, occurring in the previous 10 years, interestingly, showed limited effects of age (O'Connor et al., 2000; see also Meeter et al., 2005). In contrast, Vallet et al. (2017) reported that events occurring when individuals were around 9 years of age did not give rise to the phenomenological qualities associated with flashbulb memories, although they did not directly examine the accuracy of retrieved information.

To our knowledge, the results presented here are novel in demonstrating that, through the lens of phenomenology, memory for specific, recent events can provide insight into the "inputs into semantic memory," an area that is critical for understanding the basic processes involved and for potentially designing effective pedagogies and strategies to promote real long-term retention and integration into the knowledge base. Having established that phenomenology does map onto retrieval from episodic and semantic stores, and that recent news events do preserve characteristics of both, the next step is to use this tool to hone in on the transition process. A key contribution of our work is that we provide evidence that naturally occurring news events can be used as stimuli to explore these questions in a novel way, that allows researchers to address some of the significant limitations to this kind of work (e.g., extensive study/encoding phases, longitudinal studies).

A couple of important limitations to this work merit discussion. Of course, we had no control over initial exposure to the experimental materials or frequency of subsequent exposure. Thus, it is possible that some events were unfamiliar to participants, whereas others were highly familiar. It is further possible that some of the older events (from 2006/2007) might have been unknown to YAs who were quite young when these events took place. That said, given the robustness of the effects, the use of such stimuli is also one of the unique strengths of this work. In order to keep the task brief, we also employed a relatively small number of stimuli (100), thereby limiting the possibility of doing more in-depth and systematic analyses as a function of recency or event type (e.g., political news, tragedies, pop culture news). Thus, the extent to which event type or recency affect the transition from *remembered* to *known* remains an open question.

We acknowledge that phenomenology, behavior (e.g., performance on a multiple-choice test), and cognitive process (e.g., retrieving information from memory) do not perfectly map onto one another, as discussed by Tulving (1989) in his critique of the *doctrine of concordance*. Reliance on phenomenological responses is clearly only one step in a larger research endeavor aiming to examine the potential transition of memories from episodic to semantic (cf. Barber et al., 2008; Conway et al., 1997). However, phenomenological reports can and do provide useful information about the underlying cognitive processes going on (cf. Conway et al., 1997; Herbert & Burt, 2003, 2004; see Bahrick et al., 2011, for discussion of the validation of metacognitive concepts). Thus, to the extent that phenomenological judgments are used to draw inferences about the underlying cognitive process or mechanism, the present results indicate that recent events are retrieved from both episodic and semantic memory, that they lie at the intersection of these not-so-separate memory types. Future work will hopefully extend the present approach to tasks that are less dependent on phenomenological self-reports. Finally, we acknowledge that, to date, the use of this modified R/K paradigm—to capture retrieval of episodic versus semantic memory, aligned with natural language use and therefore not requiring extensive instructions—is limited to materials and tasks that are not purely episodic in nature; whether a similar pattern of results would emerge under different task conditions is an open question.

Before closing, we would like to entertain a brief discussion about the results of the qualitative analyses of *remember*, *know*, and *just familiar*. Although the standard R/K paradigm typically includes just R and K responses, with some researchers including guessing as an option (e.g., Gardiner et al., 1998), *knowing* and familiarity appear to reflect different phenomenological states. In previous research, the ways in which participants have justified responses based on *knowing* and familiarity are qualitatively different, as assessed by experts (Williams et al., 2013) and lay participants (Williams & Moulin, 2015). Importantly, *knowing* was associated with higher confidence than familiarity. Williams and Moulin (2015) suggested that *remembering* and *knowing* might be the result of successful and unsuccessful recollective retrieval attempts, respectively, whereas familiarity and guessing might be the outcomes of successful and unsuccessful familiarity-based retrieval processes, respectively. Along these lines, our results suggest that successfully retrieving on the basis of knowing is associated with higher confidence than retrieving on the basis of familiarity and equal levels of confidence as remembering. These findings are consistent with a point previously made by Hintzman (2011): "*Familiarity* is routinely invoked in formal and informal explanations of memory as though it were a concept with obvious meaning, but the term appears to mean more than one thing" (p. 259; emphasis in original).

In the present work, the attentive reader will have noticed that *just familiar* and *know* diverged significantly on virtually every dimension. Simply stated, *knowing* is not the same as familiarity, not even close. At least in the present context, *just familiar* emerged as a distinct construct from both *remember* and *know*. In particular, *just familiar* was characterized by retrieval associated with a lack of detail, a sense of having encountered the information in the past, and quite low levels of mastery, confidence, and accuracy. Indeed, if anything, *just familiar* responses were more similar to *remember* than to *know* responses! Although this was not the core focus of the present work, it is noteworthy, given the frequency with which many researchers have used *know* as supposedly tapping familiarity and others used *familiar* instead of *know* in experimental studies to avoid lack of clarity or confusion associated with the term *know* (see Umanath & Coane, 2020, for a review). Clearly, participants do not consider *knowing* and familiarity as synonymous. Rather, when participants are able to consider the concept for themselves, familiarity is used to describe a sense of awareness of having previously

encountered a stimulus, but an inability to retrieve details and generally low confidence (see also Conway et al., 1997). Future studies should be cautious in interpreting experimental results given these findings.

In sum, the present study contributes to a small but critically important literature exploring the transition of memory traces from episodically acquired events to semantic knowledge. Through the lens of phenomenological reports, validated by participants' own explanations, we have presented evidence that information acquired in everyday life can and is integrated into the knowledge base, while still preserving elements of episodic experience. The results suggest that memory for recent public events is supported by both episodic memory (*remember* responses) and semantic memory (*know* responses). Such findings further corroborate Tulving's notion at the opening of this manuscript that while it is useful and simplifying for us to abstractly imagine these concepts, processes, or types of memory as separate memory stores or systems, the practice is ultimately reductive and indeed rather problematic in how this conception has shaped our thinking as a field. The truth is far messier and complicated, but must be faced.

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Declarations

Conflicts of interest None.

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