

Beyond Episodic Memory:  
An Empirical Characterization of Declarative Memory Phenomenology

By

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## Abstract

Memory phenomenology is an important topic in theoretical development of memory constructs. However, most work in this area begins with the assumption that episodic memory phenomenology neatly partitions into established feature categories. Using an exploratory approach, this study examined how features combine to produce latent factors of declarative memory and how these factors characterize declarative memories. I administered a novel questionnaire sampling a broad range of memory-related constructs evoked by various probes, and, using two samples ( $n_1 = 421$ ,  $n_2 = 271$ ), allowed qualitative variation to organize memory experiences into data-driven factors. Hierarchical dimensions of episodic and semantic qualia were uncovered, confirming that episodic and semantic memory processes are distinguishable by experience. Consistent with Tulving's definition, I observed, for the first time empirically, that higher-order factors comprised partially independent modules that varied from memory to memory, including two imagery modules distinguished by the presence of movement. As expected, qualia expression diverged based on both probe type (childhood event versus childhood summary) and memory age (recent event versus childhood event). However, continued positive expression of canonical episodic qualia in the semantic condition raises questions about long-standing theoretical boundaries between episodic and semantic memory, such as the idea that mental time travel and auto-noesis distinguish episodic recall. Further to these discoveries, which validate and extend our understanding of episodic and semantic memory, this research underscores the need for a systematic, empirically grounded map of declarative memory phenomenology, while also introducing a novel instrument capable of delivering it.

*Keywords:* autobiographical memory, declarative memory, episodic memory, semantic memory, phenomenology, subjective recall experiences, memory characteristics, exploratory factor analysis

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## Chapter 1 Introduction

What is it like to remember? Prevailing theory predicts that this depends on the type of memory being recalled (Sutin & Robins, 2007, Tulving, 2002). Although subjective experience of memory is pivotal to theoretical classifications, empirical work on this phenomenology tends to focus on episodic experiences (for a review, see Chiorri & Vannucci, 2024). For example, researchers have rarely compared features of episodic and semantic memories (for a few examples, see Renoult et al., 2012 and Tanguay et al., 2023) and none have attempted to characterize the phenomenology of semantic recall. Our understanding of memory will therefore benefit from measuring variation in subjective recall across diverse memory experiences, and evaluating alignment of any discovered structure with the predictions of popular models.

In the current thesis, I investigated the phenomenology of declarative memory recall by sampling the subjective characteristics of diverse memory experiences. I aimed to identify patterns in subjective memory features and explore how they vary across memory types. By uncovering the latent factor structure of declarative memory recall and evaluating its alignment with the predictions of established cognitive models, this research deepens our understanding of how memory is experienced and provides empirical support for the classification of different types of memory. To achieve my objective, I sampled the subjective characteristics of a large number of memories prompted to encourage variation in memory types. Participants first reported the contents of each memory, then reported on its phenomenology using a range of items derived from prevailing theory. Using two samples of this kind, I conducted an exploratory factor analysis to derive and validate factors describing the natural variance found among memories. Finally, I applied these factors to address a long-standing question regarding the fate of older episodic memories. Overall, I sought to distinguish core

phenomenological features of declarative memory and evaluate the alignment of naturalistic, real-life memories with neurocognitive theories of human memory.

### **Extending the Conceptual Framework of Declarative Memory**

The tenets of autobiographical phenomenology were laid in Endel Tulving's groundbreaking *Organization of Memory* (1972) in which he proposed entry-level definitions of memory. Stating that memory is a system for processing information using specialized systems for different information, he proposed that the episodic memory system was responsible for processing information about personal experiences and temporally locating them in reference to other experiences. Furthermore, he proposed the semantic memory system was responsible for gathering, organizing, and conveying information about the meaning and interrelatedness of concepts. This once-controversial model (McKoon et al., 1986; Tulving, 1984) received continued investigation over the decades that followed (Gardiner, 1988; Markowitsch & Staniloiu, 2011; Suddendorf & Corballis, 1997; Tulving, 1984; 2002; Vandekerckhove, 2009; Wheeler et al., 1997), eventually becoming a cornerstone of declarative memory theory. While the earliest conceptualization of the declarative memory system was quickly revised (Tulving, 1984; Tulving & Thomson, 1973), many features remain relatively unchanged over the last 40 years (For an overview of the evolution of Tulving's memory theory, see De Brigard et al., 2022). Many features, however, are difficult to operationalize and test, especially those involved in re-experiencing a memory. As a result, some features are yet untested.

My literature review identified six memory assessment instruments that characterize aspects of episodic and semantic memory (Table 1). These instruments use a variety of methods to explore individual differences in memory styles (e.g., recall fluency and meta-memory judgements) and evaluate the presence of episodic and semantic content in recollections. However, they do not assess the experience of recalling individual memories. Since the aim of this study was to distinguish core

**Table 1***Instruments for Assessing Episodic and Semantic Memory*

Instrument	Type of Assessment
Autobiographical Fluency Task (AFT, Dritschel et al., 1992)	Recall information from different lifetime periods and categories. Assesses fluency of episodic and semantic recall.
Autobiographical Interview (AI; Levine et al., 2002)	Interview of autobiographical memories with follow-up probing of memories. Transcripts assessed for episodic and personal semantic content.
Autobiographical Memory Interview (AMI; Kopelman et al., 1989)	Interview of autobiographical memories. Transcripts assessed for episodic and personal semantic richness.
Autobiographical Memory Test (AMT; Williams & Broadbent, 1986)	Autobiographical memory recall. Subjects retrieve specific personal memories in response to series of emotional cue words (cue valance varies). The impact of cue valence on retrieval success and recall latency is assessed.
Autobiographical Recollection Test, Full and Brief (ART & B-ART, Berntsen et al., 2019)	A self-report questionnaire. Measures how well people think they remember personal events (meta-memory, episodic traits).
Survey of Autobiographical Memory, Full and Brief (SAM & B-SAM; Palombo et al., 2013)	A self-report questionnaire. Measures personal assessments of general mnemonic ability (meta-memory, episodic and semantic traits).

phenomenological features of declarative memory and evaluate their theoretical alignment, it is essential to quantify the phenomenological features of individual recollections.

Theorized features of memory can be used to predict what it feels like to remember and to develop instruments that quantify memory phenomenology. The *Autobiographical Memory Characteristics Questionnaire* (AMCQ; Boyacioglu & Akfirat, 2015) and *Memory Experiences Questionnaire* (MEQ; Sutin & Robins, 2007) are two examples of memory phenomenology instruments. Focusing on the experience of episodic recall, they assess vividness, mental imagery (perceptual, sensory, contextual), confidence, recall fluency, perspective, coherence, features of emotion, reliving,

and rehearsal. In contrast to the number of tools investigating episodic memory phenomenology (see Appendix A), I was unable to find any assessing the phenomenological qualities of semantic memory. This could be a result of the expectation that semantic recall only produces a sensation of knowing the information (Tulving, 1972). As discussed in a subsequent section on semantic memory features, it is possible for semantic recall to produce multi-modal experiences (Tulving, 2002). In spite of this, there is a lack of research on semantic memory phenomenology. Furthermore, research on memory phenomenology tends to focus on episodic memory (episodic-centric), meaning we may not understand the phenomenological nuances of memories that cannot be classified as fully episodic. In short, prevailing approaches to memory phenomenology constrain our understanding of how episodic and semantic memory jointly shape declarative memory experiences.

Motivated by these limitations, I explored whether current theoretical frameworks of declarative memory are aligned with memory experiences in real-world contexts. I systematically observed the subjective characteristics of declarative memory across different types of autobiographical memory recall that are common in daily use. Unlike previous instruments that were developed to measure individual a priori dimensions of memory phenomenology (e.g., vividness, coherence, and imagery; see Appendix A), this study explored how features combine to produce latent factors of declarative memory and how these factors characterize declarative memories. Individual recall experiences were self-reported using theoretically-derived items, and my factor analysis allowed the natural variance in the data to reveal the structure of declarative memory phenomenology. In short, I used an exploratory approach to analyze theoretically-derived items and identified opportunities for agreement with declarative memory theory, rather than forcing my data to fit an a priori model.

### ***Moving Beyond Episodic-Centric Measures of Memory Phenomenology***

Self-report questionnaires can be paired with individual recall to quantify the expression of memory characteristics and their relationship to variables of interest (for a review, see Chiorri & Vannucci, 2024). For example, recent memories tend to be rated as more vivid, emotionally intense, positive, and have a clearer time perspective than older memories (Sutin & Robins, 2007). Similarly, Irish and colleagues (2008) observed that memories rated as strongly relived were more likely to be associated with first-person perspective, being detailed, and strong emotional connection. A follow-up study showed that memories rated as strongly relived were also correlated with experiences of continuous imagery, increased emotional reinstatement, high vividness ratings, and frequent covert rehearsal of the memory (Irish et al., 2011). There is also evidence that memory phenomenology ratings are impacted by sociocultural factors like gender, ethnicity, and participant age (Irish et al., 2008; Irish et al., 2011; Sutin & Robins, 2007). This suggests that subjective features of memory are flexible traits influenced by demographic and temporal factors as well as by the sense of reliving a memory.

Research has provided valuable insights into the phenomenology of autobiographical episodic memory, yet important aspects remain underexplored. First, a review by Chiorri and Vannucci (2024) highlighted the need for more research sampling multiple memories per participant. Relying on single reports limits the ability to account for personal and contextual variability, obscuring typical patterns of recall. This limits the generalizability and ecological validity of research findings. Second, the use of instruments developed to measure discrete, a priori dimensions of episodic memory phenomenology (e.g., vividness, coherence, and imagery; see Appendix A) means it is not possible to detect features that blend dimensions to produce alternative constructs (see Fitzgerald & Broadbridge, 2013 for detection of a priori latent constructs with blended dimensions). For example, if memories that are strongly relived are correlated with the presence of details, vividness, emotional connection, and continuous imagery

(Irish et al., 2008; Irish et al., 2011), then these features may combine to produce the latent factor of subjective awareness. Finally, current instruments do not assess the phenomenological qualities of semantic memory. It is commonly accepted that semantic memories are just 'known' while episodic memories are 'remembered' (Tulving, 1984). However, a later section on semantic memory features proposes that a richly detailed mental model, including sensory experiences, can be constructed without being anchored to specific personal experiences (Tulving, 2002). This challenges the idea that declarative memories feature episodic qualia (e.g., vivid details) or nothing, suggesting semantic recall may produce a unique phenomenological profile. Given the apparent role of the semantic memory system in future-oriented cognition (Irish & Piguet, 2013), exploration of its phenomenological qualities is warranted. This will establish empirically how tightly aligned real memories are to the prevailing declarative memory constructs of episodic and semantic memory. Such evidence will afford development of a comprehensive memory theory capable of describing real-world memory experiences that may fall outside of traditional episodic recall.

In light of the methodological and conceptual limitations outlined above, the current study was designed to address key gaps in the memory phenomenology literature. For instance, natural variations in memory phenomenology were characterized by sampling multiple memories per participant, varying the prompts used to elicit memories, and measuring the accompanying phenomenology across a wide set of features. Furthermore, exploratory data analysis will allow me to discover the structure of declarative memory phenomenology from within this variation without limiting it to an a priori hypothesis. That is, this method is expected to capture phenomenological dimensions of memory that are not addressed by current instruments and describe real-world memory experiences that theory needs to accommodate.

## ***A Theoretical Lens for Interpreting Declarative Memory Phenomenology***

Current theories of declarative memory guided the design and interpretation of this research. This study assumes that memories are reconstructions of previous experiences, shaped by task demands, the availability of related information, and differential contributions of each memory system (Conway & Pleydell-Pearce, 2000; Moscovitch et al., 2016; Tulving, 1984, 2002). The following section explores these assumptions by reviewing the processes that support memory phenomenology, leading to a discussion of theoretical features of episodic and semantic memories.

**Encoding, Storing, and Recalling Declarative Memories.** Memories are reconstructions of experience (Moscovitch et al., 2016). Therefore, it is important to consider the dynamic nature of memory when developing methodology for exploring memory phenomenology and its natural variations. Tulving and Thomson (1973) proposed that episodic memories are recalled through synergistic ecphory, a process by which semantic cues combine with episodic memory traces to produce recollection. Likewise, they suggested that even weak episodic memory traces can be evoked when provided adequate semantic cues (Tulving, 1985a). Since external cues appear to supplement episodic memory traces during recall, we can expect memory phenomenology to vary in accordance with the mechanics of this cue-trace interaction. Before surveying the subjective qualities of declarative memories as they are currently understood, I will briefly review the processes that support memory and foster phenomenological experience.

The declarative memory system is generally believed to be composed of two separate subsystems, episodic and semantic memory, that work together to produce declarative memories (Tulving, 1984). Memory formation is thought to involve multimodal streams of information (e.g., visual and auditory pathways) that are processed during the encoding, storage, and retrieval of knowledge (Conway & Pleydell-Pearce, 2000; Moscovitch et al., 2016; Simons et al., 2022). As a part of this process,

episodic memory traces are believed to be encoded in the hippocampus and contain a variety of perceptual information that provides the substrate for the subjective characteristics of recall (qualia; Danieli et al., 2023; Moscovitch et al., 2016). Memory retrieval is a separate process involving unconscious interaction between a cue and an episodic memory trace in the hippocampus. When hippocampal activation is successful, the memory is consciously elaborated into a coherent, contextually appropriate reconstruction. This process shapes the nature of a memory, including the manifestation and expression of memory qualia that are important to quantify when exploring variations in memory phenomenology. This neurocognitive model of memory retrieval mirrors the concept of synergistic ecphory, which also emphasizes the role of cue-trace interactions in the subjective experience of recall (Tulving, 1985a).

Several theories explain how episodic memories are stored and transformed into long-lasting memories for later retrieval. The Standard Consolidation Theory proposes that information related to the original episodic memory trace is slowly reorganized and transferred to the cortex, meaning hippocampal activation is no longer required during retrieval (Squire & Alvarez, 1995). This process may result in a loss of episodic qualia over time. In contrast, the Multiple Trace Theory suggests continued involvement of the hippocampus in memory retrieval regardless of memory age since the hippocampus makes a new episodic trace every time a memory is recalled (Nadel & Moscovitch, 1997). As a result, memories are expected to retain more of their episodic qualia over time. Building on this, the Trace Transformation Theory suggests that reactivation leads to overlearning, such that more gist-like (semanticized) versions are created in addition to the original episodic memory trace (Moscovitch et al., 2016; Winocur & Moscovitch, 2011). Since both traces are available during memory retrieval, this theory predicts memories may retain their original qualia or blend episodic and semantic features. The

processes by which memories are encoded, stored, and recalled help illuminate variations in memory qualia across memory types.

**Features of Episodic and Semantic Memory.** Having reviewed the processes underlying the phenomenological experience of memory, we will now survey the characteristics of declarative memories. The episodic memory system is believed to organize knowledge about personal experiences, meaning it is responsible for memories of personally experienced events (Conway, 2009; Tulving, 1972, 1984, 2002). According to Conway (2009), episodic memories typically have a visual perspective, contain spatiotemporal relations between recalled components, orient information along an individual's personal timeline, and produce feelings of subjective awareness. Critically, a memory is considered episodic when it contains information about a personally experienced event that is subjectively anchored in time and space; however, all other memory characteristics can be at any level of specificity (Conway, 2009; Tulving, 2002).

Tulving (1984, 2002) further proposed that the features listed in the last paragraph were insufficient to determine whether a memory is episodic. Since these features only describe the what, where, and when of a memory, they do not indicate whether it refers to a real past experience. Instead, he proposed subjective awareness was the critical defining feature of episodic recall, including mental time travel and auto-noesis. Mental time travel refers to the ability to orient oneself with respect to their own past or potential future. It produces feelings about time, thoughts about what did or could happen, and sensations that orient an individual with reference to the present. Auto-noesis, however, refers to the belief or awareness that a recalled memory is actually one's own past experience. It describes a sense of personal connection to a memory, conscious awareness of personal involvement, and awareness of the temporal relationship between the current memory and other personal experiences. Furthermore, Tulving (2002) proposed that auto-noesis, mental time travel, and general recollective experience may be

closely related, with auto-noesis facilitating mental time travel. He further speculated that vivid perceptual imagery (e.g., sights, sounds, movement) may be correlated with auto-noesis. These features of episodic memory that are typically quantified in memory phenomenology tools (Appendix A). Building on this foundation, the current research identified qualities of semantic memory that can be quantified during recall.

The semantic memory system is conceptualized as a complex organization of factual knowledge and their relationships, meaning it is responsible for general knowledge about one's world (Tulving, 2002). It is assumed to accumulate knowledge by extracting information about the world from individual personal experiences (Renoult et al., 2019), similar to the process of overlearning previously described in the Trace Transformation Theory (Moscovitch et al., 2016; Winocur & Moscovitch, 2011). This removes all traces of personal experience, such as the original spatiotemporal context (Renoult et al., 2019). Even though semantic memories do not contain any information about individual experiences, they may still have knowledge of time and perceptual imagery (Klein, 2013; Tulving, 2002). Based on the current understanding of semantic memory, it is often defined by the absence of episodic characteristics rather than the presence of traits that are uniquely semantic. For instance, semantic memories are not expected to contain spatiotemporal context; they are not personal; and they should not produce a recollective experience akin to auto-noesis or mental time travel. However, the close relationship with the episodic memory system offers opportunities for subjective experience during semantic recall. In short, phenomenological experiences may not be unique to episodic memory recall.

The boundary between episodic and semantic memory may be less apparent than thought. Consequently, overlapping features of episodic and semantic recall should be considered when deciding how to measure memory experiences. For example, individuals may recall and experience semantic information in a way that mimics episodic memories. This is likely owing to a common function enabling

both systems to use information in their knowledge base to construct flexible models for reasoning, problem solving, and answering questions about one's environment (Tulving, 2002). This function can be observed in everyday situations. To illustrate, a person can compile information about their past to make a decision about a current or future activity, or refer to numerical knowledge to decide if the number 15 is even or odd. Theoretically, the first example relies on the episodic memory system while the second relies on the semantic memory system. In addition to this functional similarity, they may also share structural and experiential features. That is, semantic memory might build multimodal models. These models may be as simple as visualizing an object, such as a cat or an apple. They may also be complex, like imagining a beach scene complete with the feel of the sun and sand, the sounds of waves, and the sight of children playing. These examples of semantic modelling suggest that vivid perceptual imagery may not be restricted to episodic memory. While spatiotemporal information is often considered a defining feature of episodic memory, it may also be present during (or inferred from) semantic memories. For instance, it is possible to know the date or location of an actual event without consciously recalling a particular memory. Therefore, the presence of spatiotemporal information may not be sufficient to identify episodic recall (Tulving, 2002). Taken together, these examples highlight my rationale for using a data-driven approach for deriving memory phenomenology.

### **Current Study**

Although subjective experience of memory is pivotal to theoretical classifications, empirical work on this phenomenology tends to focus on episodic experiences (for a review, see Chiorri & Vannucci, 2024). Our understanding of memory will benefit from measuring variation in subjective recall across diverse memory experiences and evaluating whether any discovered structure aligns with the predictions of major cognitive models. In the current thesis, I investigated the phenomenology of declarative memory recall by sampling the subjective characteristics of diverse memory experiences. I

identified patterns of subjective memory features and explored how they vary across memory types. By uncovering the latent factor structure of declarative memory recall and evaluating its alignment with established cognitive models, this research deepens our understanding of how memory is experienced and provides empirical support for classifying different types of memory.

To address my aims, I sampled subjective characteristics from a large number of autobiographical memories, prompted using recent event, remote event, and period summary probes to encourage a range of memory experiences. Participants reported the contents of each memory and then rated its phenomenology using items derived from prevailing theory. Using two independent samples, I derived and validated latent factors representing the natural variation of subjective memory features. Finally, I applied these factors to address a long-standing question regarding the fate of older episodic memories. I expected self-reported characteristics across recall prompts to reveal latent factors reflecting underlying structure in declarative memory phenomenology. These factors were predicted to align with the current theoretical framework of declarative memory. I further predicted that these dimensions would include meaningful subdivisions of episodic and semantic memory, reflecting known qualitative dimensions of memory experience, such as subjective awareness. Finally, I predicted that this latent factor structure would be replicable in a second independent sample.

## **Chapter 2 Method**

### **Participants**

#### ***Sample 1***

I recruited 860 English-speaking participants over the age of 18 for an online study using Prolific (n = 670) and Reddit (n = 190). Participants who did not use a computer to access the study, did not complete the consent form, were not fluent in English, reported having a psychological diagnosis or epilepsy, reported being intoxicated, or failed data quality checks for two recall prompts (e.g., memory

description was unrelated to prompt, failed attention checks, very low response variability) were omitted from analysis (Prolific = 268, Reddit = 171). These exclusion criteria were applied to ensure that participants did not experience language barriers which may have limited their ability to understand questions and communicate information about their memories; that they do not have any conditions which are known to impact memory (e.g., depression); and that they were healthy and attentive to the study. The final sample included 421 participants (204 women) between the ages of 18 and 77 ( $M = 40.95$  years,  $SD = 14.73$ ). See Table 2 for reported ethnicities. Participants who completed the study on Prolific were paid £3.45 and participants who completed the study on Reddit were not compensated. This study received ethical approval from the Queen's General Research and Ethics Board (GREB).

### ***Sample 2***

I recruited 722 English-speaking participants for online participation from Queen's University's psychology participant pool. The same exclusion criteria used in sample 1 were applied, yielding 319 participants. Of those, data for relevant memory conditions (see Measures for Sample 2) were available from 271 participants (238 women) between the ages of 18 and 56 ( $M = 20.56$  years,  $SD = 6.64$ ; one spurious value was omitted from this calculation). See Table 2 for reported ethnicities. Participants who completed the study were compensated with course credit. This study received ethical approval from the Queen's General Research and Ethics Board (GREB).

### **Measures**

#### ***Inventory of Autobiographical Experiences***

**Computer-Guided Recall.** Motivated by the notion that recollections develop at the confluence of external demands, internal states and goals, and the availability of related information (Gardiner, 1988; Markowitsch & Staniloiu, 2011; Suddendorf & Corballis, 1997; Tulving, 1985a; Tulving & Thomson,

**Table 2**

Reported Ethnicity for Each Sample

Ethnicity	Sample 1	%	Sample 2	%
British	147	34.9%	3	1.1%
American	49	11.6%	-	-
West African	48	11.4%	-	-
English Canadian	30	7.1%	171	63.1%
Southern African	25	5.9%	-	-
Western European	23	5.5%	6	2.2%
East African	14	3.3%	-	-
South Asian	11	2.6%	15	5.5%
Eastern European	10	2.4%	12	4.4%
multiracial	8	1.9%	7	2.6%
Caribbean	7	1.7%	3	1.1%
East Asian	7	1.7%	18	6.6%
Southeast Asian	7	1.7%	4	1.5%
Australian	4	1.0%	-	-
Hispanic	3	0.7%	3	1.1%
Northern European	3	0.7%	4	1.5%
Southern European	3	0.7%	4	1.5%
Middle East Asian	2	0.5%	4	1.5%
Central African	1	0.2%	-	-
Central American	1	0.2%	-	-
French	1	0.2%	-	-
New Zealander	1	0.2%	-	-
Pacific Islander	1	0.2%	2	0.7%
South American	1	0.2%	1	0.4%
Latin American	-	-	7	2.6%
French Canadian	-	-	2	0.7%
North African	-	-	2	0.7%
Other	14	3.3%	3	1.1%

1973; Vandekerckhove, 2009), I adapted the Autobiographical Interview (Levine et al., 2002) instructions to prompt the recall of different types of memories.

**Sample 1.** Since the goal of this study was to explore variations in episodic and semantic memory recall, I sampled three autobiographical memories that are typically considered episodic or

semantic. In particular, I prompted for a recent event memory (from last week), a remote event memory (from childhood), and a remote period summary (of childhood). Each prompt consisted of a short description of the type of information expected, including examples (See Appendix B).

**Sample 2.** Participants were prompted to recall 12 different memories across three life periods (last season, last year, childhood) as prompted by condition-specific instructions (single event, repeat event, period summary, and typical experiences of other people). For consistency with sample 1, only three recall conditions were selected for analysis: a recent event memory (from last season), a remote event memory (from childhood), and a remote period summary (of childhood). These instructions were the same as in the first study, with a minor adjustment for the time frame in the recent event memory prompt.

**Questionnaire.** Existing questionnaire items were explored as a means of quantifying the expression of memory characteristics during recall. While existing questionnaires successfully identify many constructs of interest, I was unable to find items from these questionnaires that positively identify characteristics of semantic memory, beyond the general ability to learn and recall facts (see Palombo et al., 2013). Therefore, I developed novel items to assess the use of general knowledge, concepts, and ideas. Inspired by existing instruments, I developed items to assess the constructs of interest identified in my literature review (autonoesis, mental time travel, mental imagery, spatiotemporal identifiers, memory construction, and memory fluency; see Appendix C for schedule of influences). All items were refined into simple and concise sentences, using similar sentence structure to assist comprehension and speed of completion. Wherever reasonable, items were phrased to focus on the experience of recall.

The resulting instrument, which I have named *Inventory of Autobiographical Experiences* (IAE), is a 53-item self-report questionnaire that is paired with individual memory recall to quantify the expression of the phenomenology of autobiographical memory recall (see Appendix D). It includes items

that positively identify various types of memory content, including episodic content (e.g., spatiotemporal specificity), semantic content (e.g., conceptual information), content that pertains to both episodic and semantic memory (e.g., mental imagery), and other potential correlates of memory quality (e.g., elements of memory construction). All items used a 5-point scale (generally, -2 = *strongly disagree* to 2 = *strongly agree*, although 18 items used custom anchors e.g., designating temporal specificity over different scales) and item presentation was randomized within four blocks to minimize order effects. The blocks were sequenced based on expected retention of qualitative experiences, with experiential information expected to fade the quickest assessed first, and the most stable experiential information assessed last. In particular, the first two blocks include items that probe the experience of recall (e.g., sense of immersion and experience of mental imagery), items in the third block largely probe memory construction (e.g., ease of recall and use of conceptual information), and items in the fourth block probe fixed features of the memory (e.g., when and where it occurred).

### ***Demographics and Check-In Questions***

Participants were asked their age, sex, English-language competency, ability to speak other languages, ethnicity, level of education, handedness, and whether they had any psychological or neurological diagnoses. Additional check-in questions were used to verify the participant was in a fit state for participation (e.g., not intoxicated).

### **Design & Procedure**

I used a within-subjects design for this experiment. The independent variables were the three condition-specific instructions from the computer-guided recall portion of the IAE (recent event, remote event, and remote period summary) and the dependent variables were the weighted scores for each latent factor. I derived weighted scores for each latent factor discovered in the exploratory factor analysis of the IAE questionnaire.

The minimum sample size for this exploratory factor analysis was calculated as 10 participants for each item in IAE, for a minimum of 530 participants (Everitt, 1975). This is sufficient to exceed even the most stringent design criteria proposed by Fabrigar and Wegener (2012): under poor conditions, such as when communalities are less than .4 and some factors only have 2 items, a sample size of 400 is sufficient for reliable detection of latent factor structure. A large portion of participant data was not included due to post-enrolment disclosure of psychological diagnoses, meaning the final sample size did not meet the goal of 530 in either sample. The final size of the first sample was 421 participants, which exceeds Fabrigar and Wegener's (2012) recommendation. The second sample, however, only included 271 participants after condition matching, which did not meet this guideline. However, these latter data were interrogated only for validation purposes.

Participants completed the study online using a survey hosted on Qualtrics. Following collection of informed consent, they completed a demographics questionnaire, then proceeded to the computer-guided recall portion of the IAE. Participants were given a prompt corresponding to one of three conditions. After spending 1 minute writing a brief description, they completed the Inventory of Autobiographical Experience questionnaire about their memory. This sequence was repeated until all three randomly ordered conditions were complete. The expected time to complete the study was approximately 25 minutes. Upon completion, participants were thanked and debriefed.

## **Data Analysis**

### ***Data Cleaning***

In addition to the screening described in the participant section, I removed IAE responses for any recalled memories where the description was insufficient to determine compliance (less than 15 characters long, nonsense words or sentences, or unrelated to prompt; sample 1 = 4 memories; sample 2 = 4 memories before condition matching), or where the attention check was failed (sample 1 = 16

memories; sample 2 = 562 memories before condition matching). To ensure data quality among scale responses, I summed the NA values for each memory and removed any that contained 3 standard deviations or more than the mean number of NAs for each prompt type (sample 1 = 14 memories; sample 2 = 53 memories before condition matching; see Table 3). To account for bots and lazy responding, I calculated IAE response variability across items for each memory and removed any with low variability (less than 3 *SDs* below *M* variability per prompt type; sample 1 = 1 memory; sample 2 = 7 memories before condition matching). Next, I calculated mean replacement values for each IAE item by prompt type and replaced any remaining NAs with these values (see Appendix E). Finally, I calculated response frequencies for each scale point of all IAE items. To address ceiling and floor effects, items with one of the two extreme values as the median were removed from further analysis. Based on this, five items were excluded (items 14, 15, 26, 41, and 42).

**Latent Factor Structure Analysis**

I investigated the latent factor structure of declarative memory by conducting an exploratory factor analysis of participants’ responses to the IAE questionnaire. Since each condition was expected to evoke independent expressions of latent memory characteristics, all IAE questionnaire responses for each participant were included in a super factor analysis. This approach allowed me to identify the broader latent factor structure of declarative memory, then model differences in factor expression as a

**Table 3**

*NA Counts and IAE Response Variability by Prompt Condition*

Prompt	NA Count		Response Variability	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Recent Event	0.32	1.08	1.42	0.21
Remote Event	0.46	2.18	1.30	0.22
Period Summary	0.73	1.48	1.27	0.20

*Note.* Response variability calculations are based on the *SD* of IAE responses for each memory.

function of both memory condition and individual differences.

The first goal of this study was to uncover the latent factor structure of declarative memory. To choose a method of exploratory factor analysis, I visually inspected the histograms for the remaining items and found that many items had non-normal distributions. I chose the minimum residual factor analysis method since it is robust to violations of assumptions of normality and performs similar to the maximum likelihood method (Flora et al., 2012). Compared to factor analysis using Pearson's correlations, polychoric correlations are more robust to violations of normality and are better at producing unbiased estimates when extracting factors from data using ordinal scales (Flora & Curran, 2004). Since the data in this analysis violate assumptions of normality as well as being ordinal and categorical, participant responses to the IAE questionnaire were converted to a polychoric correlation matrix before conducting the minimum residual exploratory factor analysis. The indices of model fit suggested by Hu and Bentler (1998) and Finch (2020) were used to guide model selection. Hu and Bentler (1998) suggest using Root Mean Square Error of Approximation (RMSEA) value of  $\leq .08$  and Comparative Fit Index (CFI) value of  $\geq .90$  to choose a good fitting model. Finch (2020) recommends using parallel analysis in combination with  $\Delta$ RMSEA (cutoff .015) to choose the best model. However, given the current lack of guidelines for determining model fit in exploratory factor analyses (Montoya & Edwards, 2021), preference was given to the model with the simplest, most interpretable factor structure.

To determine the latent factor structure of declarative memory, items with a loading of at least .30 were considered substantially loaded on that factor (Stevens, 2002). If an item substantially loaded on more than one factor, it was assigned to the factor with the highest loading. However, if loadings were less than .10 different, the item was considered cross-loaded.

In addition to the five IAE questions that were removed from analysis for data quality concerns, four additional items were omitted. These items focused on the written narrative (items 16 and 17), were subject to demand characteristics (item 40), and had categorical responses that varied on multiple dimensions (item 1). The final factor analysis included 43 IAE questions.

To align of one of the identified factors with the more intuitive interpretation of first-person perspective, its three items were reverse scored (items 4, 5, and 10). All mean scores, factor weights, and factor scores were inspected to verify that only the desired change occurred. Only the revised factor analysis solutions were reported in this thesis.

### ***Factor Expression Analysis***

After finding the latent factor structure of declarative memory in sample 1, I ensured general compliance with condition prompts. A full analysis of the content of reported memories was beyond the scope of this study. As a result, I cannot confirm adherence to every prompt. However, I manually reviewed 50 randomly selected memories (15 recent event, 17 remote event, 17 period summary) and completed blind ratings for memory type and life period. I found that 96% of this subsample complied with the instructions to describe a single event or period summary, and 86% conformed to the specified life period. For memories that did not conform to the designated prompt condition, they were supposed to be single events but did not contain enough information to ground them in time and place. For those that did not conform to the designated life period, all but one were judged as being very recent. However, they did not contain temporal identifiers (e.g., Last Tuesday I...) indicating they occurred within the specified 1-week period. The other memory was rated as most likely to have occurred during high school rather than childhood. While it is preferable to have every memory occur during the specified life period, I deemed these variations to be minor and unlikely to impact the results.

I then conducted a series of Repeated Measures Analysis of Variance (rANOVA) test to explore the relationship between weighted factor scores and recall prompt. This method was chosen for its suitability in within-subject designs and its ability to accommodate factors with differing scales. A separate rANOVA test was conducted for each factor identified in my factor solutions. Alpha levels were adjusted using the False Discovery Rate (FDR) where appropriate. Each rANOVA was followed by two planned pairwise contrasts: one comparing remote and recent event conditions, and another comparing remote event and period summary prompts. FDR corrections were also applied to each pair of contrasts as necessary. Unless otherwise noted, reported p-values reflect uncorrected values.

### ***Confirmatory Factor Analysis***

I used the condition-matched IAE responses in sample 2 to confirm the factorial structures of declarative memory found in sample 1. Using the process described for sample 1, I conducted a minimum residual factor analysis using a polychoric correlation matrix of participant responses to determine the factor structure of the second sample. Only the preferred factor solutions from the first sample were derived and examined for model fit and factor congruence. Model fit was assessed as outlined for the factor analysis of sample 1, and factor congruence was assessed using Tucker's Score (Burt, 1937; Lorenzo-Seva & ten Berge, 2006). As recommended by Lorenzo-Seva and ten Berge (2006), values between .85 to .94 were interpreted as having fair similarity and higher values were interpreted as being equal. Since my goal was to replicate the overall factor structure rather than item loadings, I did not explore item level correlations for each factor or attempt tests of factorial invariance.

## **Chapter 3 Results**

### **Latent Factor Structure of Declarative Memory**

I conducted a minimum residual exploratory factor analysis in R (R Core Team, 2024) using the psych package (Revelle, 2025) to determine the latent factor structure of declarative memory recall in

sample 1. Bartlett's test of sphericity was significant,  $\chi^2(1225) = 28385.77, p < .001$ , and the Kaiser-Meyer-Olkin criterion was excellent (0.95), which indicated that these data are suitable for factor analysis. The parallel analysis suggested a 9-factor solution would be best while the scree plot indicated that the first six models warranted further examination. To be comprehensive, solutions for 1- to 9-factor solutions were explored. Since declarative memory is theorized to have a hierarchical structure (Tulving 1984, 2002), one focus was whether the data in sample 1 would reflect this structure. I therefore began by evaluating whether there was support for a lower-order factor solution, and if it distinguished between episodic and semantic memory phenomenology. I then evaluated support for a higher-order factor solution, including possible subscales of episodic and semantic phenomenology.

I ran the 1- to 9-factor solutions using an oblique rotation (quartimin). The factors were correlated with each other ( $\geq .66$ ), suggesting an orthogonal rotation would not be justified. The 1-factor model included 12 items that did not load; the 2-factor solution included three items that did not load; the 3- and 4-factor solutions each included one item that did not; the 5-factor solution included two items that did not load; and the 6- to 9-factor solutions each included three items that did not load ( $< .30$ ). All other items had substantial loadings ( $\geq .80$ ) on at least one factor in each solution.

#### ***Latent Factor Structure: Low-Order***

To evaluate whether the data in sample 1 support a lower-order latent factor structure, I started with the 1-factor solution and proceeded only when the next solution offered improved fit indices while remaining parsimonious and interpretable. All fit indices preferred the 2-factor model to the 1-factor model (see Table 4). I then compared the 2- and 3-factor models. The CFI and RMSEA values for the 1- to 3-factor models were below standard guidelines, while the 2-factor model was the only one of all 9 models that showed meaningful improvements in  $\Delta$ RMSEA. Considering that  $\Delta$ RMSEA has been shown to outperform absolute fit indices in simulation (Finch, 2020), I interpreted this as statistical support for

**Table 4***Fit Indices for Exploratory Factor Analysis Solutions*

Factors	CFI	RMSEA	$\Delta$ RMSEA
1	0.59	0.112	-
2	0.75	0.089	0.022
3	0.80	0.082	0.008
4	0.85	0.074	0.008
5	0.88	0.067	0.007
6	0.90	0.063	0.004
7	0.92	0.060	0.004
8	0.93	0.055	0.004
9	0.94	0.052	0.003

*Note.* Cut off values for good fit: CFI  $\geq$  .90, RMSEA  $\leq$  .08,  $\Delta$ RMSEA of .015 (the direction depends on comparison).

the 2-factor model. Next, I inspected the items loading on each factor in the 1-, 2-, and 3-factor solutions. I judged the 2-factor model to offer the simplest and most comprehensive explanation of the latent structure. Taken together with the fit indices, I concluded that the 2-factor model was preferable.

The 2-factor solution is presented in Table 5.

Internal consistency reliability was assessed by calculating MacDonal’s omega for each factor using the psych package in R (Revelle, 2025). Since omega measures the proportion of variance in the total score related to a single factor (Goodboy & Martin, 2020; Hayes & Coutts, 2020), I calculated these values only after determining the latent factor structure. I found that both factors had strong internal consistency ( $\omega_{Tot} = .96$  for episodic;  $\omega_{Tot} = .85$  for semantic).

The first factor, which I labelled *episodic features*, accounted for 32% of the variance and consisted of 33 items. Briefly, these items characterize the presence of imagery, details, vividness, connection, chronology, fluency, time, and place. Accounting for 11% of the variance and consisting of 11 items, I named the second factor *semantic features*. These items characterize the presence of third-

**Table 5***Low-Order Factor Solution*

Item	Episodic Features	Semantic Features	Item	Episodic Features	Semantic Features
2	.60	-	44	.72	-
3	.63	-	45	.31	-
4	<b>-.55</b>	-	46	.73	-
6	.72	-	47	.71	-
7	.72	-	48	.68	-
8	.67	-	49	.69	-
9	.59	-	50	.67	-
13	.58	-	51	.70	-
18	.64	-	52	.74	-
19	.79	-	53	.79	-
20	.75	-	5	-	<b>-.44</b>
21	.76	-	10	-	<b>-.61</b>
24	.43	-	11	-	.63
25	.67	-	12	-	.68
27	.60	-	22	-	.58
28	.55	-	23	-	.60
29	.46	-	33	-	.64
31	.59	-	34	-	.71
32	.47	.31	35	-	.64
37	.63	.31	36	-	.36
39	.59	-	38	.48	.42
43	.69	-	-	-	-

*Note.* For clarity, only loadings  $\geq .30$  are presented.

person perspective, generic imagery, use of general knowledge, and a lack of personal connection. One item describing the degree to which a recalled memory represented recurring experiences (item 38) substantially loaded on both factors.

Both factors were negatively correlated with each other ( $-.16$ ), meaning that episodic characteristics tend to increase in expression as semantic characteristics decrease, and vice versa. This weak correlation, however, indicated that the presence of episodic and semantic features had considerable independence. Echoing the current model of declarative memory (Tulving, 2002), I

concluded that the simplest and most comprehensive structure of declarative memory that is supported by this data involves the independent expression of episodic and semantic features.

### ***Latent Factor Structure: High-Order***

The goal of this analysis was to explore whether episodic and semantic memory characteristics could be further differentiated into subgroups. To decide whether the data in sample 1 supported a higher-order factor structure, I reviewed the fit indices of the 1- to 9-factor solutions (see Table 4). In summary, the  $\Delta$ RMSEA value preferred the 2-factor solution, the CFI reached good fit in the 6-factor solution, the RMSEA reached good fit in 4-factor solution, and both the CFI and RMSEA continued to improve across solutions. Since I found statistical support for the 4- to 9-factor models, I evaluated each one for interpretability. The 6- to 9-factor solutions had similar latent factor structure and interpretability. However, the 6-, 8-, and 9-factor solutions each included one factor with only one or two substantially loaded items. In keeping with the advice of Fabrigar and Wegener (2012), I preferred the 7-factor model because each factor had three or more items. The 7-factor solution is reported in Table 6.

Internal consistency reliability was tested by calculating MacDonal's omega for each factor using the psych package (Revelle, 2025). All but one factor in this model had good internal consistency ( $\omega_{Tot} = .84$  to  $.96$ ). A closer examination of the items on the last factor ( $\omega_{Tot} = .65$ ) revealed a tendency for responses to be skewed toward the ends of the scale. Since my current goal is not scale development, I retained this factor and interpreted the results with care.

*Suspended Imagery*, the first factor, explained 11% of the variance and consisted of nine items. These items describe the presence of non-visual and unmoving visual mental imagery during recall, such as sounds and tactile sensations. The second factor, which I labelled *autonoesis*, accounted for 10% of the variance and consisted of eight items. Briefly, these items characterize the personal relevance of a

**Table 6***High-Order Factor Solution*

Item	Suspended Imagery	Autonoesis	Details	Noesis	Dynamic Imagery	Mental Time Travel	First-Person Perspective
6	.34	-	-	-	-	-	-
45	.40	-	-	-	-	-	-
47	.69	-	-	-	-	-	-
48	.80	-	-	-	-	-	-
49	.80	-	-	-	-	-	-
52	.59	-	-	-	-	-	-
53	.47	-	-	-	-	-	-
18	-	.54	-	-	-	-	-
20	-	.36	-	-	-	-	-
31	-	.61	-	-	-	-	-
37	-	.81	-	-	-	-	-
38	-	.47	-	.35	-	-	-
39	-	.78	-	-	-	-	-
50	.33	.40	-	-	-	-	-
51	.42	.53	-	-	-	-	-
13	-	-	.71	-	-	-	-
21	-	-	.48	-	-	-	-
25	-	-	.44	-	-	-	-
27	-	-	.46	-	-	-	-
28	-	-	.69	-	-	-	-
29	-	-	.63	-	-	-	-
32	-	-	.38	.38	-	-	-
43	-	-	.53	-	.31	-	-
10	-	-	-	<b>-.48</b>	-	-	.40
11	-	-	-	.67	-	-	-
12	-	-	-	.50	-	-	-
22	-	-	<b>-.31</b>	.40	-	-	-
23	-	-	-	.66	-	-	-
33	-	-	-	.67	-	-	-
34	-	-	-	.62	-	-	-
35	-	-	-	.55	-	-	-
2	-	-	-	-	.63	-	-
3	-	-	-	-	.57	-	-
44	.40	-	-	-	.43	-	-
46	.32	-	-	-	.44	-	-
7	-	-	-	-	-	.52	-

Item	Suspended Imagery	Autonoesis	Details	Noesis	Dynamic Imagery	Mental Time Travel	First-Person Perspective
8	-	-	-	-	-	.46	-
9	-	-	-	-	-	.61	-
19	-	-	-	-	-	.55	-
4	-	-	-	-	-	-	<b>-0.49</b>
5	-	-	-	-	-	-	.81
24	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-

*Note.* For clarity, only loadings  $\geq .30$  are presented.

memory as well as the presence of thoughts, emotions, and feelings. Capturing 9% of the variance and consisting of nine items, I named the third factor *details*. These items characterize features of vivid and detailed recollections that can be specifically located in time and space. Labelled *noesis*, the fourth factor was defined by items related to the use of semantic knowledge. Capturing 8% of the variance and consisting of nine items, this factor describes the presence of generic imagery, reliance on general knowledge, and only having a basic awareness of events. I labelled the fifth factor *dynamic imagery*. Characterized by the presence of moving visual imagery during recall, such as looking at a “live” picture or watching a mental movie, this factor consisted of four items and accounted for 7% of the variance. Drawing on the construct of conscious awareness (Tulving, 2002), I interpreted the sixth factor as *mental time travel*. Explaining 7% of the variance, the four items on this factor depict sensations of being in the past and reliving the memory. I labelled the last factor *first-person perspective*. This factor accounted for 4% of the variance and consisted of three items reflecting visual perspectives and personal connection during recall.

Factor correlations are reported in Table 7. They ranged from weak to moderate and were either negative or positive, depending on the combinations. Notably, the autonoesis, details, dynamic imagery,

**Table 7***High-Order Factor Correlations*

Factor	High-Order							Low-Order	
	1	2	3	4	5	6	7	Episodic	Semantic
1 Suspended	1							.87	.01
2 Auto-noesis	.49	1						.79	.07
3 Details	.44	.31	1					.74	<b>-.39</b>
4 Noesis	.02	.06	<b>-.15</b>	1				<b>-.14</b>	.95
5 Dynamic	.50	.44	.42	<b>-.09</b>	1			.82	<b>-.24</b>
6 MTT	.43	.37	.31	<b>-.14</b>	.32	1		.73	<b>-.20</b>
7 FPP	.08	.13	.23	<b>-.38</b>	.23	.14	1	.35	<b>-.71</b>

*Note.* Abbreviations: Suspended = Suspended Imagery; Dynamic = Dynamic Imagery; MTT = Mental Time Travel; and FPP = First-Person Perspective

suspended imagery, and mental time travel factors were moderately positively intercorrelated. This indicates a tendency for these factors to increase simultaneously. In contrast, their relationship with noesis was weak, indicating considerable independence between the expression of noesis and any of these factors. There was also a moderate negative relationship between the first-person perspective and noesis factors, indicating a tendency for first-person perspective to decrease as noesis increases, and vice versa.

The noesis factor had three items that substantially loaded on three other factors. Item 10 cross-loaded on first-person perspective, indicating that autobiographical recall that feels impersonal is positively related to noesis and negatively related to first-person perspective. Cross-loading on details, item 22 indicates that the inability to retrieve details in autobiographical recall is positively related to noesis and negatively related to details. Item 32 cross-loaded on details, indicating that recalling activities similar to those which a person is frequently involved is positively related to both factors. The suspended imagery factor also included two items that substantially loaded on other factors. Item 44

cross-loaded on dynamic imagery, indicating that autobiographical recall which involves live pictures is positively related to both suspended and dynamic imagery. Cross-loading on auto-noesis, item 50 indicates that recall including one's original thoughts is positively related to suspended imagery and auto-noesis.

### ***Latent Factor Structure: Hierarchical***

To explore whether the data in sample 1 supported Tulving's (1984, 2002) theorized hierarchical structure of declarative memory, I compared the low- and high-order factor structures. I compiled a list of IAE items along with their associated low- and high-order factors. As shown in Figure 1, the low-order episodic features factor further separated into the high-order factors of suspended imagery, auto-noesis, details, dynamic imagery, and mental time travel. Similarly, the low-order factor of semantic features further differentiated into high-order factors of first-person perspective and noesis. While including first-person perspective under semantic features seemed counterintuitive, it reflected a negative correlation between items assessing 1st and 3rd person perspective. For most items, those associated with episodic or semantic features factors in the low-order structure remained within theoretically consistent categories in the high-order structure. In the few instances where cross-loadings emerged in theoretically inconsistent categories (items 4 and 22), they switched from negative to positive correlations. I judged these differences to be negligible.

Building on this visual inspection, Table 7 shows correlations between low- and high-order factors. The low-order episodic and semantic features factors were both strongly correlated with their respective subgroups, and weakly correlated with the other subgroup. These analyses suggest the high-order structure mapped onto the low-order structure. They support the notion that the high-order factors represent subtypes of episodic and semantic memory within the hierarchy of the declarative memory system.

**Figure 1**

*Hierarchical Factor Structure*



*Note.* Cross-loadings omitted for clarity. Abbreviations: Suspended = Suspended Imagery; Dynamic = Dynamic Imagery; MTT = Mental Time Travel; and FPP = First-Person Perspective.

### **Latent Factor Expression in Autobiographical Recall**

#### ***Weighted Factor Scores***

Having determined the low- and high-order latent factor structure of declarative memory in sample 1, I then compared the expression of latent factors in each recall condition (recent event, remote event, period summary). Again using the psych package (Revelle, 2025), I extracted the factor weights for each item for the low- and high-order factor solutions. I multiplied factor weights by participant's

centered item responses, and then summed weighted values for each factor across all IAE items. This created weighted scores per factor, per participant, for each recall prompt. I conducted this process for the low- and high-order latent factor structures of declarative memory recall, using the 2- and 7-factor solutions respectively. Examples of memories with high scores on each factor are presented in Table 8.

**Table 8**

*Representative Excerpts of Memories for Each High-Order Factor*

Quale	Representative Excerpt
Details	“Last Friday (5 days ago) I went to the local market. It was bitterly cold and not pleasant to be outside. I was on my own. I stopped and chatted with an old patient at the fish van, then selected produce at the vegetable stall. I went to the bakery and bought a sourdough bread plus two small cakes for my daughter and Mum.”
Suspended Imagery	“The breeze was cool but gentle, and I could hear the rustling of the leaves in the trees as I walked. I felt at peace, just enjoying the solitude of the moment.”
Dynamic Imagery	“I set up the living room so we could have tv trays and blankets, so we could stay warm, as it was very snowy and cold outside and our building is old, so cold air comes through. I then went and got the pizza from our favorite pizza place and walked back during the snowy day.”
First-Person Perspective	“Last weekend I went to visit my family. I expected my daughter to open the front door when I arrived, but instead my very young grandchild was waiting by the door, excited to show me their latest item from their dressing-up box.”
Mental Time Travel	“The teacher pointed to lists of words which I had to (try and) pronounce. These got gradually harder. I kept going further than the teacher thought I was going to, and he got quite excited that I was getting so far. I remember that toward the end most of the words I wasn't familiar with, and I was having to guess pronunciations.”
Autonoesis	“My husband and I were in the bathroom happily looking at the pregnancy test that showed that I was pregnant. This was to confirm that we were having our second biological child. He hugged me with joy as we are both employed and have been trying.”
Noesis	“I was a bit of a shy kid, but I had a close-knit group of friends who made me feel included and supported. We would spend hours playing together, sharing secrets, and having sleepovers. My family was very loving and supportive.”

*Note.* Edited for brevity, spelling, and punctuation.

Since one of the aims of this study was to interpret differences in factor expression across prompts, I did not standardize the scales across factors. Standardizing would rescale scores relative to each factor's mean, obscuring the raw values and making it harder to interpret changes in expression. Consequently, variances across scales means that within-condition cross-factor comparisons are not meaningful and potentially misleading. However, since all items were centered at the scale midpoint, factor scores of 0 consistently reflected 50% expression. Accordingly, factor scores above 0 were labelled positive (stronger endorsement) and scores below 0 were labelled negative (weaker endorsement).

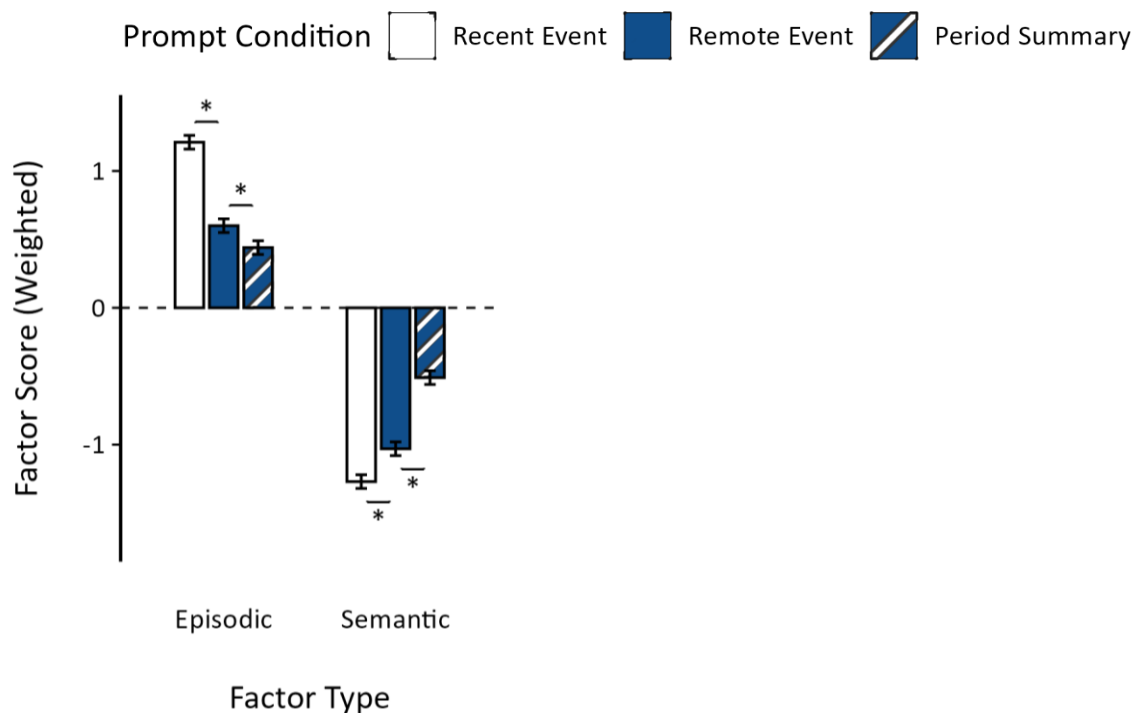
### ***Factor Expression During Recall: Low-Order Structure***

To explore the relationship between the outcome variable of factor scores (episodic and semantic features) and the predictor variable of recall prompt (recent event, remote event, and period summary), I conducted separate rANOVA tests for both factors in the low-order structure. I found a strong main effect of recall prompt on episodic features factor scores,  $F(2, 768) = 142.64, p < .001, \eta_p^2 = 0.27$ , indicating that scores varied across conditions. I followed up the significant main effect with planned contrasts using the remote event condition as my baseline. As illustrated in Figure 2, pairwise comparisons revealed that the recent event condition ( $M = 1.21, SD = 0.91$ ) had higher episodic features factor scores than the remote event condition ( $M = 0.60, SD = 1.04$ ),  $t(768) = 12.81, p < .001, d = 0.65$ . In contrast, the period summary prompt ( $M = 0.44, SD = 1.15$ ) had lower episodic features factor scores than the remote event condition,  $t(768) = 3.13, p < .001, d = -0.16$ .

I also found a strong main effect of recall prompt on semantic features factor scores,  $F(2, 768) = 133.25, p < .001, \eta_p^2 = 0.26$ , indicating that scores varied across conditions. Pairwise comparisons revealed that the recent event condition ( $M = -1.27, SD = 1.03$ ) had lower semantic features factor scores than the remote event condition ( $M = -1.03, SD = 1.05$ ),  $t(768) = 5.03, p < .001, d = -0.25$ . In contrast, the period summary prompt ( $M = -0.51, SD = 0.99$ ) had higher semantic features factor scores than the

**Figure 2**

*Low-Order Factor Expression*



Note. \*  $p < .001$ . Error bars designate  $\pm 1$  SE.

remote event condition,  $t(768) = 10.94$ ,  $p < .001$ ,  $d = 0.55$ . Overall, episodic features factor scores decreased across recent event, remote event, and period summary prompts. Similarly, semantic features factor scores increased across these conditions.

***Factor Expression During Recall: High-Order Structure***

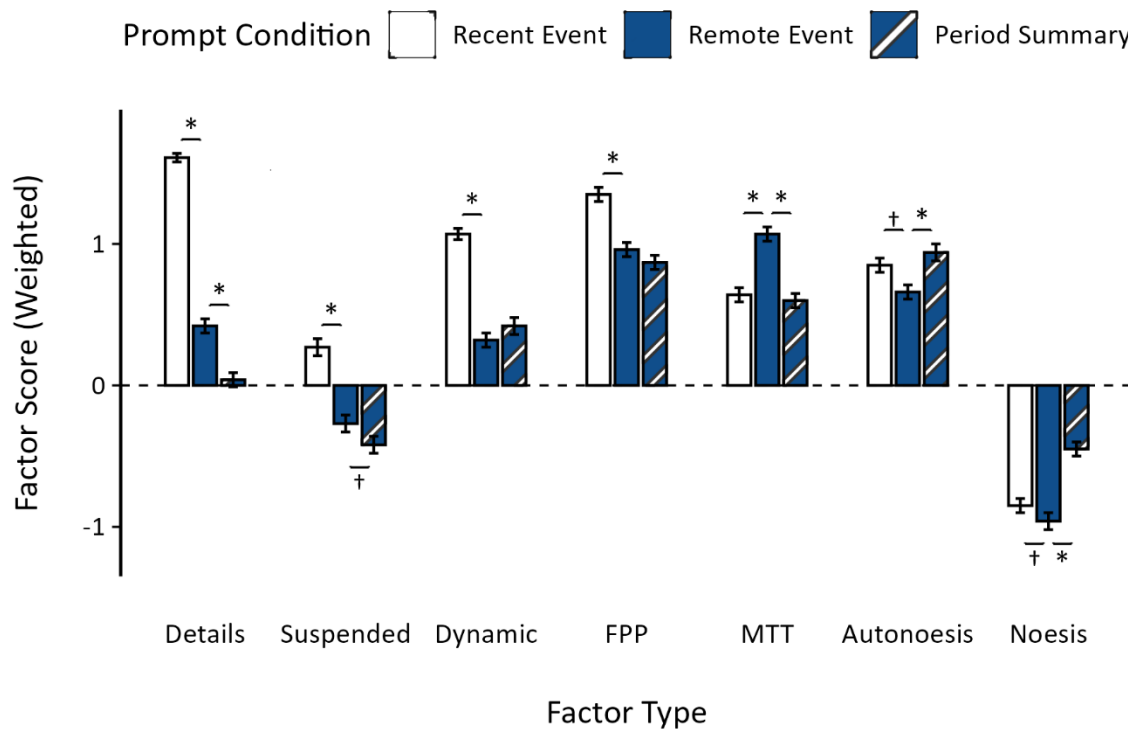
Next, I explored the relationship between recall prompt and factor expression in the high-order structure for sample 1. Using the same process as described in the last section, I explored the relationship between the outcome variable of factor scores (suspended imagery, autooensis, details, noesis, dynamic imagery, mental time travel, and first-person perspective) and the predictor variable of

recall prompt. I conducted separate *r*ANOVA tests for each of the seven factors in the high-order structure. To understand patterns of factor expression, I followed up all significant tests with two planned pairwise comparisons that used the remote event condition as the baseline. The results of these analyses are presented in Figure 3.

I found a strong main effect of recall prompt on detail factor scores,  $F(2, 768) = 520.88, p < .001, \eta_p^2 = 0.58$ , revealing differences in factor expression across conditions. Details factor scores were higher in the recent event condition ( $M = 1.61, SD = 0.58$ ) compared to the remote event condition ( $M = 0.42, SD = 0.89$ ),  $t(768) = 23.45, p < .001, d = 1.19$ , a pattern not observed in the period summary prompt.

**Figure 3**

*High-Order Factor Expression*



*Note.* Abbreviations: Suspended = Suspended Imagery; Dynamic = Dynamic Imagery; MTT = Mental Time Travel; and FPP = First-Person Perspective. †  $p < .025$ , \*  $p < .001$ . Error bars designate  $\pm 1$  SE.

Scores were lower in the period summary prompt ( $M = 0.04$ ,  $SD = 0.98$ ) compared to the remote event condition,  $t(768) = 7.49$ ,  $p < .001$ ,  $d = -0.38$ . In summary, scores for the details factor decreased across recent event, remote event, and semantic recall prompts. This effect was strong in the recent event contrast and moderate in the semantic contrast.

I found a strong main effect of recall prompt on suspended imagery factor scores,  $F(2, 768) = 94.22$ ,  $p < .001$ ,  $\eta_p^2 = 0.20$ , indicating that scores were significantly different across conditions. I observed that the recent event condition ( $M = 0.27$ ,  $SD = 1.20$ ) had higher suspended imagery factor scores than the remote event condition ( $M = -0.27$ ,  $SD = 1.20$ ),  $t(768) = 10.15$ ,  $p < .001$ ,  $d = 0.52$ . In contrast, the period summary prompt ( $M = -0.42$ ,  $SD = 1.19$ ) had lower scores than the remote event condition,  $t(768) = 2.93$ ,  $p = .003$ ,  $d = 0.15$ . Similar to the details factor, suspended imagery factor scores decreased across recent event, remote event, and semantic recall prompts. While the effect was moderate in the recent event contrast, it was small in semantic contrast.

There was a strong main effect of recall prompt on dynamic imagery factor scores,  $F(2, 768) = 121.85$ ,  $p < .001$ ,  $\eta_p^2 = 0.24$ , signifying that scores varied across conditions. I found that this effect was driven by the recent event condition. The recent event condition ( $M = 1.07$ ,  $SD = 0.84$ ) had higher dynamic imagery factor scores than the remote event condition ( $M = 0.32$ ,  $SD = 0.91$ ),  $t(768) = 14.35$ ,  $p < .001$ ,  $d = 0.73$ . While the period summary prompt ( $M = 0.42$ ,  $SD = 1.08$ ) had higher scores than the remote event condition,  $t(768) = 1.86$ ,  $p = .06$ ,  $d = 0.09$ , the effect did not reach significance. In summary, dynamic imagery factor scores decreased across recent and remote event conditions before stabilizing in the period summary prompt. This effect was strong in the recent event contrast.

I found a moderate effect of recall prompt on first-person perspective factor scores,  $F(2, 768) = 48.51$ ,  $p < .001$ ,  $\eta_p^2 = 0.11$ , revealing significant differences in scores across conditions. This main effect was driven by differences between recent and remote event condition. First-person perspective scores

were higher in the recent event condition ( $M = 1.35, SD = 0.92$ ) compared to the remote event condition ( $M = 0.96, SD = 0.93$ ),  $t(768) = 7.54, p < .001, d = 0.38$ . While scores were lower in the period summary prompt ( $M = 0.87, SD = 0.98$ ) compared to the remote event condition,  $t(768) = 1.71, p = .09, d = -0.09$ , the effect did not reach significance. Similar to the dynamic imagery factor, scores for first-person perspective decreased across recent and remote event conditions before stabilizing in the period summary prompt. This effect was moderate in the recent event contrast.

Mental time travel factor scores were significantly different across recall prompts,  $F(2, 768) = 50.14, p < .001, \eta_p^2 = 0.12$ . I found that the recent event condition ( $M = 0.64, SD = 0.96$ ) had lower mental time travel factor scores than the remote event condition ( $M = 1.07, SD = 0.93$ ),  $t(768) = 8.26, p < .001, d = -0.42$ . The period summary prompt ( $M = 0.60, SD = 1.04$ ) also had lower scores than the remote event condition,  $t(768) = 9.03, p < .001, d = -0.46$ . Mental time travel factor scores were highest in the remote event condition, with moderate effects in both contrasts.

There was a significant, but small, main effect of recall prompt on auto-noesis factor scores,  $F(2, 768) = 12.54, p < .001, \eta_p^2 = 0.03$ , signalling that scores varied across conditions. Participants expressed higher auto-noesis factor scores in the recent event condition ( $M = 0.85, SD = 1.04$ ) than in the remote event condition ( $M = 0.66, SD = 1.06$ ),  $t(768) = 3.27, p = .001, d = 0.17$ . Similarly, participants expressed higher scores in the period summary prompt ( $M = 0.94, SD = 1.10$ ) than in the remote event condition,  $t(768) = 4.92, p < .001, d = 0.25$ . This indicated that auto-noesis factor scores were lowest in the remote event condition; however, these effects were small in both contrasts.

Noesis factor scores varied significantly across recall prompts,  $F(2, 768) = 63.06, p < .001, \eta_p^2 = 0.14$ . Participants expressed significantly higher noesis factor scores in the recent event condition ( $M = 0.85, SD = 1.04$ ) than in the remote event condition ( $M = -0.96, SD = 1.13$ ),  $t(768) = 2.29, p = .02, d = 0.12$ . This pattern extended to the period summary prompt ( $M = -0.45, SD = 1.06$ ),  $t(768) = 10.67, p <$

.001,  $d = 0.54$ . Mirroring the auto-noesis factor, scores for the noesis factor were lowest in the remote event condition. However, while this effect was small in the recent event contrast, it was moderate in the semantic contrast.

### **Latent Factor Structure of Declarative Memory: Replication in Sample 2**

Using the same method as in sample 1, I conducted a minimum residual factor analysis with oblique rotation (oblimin). This analysis used a polychoric correlation matrix of IAE responses to determine the latent factor structure of declarative memory recall in sample 2. Bartlett's test of sphericity was significant,  $\chi^2(903) = 18588.27, p < .001$ , and the Kaiser-Meyer-Olkin criterion was excellent (0.93), which indicated that these data were suitable for factor analysis. Similar to the factor analyses for sample 1, the overall fit of the 2- and 7-factor solutions were assessed using CFI, RMSEA, and  $\Delta$ RMSEA values. I started by inspecting the fit indices for the 2-factor solution. The CFI value was 0.69, the RMSEA was 0.10, and the  $\Delta$ RMSEA did not indicate a significant improvement over adjacent models (0.012 and 0.010). The RMSEA and  $\Delta$ RMSEA values were near, but did not meet the cutoffs for fair fit; however, these values are very similar to the fit indices for the low-order solution in sample 1. Given this, I judged the 2-factor solution to have acceptable fit. Next, I evaluated the fit indices for the 7-factor solution. The CFI value was 0.89, the RMSEA value was 0.07, and the  $\Delta$ RMSEA did not indicate a significant improvement over adjacent models (0.002 and 0.005). Since the RMSEA met the cutoff for fair fit and the rest of the values were similar to the fit indices for the high-order solution in sample 1, I judged the 7-factor solution to have acceptable fit.

I then tested whether the low- and high-order factor structures were congruent across both samples. I used the psych package (Revelle, 2025) in R (R Core Team, 2024) to determine Tucker's score for the 2- and 7-factor solutions in both samples. The 2-factor solution had fair factor congruency on the episodic features factor (.93), but the semantic features factor (.76) did not reach the cutoff value of .85

(Lorenzo-Seva & ten Berge, 2006). The 7-factor solution had fair factor congruency (.85 to .95) on all but two factors. Noesis (.84) fell just below the cutoff, and first-person perspective (.64) showed poor congruency. Given the low  $\omega_{Tot}$  value for the first-person perspective factor in the first sample, poor congruency on this factor – and its corresponding low-order factor (semantic features) – is not surprising. Since the fit indices were similar and most dimensions showed acceptable factor congruency, I judged the low- and high-order factor structures to have fair similarity across samples. My goal was to replicate the overall factor structure rather than item loadings, so I did not explore item-level correlations for each factor or attempt tests of factorial invariance. This aligned with my main goal of exploring the latent structure of declarative memory at the construct level.

#### **Chapter 4 Discussion**

Here, I investigated the structure of memory phenomenology, a topic that has received extensive discussion in theoretical development of memory constructs but often relies on scales built to measure distinct, a priori dimensions (e.g., vividness, coherence, and imagery). Whereas most work in this area begins with the assumption that phenomenology neatly partitions into established categories, this study investigated how features combine to produce latent factors of declarative memory and how these factors characterize declarative memories. I administered a novel questionnaire sampling a wide variety of memory-related constructs and allowed qualitative variation in memory to organize into data-driven factors. Factor analysis of self-reported characteristics distinguished canonical qualia of episodic and semantic memory in what is potentially the first study to use an exploratory approach to derive constellations of features that resemble Tulving's (2002) core memory qualia of mental time travel, auto-noesis, and noesis. This analysis also identified an unexpected differentiation between suspended and dynamic imagery. Episodic and semantic qualia were organized hierarchically, belonging to their respective lower-order factor. Yet, they were not monolithic: correlated but still largely independent,

they showed divergent patterns for older events and period summaries. Notably, one quale linked to episodic memory was paradoxically most strongly expressed in the semantic condition. The next section reviews the current study's novel findings and theoretical implications of the discovered latent factor structure on declarative memory recall.

### **Latent Factor Structure of Declarative Memory**

To my knowledge, this is the first study to use an exploratory approach to derive the latent factor structure of declarative memory phenomenology (for a confirmatory analysis of a priori constructs with blended dimensions, see Fitzgerald & Broadbridge, 2013), illuminating the relationship between established categories of episodic memory phenomenology. One novel finding permitted by this approach is the detection of separate but correlated networks of memory characteristics resembling Tulving's (2002) concepts of mental time travel and auto-noesis. As theorized by Tulving (2002), these dimensions were moderately correlated with each other as well as details and imagery. These dimensions will be explored more fully in a subsequent section.

Another novel discovery is a factor resembling Tulving's (2002) concept of noesis. Few, if any, questionnaires exist that probe for a potential phenomenological profile of semantic recall (for a measure gauging perceived ability to recall facts, see Palombo et al., 2013). This likely arises from the tendency to treat semantic memories as content-only, meaning information is simply known rather than experienced (Tulving, 1985b). Notably, this was the only factor I observed that included items assessing both memory qualia and strategies used to build memories. If semantic memory is a system of general factual knowledge absent any specific context (Tulving, 2002), then it follows that tactics for memory formation would align with sensations reflecting general rather than specific knowledge. Supporting the idea that semantic memory is a distinguishable system (Tulving, 2002), this factor was largely

independent. Likewise, it correlated most highly with the other subtype of semantic memory: first-person perspective (reverse scored).

Having initially assumed that all imagery related items would consolidate into a single dimension, I was surprised by the emergence of two distinct factors representing imagery. The finding that imagery dissociated into separate groups under the larger umbrella of episodic qualia suggests they reflect distinguishable characteristics of episodic remembering. A clue for this distinction is found in research exploring auto-noetic experiences (Irish et al., 2008; Irish et al., 2011). Prior research found that reliving a memory was predicted by dynamic imagery ratings, with moving imagery (e.g., video) having the strongest predictive value. When we consider the previously identified relationship alongside the notion that suspended imagery is among qualia used to judge memory quality (for example, see Cooper & Ritchey, 2022), a potential functional distinction between these dimensions emerges. If moving imagery predicts the sensation of reliving, high dynamic imagery ratings may reflect temporal structuring of memory qualia like suspended imagery and details.

Building on the novel individual factor-level findings, I now turn to the broader organization of memory qualia. Factor analysis of participants' IAE responses revealed a hierarchical latent factor structure of declarative memory recall that broadly conformed with theoretical expectations. The low-order structure had one factor that distinguished strong versus weak experiences of subjective features that are typically associated with episodic memory (e.g., detailedness, vividness), and another that characterized high versus low involvement of generalized information during recall. These factors further separated in the high-order structure analysis, such that the overall phenomenology of episodic memory was represented by factors characterizing the manifestation of details, suspended imagery, dynamic imagery, mental time travel, and auto-noesis. Similarly, the low-order factor characterizing semantic features of recall divided into two high-order factors: noesis and first-person perspective. Importantly,

items on the last factor were reverse scored to align with first-person perspective. Taken together, this suggests that episodic and semantic memory subsystems have distinct roles and characteristics, but they interact to produce recall. The method of interaction between systems, however, remains an open question.

Tulving (1972, 1984) asserted that episodic and semantic memory were related but functionally distinct systems. While this allows for independent operation of each system, Tulving (1984) suggested operations may not be as efficient as when the systems cooperate. In fact, Tulving and Thomson's (1973) model of synergistic ecphory relies on input from both the episodic and semantic system. Later, Tulving (1985a) conceptualized memory as a hierarchical system with three levels, where each level relies on all lower systems. Tulving placed episodic memory at the top, followed by semantic memory, and then procedural memory. Mimicking the theory of synergistic ecphory, this means that episodic memory requires semantic memory to function, while semantic memory may operate independently. This suggests semantic qualia may be present during episodic recall, potentially complicating its detection. Nevertheless, there was enough variance between IAE items to reveal patterns that distinguish between episodic and semantic qualia.

Weak correlations between the low-order episodic and semantic features support the notion that episodic and semantic memory are functionally distinguishable systems. Comparing against studies investigating both episodic and semantic memory (Dritschel et al., 1992; Palombo et al., 2013), my sample showed a higher degree of independence between factors. In contrast with my method, however, these studies do not assess the phenomenology of individual memories. Instead, they assess recall fluency (Dritschel et al., 1992) and meta-memory judgements (Palombo et al., 2013). Turning to studies investigating the episodic qualia of individual memories, between factor correlations for the AMCQ were similar to the current study (Boyacioglu & Akfirat, 2019). Furthermore, the current study

found that factors in the episodic subgroup shared a maximum of a quarter of their variance, a pattern also observed in the semantic subgroup. The high level of independence between low-order episodic and semantic features appears to extend to the high-order episodic and semantic subgroups. This finding suggests the involvement of several distinguishable processes of episodic and semantic memory during recall.

The dissociation between episodic and semantic qualia challenges the model of synergistic ecphory, which describes concurrent retrieval of episodic and semantic content. Synergistic ecphory, however, predicts a non-linear relationship during recall. Therefore, correlations between episodic and semantic factors could be misleading. The next section will review the expression of memory qualia through the lens of prompt types.

### **Factor Expression as a Function of Prompt Type**

In the current experiment, memory prompts encouraged participants to report memories of various kinds to establish a diversity of memory experiences. Prompts were selected to elicit memories of several key theoretical categories: recent events, which have had little time to be subjected to hypothesized memory consolidation processes and are therefore likely more episodic; remote events, which are subject to divergent predictions regarding their episodic or semantic status; and period summaries, which encapsulate large spans of personal past and are therefore expected to concern semantic generalizations to a greater degree than event reports (Conway & Pleydell-Pearce, 2000; Tulving, 1989, 2002).

Given the lack of research on semantic memory phenomenology and semantic autobiographical memories, it was difficult to predict the expression of noesis or the outcome of the period summary condition. Most research on memory phenomenology considers the presence of factors like details and suspended imagery to be unique to episodic recall, with decreasing expression as memories age

(Boyacioglu & Akfirat, 2015; Sutin & Robins, 2007). However, the declarative memory model suggests that semantic recall can involve building flexible models that range in complexity and detailedness (Tulving, 2002), meaning imagery, details, and noesis may be positively endorsed in this condition. In contrast, this model asserts that auto-noesis, mental time travel, and first-person perspective are unique to episodic memory, meaning they should be negatively endorsed in semantic recall. Building on these predictions, the model of synergistic ecphory proposes an inverse relationship between episodic and semantic memory (Tulving & Thomson, 1973). This means the expression of noesis should increase as the expression of episodic memory qualia decreases, such as during the recall of old or semantic memories.

Guided by these theoretical perspectives, I used the discovered latent factor structure to analyze the variation between recall experiences. I found that the low-order episodic quale was strongly expressed in all conditions, with expression decreasing between recent and remote event prompts as well as between remote event and period summary prompts. In contrast, the low-order semantic quale demonstrated the opposite pattern of increasing expression between conditions. Expression of high-order qualia was more complex. The recent event prompt was characterized by positive expression of all factors, except noesis. The remote event prompt was characterized by positive expression of auto-noesis, details, dynamic imagery, mental time travel, and first-person perspective. In contrast, it showed negative expression of suspended imagery and noesis. Two features of note for this condition were that it had the highest mental time travel factor score and the lowest noesis factor score. The period summary prompt was characterized by positive expression of auto-noesis, dynamic imagery, mental time travel, first-person perspective, and neutral expression of details. In contrast, it showed negative expression of suspended imagery and noesis. As predicted, this condition showed the highest factor

scores for noesis despite not having reached positive levels of expression (difference not statistically tested).

Between prompt comparisons of high-order factor expression largely followed predictions based on current theory and prior research. In the recent and remote event comparison, the mental time travel factor increased and all other factors decreased as memories aged. In the remote event and period summary comparison, there was a decrease in details, suspend imagery, and mental time travel as well as an increase in auto-noesis and noesis as the predicted amount of semantic generalizations increased. Dynamic imagery and first-person perspective were relatively consistent across this comparison. While commonly researched episodic memory qualia (e.g., imagery, details, first-person perspective) sampled in this study followed previously observed patterns of decreasing expression as memories age (Sutin & Robins, 2007), auto-noesis was unexpectedly greater in the period summary than remote event condition. To further investigate these results, the next section considers the influence period summary recall on memory qualia.

### **Effect of Period Summary Context on Recall**

A possible explanation for this condition's unexpected positive expression of auto-noesis, dynamic imagery, mental time travel, and first-person perspective emerges from the idea that semantic information about the self may retain source information (Conway & Pleydell-Pearce, 2000). Contextual or temporal tags may continue to connect semantic information to its original episodic trace, potentially relying on a mechanism like synaptic tagging (Frey & Morris, 1997). As a result, the period summary prompt may have evoked a hybrid form of recall that falls between episodic and semantic recall (for practical examples, see Renoult et al., 2012 and Tanguay et al., 2023). This mode of recall could be supported the Trace Transformation Theory, which posits that the original episodic memory trace as well as separate gist-based and semantic versions may be accessible during recall (Moscovitch et al., 2016;

Winocur & Moscovitch, 2011). Taken together, this may permit connection to episodic traces while accessing semantic information about the self, potentially enabling positive expression of features that fall under the umbrella of episodic memory qualia such as details, mental time travel, and auto-noesis. While this explanation suggests a functional relationship between episodic and semantic memory, their corresponding qualia were only weakly correlated in the current study. This relationship may have been specific to the period summary condition, and therefore obscured by the aggregated factor analysis.

The possible episodic memory connection could also explain the lack of positive expression of noesis. To contextualize, noesis was the only quale to emerge that contained items assessing both experiential and strategic features of remembering. These strategic features can be interpreted as indicators of semantic scaffolding during recall: the use of general knowledge to facilitate recollection by binding features of an episodic memory to a structural framework provided by semantic memory (Irish & Piguet, 2013). Building on this framework, the low expression of noesis across all conditions can be understood through the model of synergistic ephory (Tulving & Thomson, 1973). This model proposes that the amount of semantic scaffolding required to produce recall is inversely related to the amount of episodic information. Consequently, noesis may have remained low because participants were able to rely on episodic traces, reducing the need for semantic scaffolding that might otherwise increase noesis scores. In summary, these findings challenge the common notion that only episodic memories give rise to phenomenological qualities.

### **Auto-noesis, Mental Time Travel, and the Construct of Subjective Awareness**

Tulving (2002) theorized that auto-noesis and mental time travel combine to produce a sense of subjective awareness during recall, and that they are both necessary for, and unique to episodic recall. To my knowledge, no prior work has identified dimensions of auto-noesis and mental time travel using a bottom-up approach, nor examined how their expression may vary across recall types. For instance, Irish

and colleagues (2011) measured feelings of reliving across five recall conditions, but only assessed whether memories were relived, and the percentage that were re-experienced. This study, however, used an exploratory approach to derive and replicate networks of features that resemble Tulving's (2002) constructs of auto-noesis and mental time travel, and explored differences in expression across conditions.

Notably, auto-noesis was positively expressed in all conditions, implying that even memories that are not expected to be episodic can produce engaging and meaningful personal connection. This is perhaps not surprising, as all prompts encouraged participants to either summarize or describe specific events from their personal past. Perhaps more surprising was greater auto-noesis in the period summary than remote event condition, and in the remote than recent condition. It might reasonably be the case that a summary tailored to convey one's childhood experiences might evoke even more feelings of personal connection to that past than a single event selected from that time; and that the loss of detail associated with the remote relative to recent event condition contributed to a diminished sense of personal connection to those events. Considered in this light, Tulving's emphasis of auto-noesis in episodic memory, specifically, could be considered puzzling.

Inspired by William James, Tulving asserted that episodic remembering can only be distinguished by the presence of conscious awareness (Tulving, 1984). He contended that all memories that represent past experiences (and only those that do) are accompanied by a sense of personal intimacy. However, his intentions with this term are elusive; as one of the least intuitive aspects of the episodic memory construct, it has been interpreted and operationalized in many ways. While our factor contains items that closely replicate Tulving's (2002) definition of auto-noesis, these somewhat abstract concepts may have been interpreted other than intended. For example, participants may have inferred that any memory about themselves was intimate, rather than judging feelings of intimacy with the recollection.

Even if two memories of events produced qualitatively different sensations of personal connection, participants may have rated them similarly due to this logical inference. Given the nuance of interpretation, this quale does not necessarily align with the apparent intent of this term: identifying successful episodic memory retrieval through conscious recollective experience. For example, Tulving (1989) interviewed a patient with anterograde and retrograde amnesia, K.C., about experiences prior to their injury. While K.C.'s responses gave the appearance of remembering, further probing revealed that these personal facts were actually inferred. Therefore, it may not be possible to tap into the apparent intent of auto-noesis without a means of confirming successful memory retrieval.

Despite the challenge of operationalizing auto-noesis, the factor structure of this sample offers compelling evidence that it is primarily associated with episodic memory. Auto-noesis was strongly correlated with the low-order episodic features factor and weakly correlated with the semantic features factor. This indicates that auto-noesis shares substantial variance with overall episodic qualia, consistent with Tulving's (2002) conceptualization, and shows little shared variance with overall semantic qualia. Although these correlations may have been inflated by the inclusion of auto-noesis in the construction of both low-order factors, the difference in strength suggests it was more closely aligned with episodic memory. The mental time travel factor showed a similar pattern, further reinforcing the role of subjective awareness in episodic recall.

Next, I will consider the expression of mental time travel in this study. The mental time travel factor was again expressed positively in all conditions, but was more strongly expressed in memories evoked by the remote event prompt than either the recent event or period summary prompts. Increased expression in the remote event compared to the period summary condition is a canonical prediction by Tulving: episodic re-experiencing is proposed to entail direct re-experiencing of the past, as if one were placed in one's own shoes. Also, increased expression of mental time travel in the remote compared to

the recent event prompt may hinge on participant interpretation of questionnaire items. That is, even if re-experiencing an event from earlier in the day felt qualitatively identical to re-experiencing events from childhood, the re-experiencing of today's event might linguistically seem less like "being in the past" than "being in the present," evoking lower endorsement for recent than remote event prompts.

An alternate explanation for this finding comes from the recency of the event used in the recent event condition. Since very recent events are expected to be more detailed and accessible than older events (Conway & Loveday, 2015), there may be little need to activate mental time travel to revisit the details. Effectively, the need for mental time travel may be supplanted by the presence of highly detailed and vivid memories. This means participants may be able to recall events from the recent week with very little effort – they know what happened without the necessity of grounding it in a complete spatiotemporal recreation. In contrast to Tulving's (2002) assertion that mental time travel and autoindexing are both necessary for and characteristic of episodic recall, the observation that they were expressed during semantic recall challenges the view that they are diagnostic of episodic memory.

### **The Fate of Older Episodic Memories: Comparing Recent and Remote Events**

There is ongoing debate regarding the effect of consolidation processes on memories. Are older memories only subject to a loss of phenomenological qualities caused by decay in the original episodic memory trace, or do memories transition into gist-based and then semantic versions as they age (for a review, see Gentry & Buckner, 2024). This section assesses the results of the current study for contributions to the debate about whether older memories are episodic or semantic.

To review, episodic and semantic memory systems cooperate to produce declarative memories (Tulving, 2002). Whereas episodic memories contain information about personally experienced events that are subjectively anchored in time and space, semantic memories contain factual knowledge about the world and the relationship between conceptual nodes. While Tulving (2002) defined episodic

memories as those producing a sense of conscious awareness, this study suggests that memories which are traditionally considered semantic also produce this sensation. Further complicating the assessment of episodic decay versus semantic transformation is the notion that episodic memories can have any level of detail and specificity, provided that they meet the core definition (Conway & Pleydell-Pearce, 2000; Tulving, 2002).

Given that semantic memories are conceptual representations of factual knowledge (Tulving, 2002), I found little support for the notion that older memories are semantic. In contrast to current understanding of semantic memory, this condition showed the continued positive endorsement of episodic qualia. Furthermore, older memories in this study showed the lowest expression of noesis and the highest expression of mental time travel. Since noesis indicates the presence of generalized information and mental time travel indicates self-projection across a personal timeline, their expression in this condition suggests older memories are distinct from semantic memory.

Further support for the idea that older memories differ from semantic memory comes from their contrast with period summaries. Assuming the period summary prompt largely produced semantic recall, I would expect similar expression in both conditions if older memories were semantic. In contrast, auto-noesis was highest in the period summary prompt, and only dynamic imagery and first-person perspective were consistent across conditions. Given the lack of support in this study for theories of semantic transformation and the observed decrease in episodic qualia as memories aged, these findings support the notion that the reported remote events were mostly episodic. However, this interpretation must be weighed against the study's methodological constraints.

It is important to note that this study allowed participants to single out memories. Given control over memory selection, participants may have exhibited a bias toward highly meaningful experiences across conditions. The short time frame of 1-week in the recent condition may have produced fewer

meaningful memories from which to choose, resulting from fewer prospects for special events. In spite of this potential bias toward older events, this study still replicated prior findings that episodic memory qualia expression decreases as memories age (Sutin & Robins, 2007). In summary, the current results support the notion that older memories remain episodic and experience decay in episodic qualia over time.

### **Strengths and Limitations**

One strength of this study is the replication of the factor structure in two samples with considerably different demographics. The first was recruited from Prolific and Reddit, while the second sample was recruited from the Queen's Psychology participants. These samples differed notably in age, gender, and ethnicity. Finding broadly similar dimensions of phenomenological experience across samples despite these differences suggests the discovered latent factor structure of declarative memory qualia is likely generalizable across healthy samples.

Another strength of this study is the IAE, a novel measure that derived constructs of declarative memory using a bottom-up analytic approach. Using flexible prompts to encourage different types of declarative memory recall, it successfully captured and quantified episodic and semantic qualia. Tests of internal consistency using McDonald's Omega Total showed that all but one factor had good internal consistency. The first-person perspective factor, however, could benefit from revision to reduce response skew, and increase coverage of the construct.

While the IAE identified dimensions resembling Tulving's (2002) constructs of mental time travel, auto-noesis, and noesis, each could benefit from the additional refinement. For instance, the noesis factor would benefit from items that distinguish between failure to recall, strategy, and semantic experiences. The unexpected presence of episodic qualia in the semantic condition underscores the need to tease apart the effects of condition, temporal distance, and re-experiencing. Similarly, difficulty

operationalizing auto-noesis suggests the need to distinguish between inferred (know) and recollective (remember) responses. These limitations could be addressed by adding items targeting each deficiency and adapting the IAE's instructions to test effects across different time frames and recall types.

The repeated-measures design of this study represents both a strength and weakness. Since each participant served as their own control, it was possible to measure changes resulting from prompt type without exposing the measurement to between-subjects noise. On the other hand, each condition required generating a memory and completing a 53-item questionnaire, potentially causing participant fatigue. The IAE would benefit from future refinement that reduces each construct to three to five items.

Another methodological limitation is aggregation of participant responses across all conditions. While a super-subject exploratory factor analysis was chosen based on the expectation that each prompt would evoke independent expressions of memory, it conflates within and across condition variance. To test this limitation, I conducted two follow-up analyses. First, I replicated the goal of the current study by randomly assigning participants to three different staggered condition groups: each participant contributed a single randomly assigned prompt condition to each group, and each group had a similar quantity of responses for each prompt condition. Following the procedure described in the methods section, I performed a factor analysis on one of the staggered groups and assessed it for congruence with the super-subject analysis used in this study. Tucker's scores ranged from .97 to 1, indicating factor equality (Lorenzo-Seva & ten Berge, 2006). For the second analysis, I grouped responses by condition and repeated the same process. Tucker's scores ranged by prompt condition: recent event scores ranged from .97 to .99 (factor equality), while remote event and period summary scores ranged from .85 to .97. The remote event and period summary conditions each had three factors that were equal and four with fair congruence. Since my analysis aimed to identify the broad latent factor structure across declarative memory, it is not surprising that congruency reduced in some conditions. Given that the staggered group

analysis should match the current study's aim of producing a broad latent factor structure across declarative memory and it demonstrated factor equality, I would expect it to have functionally similar factor weights and patterns of factor expression to the super-subject analysis used in this study. I therefore judged the conflation of within and across condition variance as being unlikely to impact the current results.

### **Future Directions**

The current work establishes a foothold in understanding memory experiences. However, much work remains to be done before a full understanding is established. The IAE is a promising tool for this line of research. Its ability to elicit different memory functions through prompt variation and to quantify memory qualia enables systematic investigation of declarative memory phenomenology. For instance, comparing recollections of episodic and episodic-near memories (e.g., repeated events) with semantic control conditions (e.g., describing typical experiences of others) may help disentangle dimensions of memory phenomenology attributable to each memory system. The observation of systematic differences between these conditions may lead to the development of a phenomenological map of episodic and semantic memory subtypes, supporting more nuanced taxonomic classifications that reflect the complexity of human memory. However, before the IAE can be used for large-scale memory classification, its psychometric properties should be refined through validation and expansion of the latent factors uncovered in this study.

Beyond behavioural methods, it may be possible to clarify which brain regions correspond to each quale by extending the IAE to neuroimaging paradigms (e.g., fMRI). Since subjective experiences of memory are pivotal to theoretical classifications (Tulving, 2002), and episodic memory is inextricably linked to the hippocampus (Danieli et al., 2023; Moscovitch et al., 2016), connecting memory qualia to a neural profile may help distinguish between the neural signatures of episodic and semantic recall.

Starting with episodic memory, the hippocampus is believed to be strongly associated with episodic qualia, and each quale may engage neural systems tied to specific sensory experiences. In contrast to episodic memory's association with distinct brain regions (Moscovitch et al., 2016), semantic qualia are expected to show the widely distributed neural networks that characterize semantic memory (Ovando-Tellez et al., 2022). Once mapped, these neural profiles can be used to explore variability across individuals or groups, such as why some people report episodic memories without mental imagery. This line of research may help unite Tulving's (2002) framework of declarative memory with the neural substrates of memory qualia.

## **Conclusion**

This study investigated the structure of memory phenomenology, a principal topic in the development of memory constructs. Motivated by the limitations in existing approaches that neatly partition episodic memory phenomenology into established dimensions, this study adopted an exploratory approach to examine how features combine to produce latent factors of declarative memory and how these factors characterize declarative memories. By sampling a wide variety of memory-related characteristics and using exploratory data analysis, this study identified data-driven factors that reflect canonical qualia of episodic and semantic memory. Notably, this is one of the first studies to derive the latent factor structure of declarative memory phenomenology (for a confirmatory analysis of a priori latent constructs with blended dimensions, see Fitzgerald & Broadbridge, 2013), revealing constellations of features that resemble Tulving's (2002) core memory qualia of mental time travel, auto-noesis, noesis, as well as two distinct dimensions of imagery. The current study suggests a hierarchical organization of episodic and semantic qualia, with qualia expression diverging across conditions to produce distinguishable episodic and semantic memory experiences. Contrary to the idea that older memories are semantic, the current results suggest that older memories retained episodic qualities. These findings

encourage further classification and characterization of memory qualia patterns that emerge during declarative memory recall, a task the IAE is well-equipped to address. By capturing and quantifying the phenomenology of declarative memory in real-world contexts, the IAE helps bridge theoretical and lived memory experiences. Future IAE investigations may provide groundwork for understanding how personal memories are stored, retrieved, and used in daily life.

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## Appendix A

### Instruments Assessing Memory Phenomenology and their Development

Structure Tested	Instrument	Goal and Analysis Method	Scale Dimensions
Yes	Autobiographical Memory Characteristics Questionnaire (AMCQ; Boyacioglu & Akfirat, 2015)	Build scales for hypothesized dimensions. Items with problematic correlation patterns were removed from analysis (low, multi, inconsistent). Principal axis factor analysis used to determine number of factors followed by explanatory analysis to tests solutions (method unspecified). Based on description, they appear to have used it to remove problematic items, increase internal consistency, and increase structural reliability. Subsequent studies used this structure in confirmatory factor analyses (CFA).	Vividness, belief in accuracy, place details, sensory details, accessibility, sharing, observer perspective, field perspective, narrative coherence, recollection, emotional valence, emotional intensity, emotional distancing, and preoccupation with emotions.
Yes	Autobiographical Memory Questionnaire (AMQ) with additional items (Fitzgerald & Broadbridge, 2013)	Test for hypothesized structure in AMQ (Rubin et al., 2003) and new items. Items grouped into hypothesized structure and tested for agreement using CFA.	Recollection, belief, impact, and rehearsal.
Yes	Memory Experiences Questionnaire (MEQ; Sutin & Robins, 2007)	Build scales for hypothesized dimensions. Reliability analyses used to test for consistency with hypothesized dimensions. Items that reduced Alpha were removed. Followed up with CFA of hypothesized dimensions, comparing 1-, 2-, 8-, and 10-dimension models for best fit.	Vividness, coherence, accessibility, time perspective, sensory detail, visual perspective, emotional intensity, sharing, distancing, and valence.

Structure Tested	Instrument	Goal and Analysis Method	Scale Dimensions
No	AMQ (Rubin et al., 2003)	Used items to explore relationships with other variables (recollection and belief). No factors were derived. However, a principal components analysis was used to better understand between-item relationships.	Predictors of recollection and belief included visual imagery, contextual imagery, auditory imagery, and narrative coherence.
No	Assessment of the Phenomenology of Autobiographical Memory (APAM; Vannucci et al., 2020)	Used three existing instruments and new items to explore relationships with other variables. Used Cronbach's alpha to confirm reliability and unidimensionality across different memory conditions. No factors were derived; however, a PCA was used to better understand item relationships across conditions.	Assessed characteristics of memory phenomenology.
No	APAM, Online Version (Vannucci et al., 2021)	Test for consistency between in-person and online formats. No factors derived, only item validation.	Validated consistency of phenomenal characteristics across formats.
No	Episodic Autobiographical Memory Interview (EAMI - Autonoetic Subscale; Irish et al., 2008)	Explore phenomenological characteristics associated with reliving memories. Non-parametric analysis of items, no factors derived.	Assessed characteristics of memory phenomenology.
No	Memory Characteristics Questionnaire (MCQ; Johnson et al., 1988)	Used items used to compare phenomenological expression in real versus imaginary memories. No factors derived.	Assessed characteristics of memory phenomenology.

Structure Tested	Instrument	Goal and Analysis Method	Scale Dimensions
No	MEQ, Short Form (MEQ-SF; Luchetti & Sutin, 2016)	Shorten the original MEQ. Cronbach's alpha used to decide items to retain.	Same dimensions as full MEQ.
No	Scene construction and spatial coherence ratings (Marlatte et al., 2022)	Used items to explore elements of memory related to location. No factors derived; however, items were used in a multifactor analysis with structural brain data.	Assessed theorized elements of scene construction and spatial coherence.

## Appendix B

### Inventory of Autobiographical Experiences: Computer-Guided Recall

#### General Instructions

We are going to ask you to tell us about different periods of your life. You can choose any personal memories you wish, as long as they happened during the periods of your life we will specify. These memories should be from your own experience. These memories should not be about things you heard from others.

Our interest is not so much in what you choose to discuss, but rather how you describe your experience. Please be sure to only choose experiences that you feel comfortable discussing in detail.

You do not have to answer any questions that you do not want to and you can stop at any time by closing your browser and emailing [ ].

#### Condition Prompts

##### *A Specific Experience From [ ]*

Please tell us about a specific experience from this period of your life. You can choose any experience that you have a personal recollection of being involved in. Do not pick an experience that you heard about from others. The experience must be specific in time and place and it must have happened during this period.

We want you to provide as much detail as you can about your experience. Can you remember the date, time, and location? Can you explain what happened and who was there? What did you see, hear, think, and feel?

For example, when you were 3 or 4, you might have fallen and skinned your knee right before a wedding, and you might have been wearing a white shirt and remember wind in your hair.

Please take a moment to imagine a specific experience from this time, and allow your ideas to form. As soon as you have accomplished this, proceed to the next screen.

If you are stuck, here are more examples of specific experiences: The time I won bronze at a swimming competition in grade 5, or the first time I saw the Nutcracker Ballet when I was in grade 2. Any specific personal experience.

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Please spend approximately 1 minute writing about your memory. Proceed to the next screen when you are done. [Text entry box]

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We will now ask you questions about the memory that you came up with. Proceed to the next screen when you are ready.

***General Experiences from [ ]***

Think about your life during this time. Do any overarching themes stand out in your memory? What was going on in this part of your life? Were there important activities, places, or people during this period?

For example, when you were 3 or 4 years old you may have been spending most of your time playing with friends at daycare, and you may have had a favourite toy car, bedtime story, and blanket.

Please take a moment to imagine your experiences during this time, and try to capture the overall feel of it. As soon as you have accomplished this, proceed to the next screen.

If you are stuck, here are more examples of general experience topics: Personal characteristics and traits, relationships with family and friends, school experiences. Any personal life themes.

---

Please spend approximately 1 minute writing about your general experiences during this time. Proceed to the next screen when you are done.

---

We will now ask you questions about the memory that you came up with. Proceed to the next screen when you are ready.

## Appendix C

### Inventory of Autobiographical Experiences: Influences from Phenomenology Instruments

IAE Item	Instrument	Question
1, 2, 3	EAMI	When you picture this event do you visualise it as a continuous video that plays with no breaks, moving video clips with some breaks, one moving image, or is it more like a set of snapshots with no movement, or something else? One smooth video (1), Video clips with breaks, One moving image, Snapshots in a sequence (4), One static snapshot, Hazy image, No imagery (7)
4, 5	AMCQ AMCQ AMCQ AMCQ AMCQ APAM EAMI MCQ	As I remember the event, I imagine it again through my own eyes. I view this memory through my own eyes, from my own perspective. As I remember the event, I feel as though I am seeing the event out of my own eyes rather than as an outside observer. As I remember the event, I feel as though I see the event as an outside observer. As I remember the event, I feel as though I am looking at the past me and others around me from above or far away. I view this memory as if I was an observer to the experience. When you recall this event are you viewing the scene through your “own eyes” or can you see yourself in the memory from a third-person perspective? Own eyes (1), Third person (2), Mixture own eyes / 3rd person (3) Off-tangent imagery (4), No Imagery (5) I remember the event as if I were seeing myself in the scene (observer perspective):
6, 7, 8, 9	AMCQ AMCQ AMQ AMQ APAM APAM Marlatte et al., 2022	I can remember the situation in which the event occurred vividly, as though I were there. As I remember the event, I feel as though I am travelling to the time the event happened. As I remember the event, I can see it in my mind. As I remember the event, I feel that I travel back to the time when it happened, that I am a subject in it again rather than an outside observer tied to the present. As I remember the event, I can see it in my mind. As I remember the event, I feel as though I am reliving the original event. Thinking about the scene you just imagined rate your sense of presence on a scale from 1 to 5.

IAE Item	Instrument	Question
10	AMCQ	As I remember the event, I feel as though I am watching a short-film about someone else.
	APAM	I feel like the person in this memory is a different person than who I am.
13	AMCQ	I remember the event in a chronological order (before, during and after).
	MCQ	The temporal order of events is: 1 = vague; 7 = clear/distinct
	MEQ-SF	The order of events in the memory is clear.
15	AMQ	I believe the event in my memory really occurred in the way I remember it and that I have not imagined or fabricated anything that did not occur.
	APAM	I believe the event in my memory really occurred in the way I remember it and that I have not imagined or fabricated anything that did not occur.
	MCQ	The amount of doubt I have about the occurrence of the event is:
18, 19, 20	AMCQ	As I remember the event, I feel as though I travelled back and became the same person in the event.
	AMQ	As I remember the event, I feel that I travel back to the time when it happened, that I am a subject in it again rather than an outside observer tied to the present. 1 = not at all, 7 = as clearly as if it were happening right now
	AMQ	As I remember the event, I feel the emotions that I felt then.
	APAM	As I remember the event, I feel as though I am reliving the original event.
	APAM	As I remember the event, I can feel now the emotions that I felt then. 1 = not at all; 7 = as clearly as if it were happening right now
	EAMI	When you think about this event now, do you re-experience any of the emotion you originally felt at the time?
	MCQ	I can recall the feelings I had at the time the event occurred: 1 = not at all; 7 = vividly/distinctly
21	AMCQ	My memory of this event is very detailed.
	MCQ	The clarity of my memory is: 1 = vague; 7 = sharp/clear
	MEQ & MEQ-SF	My memory for this event is very detailed.
22	MCQ	My overall memory for the event is: 1 = vague/fragmentary; 7 = clear/distinct
	MEQ	My memory for this event is very vague.
25	AMCQ	I can remember the city in which the event took place.
	AMQ	As I remember the event, I can recall the setting where it occurred.

IAE Item	Instrument	Question
25	AMQ	As I remember the event, I know its spatial layout.
	APAM	As I remember the event, I can recall the spatial layout of the setting.
	MCQ	I can recall the location of the event: 1 = vague; 7 = clear/distinct
	MCQ	I can recall the setting where the event occurred: 1 = vague; 7 = clear/distinct
26	AMCQ	I can remember the district in which the event took place.
	AMCQ	I can remember the country in which the event took place.
27, 28	MCQ	The year the event occurred is: 1 = vague; 7 = clear/distinct
	MCQ	The day the event occurred is: 1 = vague; 7 = clear/distinct
	MCQ	The hour the event occurred is: 1 = vague; 7 = clear/distinct
29	AMCQ	I remember the event in a chronological order (before, during and after)
	MCQ	The temporal order of events is: 1 = vague; 7 = clear/distinct
31	AMQ	Since it happened, I have thought or talked about this event. 1 = not at all; 7 = as often as any event in my life
	EAMI	How often would you estimate you have thought about this memory since it first occurred.
	MCQ	I thought about it: 1 = not at all; 7 = many times
36	APAM	I feel like the person in this memory is a different person than who I am.
37, 39	AMQ	This memory is significant for my life because it imparts an important message for me or represents an anchor, critical juncture, or a turning point.
	APAM	This memory is significant for my life because it imparts an important message for me or represents an anchor, critical juncture, or a turning point.
	MCQ	The event is self-revealing of some aspect of my personality: 1 = not at all; 7 = very much
	MCQ	The event actually had important implications for my life: 1 = not at all; 7 = very much

IAE Item	Instrument	Question
32, 38, 40, 41, 42	AMQ  MCQ MEQ-SF  MEQ-SF	To the best of your knowledge, is the memory of an event that occurred once at one particular time and place, a summary or merging of many similar or related events, or for events that occurred over a fairly continuous extended period of time lasting more than a day? 1=once; 2=merging; 3=extended [Once/many (1 if occurred once in single day, 0 if longer) and Merged/extended (1 if merging, 0 if extended)]  The duration of the event in real time is: 1 = very short; 7 = very long  This memory is of an event that occurred once at a particular time and place, not a summary or merging of many similar or related events.  This memory is a blending of many similar, related events rather than a specific memory about a particular event.
43	AMCQ APAM EAMI  MCQ MCQ MEQ MEQ & MEQ-SF	I remember the event vividly.  My memory for this event is: 1 = vague; 7 = very vivid  When you recall this event how would you describe it in terms of vividness? This can apply to the richness of sights, sounds, smells, tastes, touch, and any movements you may have made.  The clarity of my memory is: 1 = vague; 7 = sharp/clear  The memory of the event is: 1 = dim/faint; 7 = vivid/distinct  My memory for this event is clear.  My memory for this event is very vivid.
44, 45, 46	EAMI	When you picture this event do you visualise it as a continuous video... or something else? One smooth video (1)... No imagery (7)
47	MCQ AMQ APAM APAM MEQ-SF	The amount of sound detail in my memory for the event is:  As I remember the event, I can hear it in my mind.  My memory for this event involves sound.  As I remember the event, I can hear it in my mind.  I can hear it in my mind.
48	APAM MCQ	My memory for this event involves smell.  The amount of smell detail in my memory for the event is:
49	APAM MCQ	My memory for this event involves touch.  The amount of touch detail in my memory for the event is:
50	MCQ	I can recall the thoughts I had at the time the event occurred.

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IAE Item	Instrument	Question
51	APAM	As I remember the event, I can feel now the emotions that I felt then. 1 = not at all; 7 = as clearly as if it were happening right now
	MCQ	I can recall the feelings I had at the time the event occurred.

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## Appendix D

### Inventory of Autobiographical Experiences: Questionnaire

All questions are answered on a 5-point scale. Scale anchors are as noted.

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
1	1	I experienced this memory as:	No re-experiencing (I merely know what happened without accompanying experiences)	Islands of imagery (isolated experiences such as mental pictures or sensations that do not tell an integrated story on their own)	Mental replay (an ordered flow of related experiences such as mental pictures, movies or sensations)	Direct re-living (a mental simulation, as though experiencing the event again)	Other memory experience [Please Specify]
1	2	Number of mental images/movies:	None	One	A few (2-3)	Some (4-9)	Countless (10+)
1	3	I experienced each image/movie for:	No images	A second or less	A few seconds	4-9 seconds	10+ seconds
1	6	I felt like: I experienced old sensations (sights, sounds, etc).	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	7	I felt like: I was physically "present" in a real 3D space.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
1	8	I felt like: I saw old events unfolding.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	9	I felt like: I was actually "in the past".	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	10	I felt like: this memory was so impersonal, it could have been about someone else.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree *
1	18	I felt like I had an intimate connection to this memory.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	19	I felt like I was actually reliving my original experience.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	20	I felt like my original feelings came to life.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	21	I felt like this memory was very detailed.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	25	I felt like the spatial context of this memory (setting, layout, location, etc.) was clear and detailed.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores					*
			-2	-1	0	1	2	
1	4	I felt like I saw images through my own eyes (1st person).	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	*
1	5	I felt like I saw images through "Others" eyes (3rd person).	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	*
1	43	Please rate the vividness of this memory as a whole.	Not vivid at all	Vague and dim	Moderately clear and lively	Reasonably clear and vivid	Perfectly clear and vivid	
2	44	My mental imagery for this memory involved: Live pictures (a moving snapshot of a moment).	None at all	A little	A moderate amount	A lot	A great deal	
2	45	My mental imagery for this memory involved: Non-moving pictures.	None at all	A little	A moderate amount	A lot	A great deal	
2	46	My mental imagery for this memory involved: Mental movies (longer-playing than a single moment).	None at all	A little	A moderate amount	A lot	A great deal	
2	47	My mental imagery for this memory involved: Sounds	None at all	A little	A moderate amount	A lot	A great deal	

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
2	48	My mental imagery for this memory involved: Smells.	None at all	A little	A moderate amount	A lot	A great deal
2	49	My mental imagery for this memory involved: Tactile sensations (touch/feel).	None at all	A little	A moderate amount	A lot	A great deal
2	50	My mental imagery for this memory involved: Thoughts.	None at all	A little	A moderate amount	A lot	A great deal
2	51	My mental imagery for this memory involved: Emotions.	None at all	A little	A moderate amount	A lot	A great deal
2	52	My mental imagery for this memory involved: Sensations of movement.	None at all	A little	A moderate amount	A lot	A great deal
2	53	Further searching this memory right now, I can experience additional related mental imagery (sights, sounds, etc).	None at all	A little	A moderate amount	A lot	A great deal
2	35	My mental imagery for this memory is “generic” rather than involving any specific experiences I had.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
3	17	I edited parts of this memory while narrating it (e.g., to avoid disclosing uncomfortable details, make it easier to follow, or make it more entertaining. We will not ask you about what was or wasn't edited/censored or why you did this).	No edits	One or two edits	A few edits	Numerous edits	Extensive edits
3	12	I got quite stuck while trying to remember.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	11	I figured out the story as I went along.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	13	The pieces of this memory all came to me in order.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	14	Coming up with this memory was easy.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	15	I am confident that this memory is what "truly what took place".	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	16	My narration captured the essence of this event.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
3	22	I felt like I was unable to mentally "pin down" the details.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	23	I used my ideas and general knowledge as a scaffold to develop this story.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	24	I felt like I kept returning to central imagery or thoughts when thinking about what happened.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	29	The events followed a chronological order.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	30	An invisible unicorn sang me a lullaby in this memory.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	37	This experience or set of experiences has strongly influenced the way I think and feel.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	38	This memory is representative of recurring experiences during this time.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
3	39	This memory is related to a key aspect of who I am.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	33	I mostly thought about concepts, ideas, and/or knowledge.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	34	I had a more general than specific sense of what happened.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	36	I can't relate to the "me" that was part of this memory.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4	26	I am very familiar with the location(s) in this memory.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4	42	This memory took place in:	A single location	A continuous series of connected locations	Multiple similar locations	Multiple different locations	I don't know where it took place
4	31	I have frequently thought about this memory.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4	32	I am often involved in activities similar to those I described.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Block #	Item #	Question	Response Options and Scores				
			-2	-1	0	1	2
4	27	I am able to locate this memory in time in relation to other memories.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4	28	I know the exact date and time that this happened.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4	40	How much time falls between the start and end of what you told us about your memory?	Less than a few hours	Less than 24 hours	Less than a month	Less than a year	Less than a decade
4	41	This memory took place:	Once (a single day)	Once (continuously for a few days)	Infrequently (a few times over days to decades)	Often (many times over days to decades)	Frequently (regularly over days to decades)

Note. \* indicates items that were reverse scored.

## Appendix E

### Item Level Summary Statistics by Prompt Condition

Item	Recent Event			Remote Event			Period Summary		
	<i>M</i>	<i>SD</i>	NAs	<i>M</i>	<i>SD</i>	NAs	<i>M</i>	<i>SD</i>	NAs
1	3.23	0.86	4	2.68	0.92	4	2.53	0.89	1
2	3.91	1.08	0	3.40	0.95	1	3.48	1.10	0
3	3.59	1.08	0	3.25	1.02	2	3.10	1.08	1
4	4.39	0.89	0	4.01	1.02	1	3.89	1.02	0
5	2.12	1.20	0	2.29	1.24	0	2.36	1.21	0
6	3.83	1.10	0	3.62	1.13	0	3.58	1.13	0
7	3.82	1.12	0	3.36	1.18	0	3.16	1.22	0
8	3.85	1.05	0	3.93	0.87	0	3.69	1.04	0
9	3.39	1.26	0	3.58	1.14	0	3.40	1.23	0
10	1.89	1.15	0	1.87	1.06	0	1.97	1.07	0
11	2.30	1.35	1	2.43	1.33	2	2.68	1.31	4
12	1.65	0.93	1	2.11	1.14	2	2.39	1.22	3
13	4.30	0.86	0	3.87	1.04	2	3.38	1.21	1
14	4.65	0.67	1	4.16	0.90	1	4.06	1.01	2
15	4.81	0.44	0	4.52	0.66	1	4.34	0.80	1
16	4.29	0.80	2	4.11	0.83	0	3.90	0.87	1
17	1.41	0.87	0	1.38	0.82	5	1.45	0.93	8
18	4.12	1.07	0	4.04	0.94	0	3.97	1.03	0
19	3.98	1.02	0	3.58	1.12	0	3.37	1.17	0
20	4.13	0.90	0	3.85	1.02	0	3.67	1.08	0
21	4.36	0.80	0	3.69	1.09	0	3.48	1.18	0
22	2.03	1.24	0	2.47	1.22	0	2.73	1.26	3
23	2.62	1.27	3	2.52	1.21	3	2.79	1.20	5
24	3.57	1.13	2	3.64	1.09	2	3.64	0.99	2
25	4.50	0.74	0	3.98	0.92	0	3.72	1.06	0
26	4.47	0.90	1	4.16	1.00	1	4.23	0.96	1
27	4.51	0.70	1	3.85	1.04	3	3.88	1.00	1
28	4.59	0.75	1	2.48	1.31	0	2.32	1.21	6
29	4.27	0.85	1	3.86	0.99	4	3.25	1.17	2
30	-	-	-	-	-	-	-	-	-
31	3.40	1.29	3	3.30	1.29	0	3.37	1.27	1
32	3.61	1.25	1	2.35	1.26	1	2.68	1.32	3
33	2.62	1.24	0	2.67	1.22	1	2.99	1.22	3
34	2.44	1.27	1	2.84	1.29	1	3.29	1.29	3
35	2.15	1.19	4	2.28	1.21	5	2.68	1.31	4
36	2.42	1.51	1	2.64	1.36	1	2.75	1.44	1

Item	Recent Event			Remote Event			Period Summary		
	<i>M</i>	<i>SD</i>	NAs	<i>M</i>	<i>SD</i>	NAs	<i>M</i>	<i>SD</i>	NAs
32	3.34	1.27	4	3.23	1.24	1	3.56	1.23	0
33	3.41	1.27	3	3.00	1.33	3	3.77	1.17	1
34	3.52	1.23	3	3.38	1.24	1	3.73	1.14	2
35	1.67	0.90	12	1.87	1.30	50	3.32	1.67	70
36	1.14	0.46	11	1.32	0.81	23	2.79	1.70	113
37	1.50	0.86	0	1.41	0.78	0	2.02	1.14	3
38	4.72	0.61	0	3.88	0.98	1	3.65	1.14	1
39	3.83	1.22	4	3.38	1.21	2	3.27	1.28	1
40	2.80	1.30	0	2.66	1.29	1	2.77	1.25	0
41	3.71	1.23	2	3.17	1.29	2	3.00	1.34	1
42	3.43	1.37	0	2.78	1.38	1	2.60	1.37	0
43	2.53	1.47	0	1.96	1.32	0	2.00	1.28	0
44	2.95	1.49	1	2.69	1.43	0	2.48	1.40	0
45	4.10	1.02	2	3.75	1.20	3	3.69	1.27	1
46	3.93	1.14	1	3.81	1.18	0	3.68	1.26	3
47	3.44	1.37	2	3.13	1.32	0	2.85	1.36	0
48	3.59	1.25	0	2.90	1.32	2	2.98	1.35	0

*Note.* The replacement value for each item is its *M*. Item 30 is the attention check question.

## Appendix F

### Research Ethics Approval



Queen's University General Research Ethics Board (GREB)

RE: GREB Initial Ethics Approval

March 13, 2024

Ms. Blaney-Gale  
Department of Psychology\Unit REB  
Psychology Queen's University

**TRAQ #: 6040766**

**Study Title: "Investigating Recall for Personal Experiences"**

**Co-Investigators/Supervisor: Miss Mikayla Reymer, Dr. Jordan Poppenk**

**Review Type: Delegated**

**Date of Full Board Meeting: N/A**

**Date Ethics Approval Issued: March 13, 2024**

**Date of Expiry of Ethics Approval: March 13, 2025**

Dear Ms. Blaney-Gale

Thank you for submitting the above referenced study to The Queen's University General Research Ethics Board (GREB). GREB has reviewed the study and granted initial ethics approval for this study as of the date noted above.

#### Documents Approved:


Document Name	Comments	Version Date
Other document	Clean Study 2 SONA ad	2024/02/14
Letter of Information/Consent Form (combined document)	Clean study 2 LOI	2024/02/14
Letter of Information/Consent Form (combined document)	Clean Study 1 LOI	2024/02/14
Other document	Linking Log	2024/02/06
Other document	Exp 1 Sona Ad	2024/02/06
Debriefing Form/Letter	Exp 2 Debriefing	2024/02/06
Debriefing Form/Letter	Exp 1 Debriefing	2024/02/06
Questionnaire	Exp 2 Materials and Measures	2024/02/06
Questionnaire	Demographics and check in questions	2024/02/06

Questionnaire	Study #1: Post-interview self-rated questions for counterbalance orders B and D	2023/12/20
Questionnaire	Study #1: Post-interview self-rated questions for counterbalance orders A and C	2023/12/20
Interview Guide	Study #2 Interview Scrip-Online	2023/12/20
Interview Guide	Study #2 Interview Script-In person study	2023/12/20
Interview Guide	Study #1: Interview script for counterbalance orders	2023/12/19
	B and D	
Interview Guide	Study #1: Interview script for counterbalance orders A and C	2023/12/19
Questionnaire	Memory Style Questionnaire	2023/12/15

No deviations from, or changes to, the protocol should be initiated without prior written approval from GREB, except when necessary to eliminate immediate hazard(s) to study participants.

On behalf of the GREB, I wish you success in your research.

Sincerely,



Jacob Brower  
Chair, General Research Ethics Board (GREB)  
Associate Professor and Distinguished Faculty Fellow of Marketing,  
Academic Co-Director (Business), Master of Digital Product Management  
Smith School of Business  
[chair.greb@queensu.ca](mailto:chair.greb@queensu.ca)  
Queen's University  
Kingston, ON K7L 3N6

GREB operates in compliance with, and is constituted in accordance with, the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. Federalwide Assurance Number: FWA#: 00004184, IRB#: IRB00003062. GREB members involved in the research project do not participate in the review, discussion, or decision.