Long-term memory for nostalgic stimuli across the lifespan: An examination of episodic and semantic memory using naturalistic stimuli presented across three modalities

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TABLE OF CONTENTS

ABSTRACT

Music has been shown to successfully prompt memory retrieval in healthy individuals as well as people with memory disorders. However, it is unclear whether music confers a *unique* advantage for this purpose, compared to other sensory cues. A possible explanation for this observed effect is the strong emotional and nostalgic grip of music and our repeated exposure to songs over time. We used advertising stimuli representing three isolated modalities (auditory, visual, and verbal) to empirically examine whether musical stimuli (jingles) uniquely promote memory retrieval and induce nostalgia compared to verbal (slogans) and visual (logos) stimuli in healthy adults across the lifespan.

In Study 1, participants from three different age groups (young adults: 18 to 30 years of age, middle-aged adults: 31 to 64 years of age, and older adults: 65 years and older) rated jingles, slogans, and logos associated with 383 advertising campaigns to examine the effects of modality and age on subjective ratings of familiarity and nostalgia, and to identify suitable stimuli for Study 2. Exploratory factors, including potential length of exposure to the advertising campaigns and nostalgia-proneness (Routledge et al., 2008), were also included to account for their interaction with our main variables of interest.

Advertisements for visual stimuli were rated as more familiar than verbal and auditory stimuli across both age groups as well as within each age group in Study 1. However, auditory musical stimuli were rated as more nostalgic across all participants, which supports prior findings regarding the use of music to evoke nostalgia (e.g., Barrett et al., 2010; Juslin et al., 2008; Batcho, 2009) and provides the first comparison of nostalgia evoked by isolated modalities in advertisements. We also observed an effect of age, such that young adults provided higher nostalgia ratings than older adults. In line with the often cited “positivity effect” (Carstensen &

Mikels, 2005; Kennedy, Mather, & Carstensen, 2004), middle-aged adults and older adults provided higher happiness ratings than young adults across modalities, and young adults provided higher sadness ratings across modalities, compared to older adults and middle-aged adults. Lastly, participants who are more prone to experiencing nostalgia, provided higher familiarity and nostalgia ratings, suggesting a general bias toward rating items as more familiar and nostalgic. We examined this further in Study 2 by using nostalgia-proneness to analyze the retention and retrieval of semantic and autobiographical memories.

Study 2 expanded on the results from Study 1 by delving into semantic and episodic memory recall as opposed to solely testing familiarity with the advertisements and advertised brands and products. We compared the number of autobiographical memories and correct semantic details (the advertised product and company) retrieved by young adults (18-30 years old) and older adults (65 years or older) in response to 55 advertising campaigns from Study 1 which met a minimum familiarity threshold. We also examined whether jingles prompted richer, more perceptually vivid episodic reminiscence among older adults by analyzing memory content using a modified version of the Autobiographical Interview scoring manual (Levine et al., 2002).

Consistent with Study 1, visual stimuli emerged as superior semantic memory cues and older adults retrieved more autobiographical memories in response to logos, compared to jingles and slogans. Age also predicted memory content and retrieval. In line with previous work on the preservation of semantic memory for individuals later in the lifespan (e.g., Levine et al., 2002; Piolino et al., 2002), older adults performed within the young adult range in our semantic memory task. Autobiographical memories provided by young adults contained more internal details and fewer external details compared to older adults. Contrary to previous studies which reported that older adults provide more positive memories than young adults, we did not find an

effect of age in this study. However, this may have been a byproduct of data collection during the COVID-19 pandemic. Lastly, we found that more nostalgic products and advertisements evoked more autobiographical memories, as did nostalgia-proneness. This work builds on existing research on aging, modality, nostalgia, and memory while extending these findings to realistic applications, such as marketing and advertising. We also provide promising insights to help identify modalities that can be used in therapeutic interventions to uniquely facilitate autobiographical memory retrieval across the lifespan, and potentially mitigate age-related effects on autobiographical memory.

CHAPTER I

INTRODUCTION

Musical stimuli have been found to successfully prompt memories in healthy individuals (Cady, Harris, & Knappenberger, 2008; Schulkind, Hennis, & Rubin, 1999; Janata, Tomic, & Rakowski, 2007), as well as people with significant memory impairment (Bartlett, Halpern, & Dowling, 1995; Foster & Valentine, 2001; Irish et al., 2006; Simmons-Stern, Budson, & Ally, 2010; El Haj, Fassoti, & Allain, 2012; El Haj et al., 2013; Baird & Samson, 2009; Cuddy & Duffin, 2005; Beatty et al., 1988; Polk & Kertesz, 1993; Kopelman, Wilson, & Baddeley, 1989). However, it is not clear whether music uniquely facilitates memory retrieval in these populations compared to other types of sensory cues.

We used advertising stimuli presented across three isolated modalities (auditory, visual, and verbal) to empirically examine whether the mode through which information is presented affects memory retrieval and emotion ratings provided by healthy individuals across the lifespan (18 to 89 years old). Advertisements were used for this purpose because: (1) they are intended to be memorable and emotionally engaging, (2) they often evoke nostalgia, which is tightly coupled with reminiscence, (3) they are aired repeatedly at various points across the lifespan, and (4) advertising campaigns typically include a jingle, slogan, and logo (representing the three isolated modalities in this work) to advertise the same product and brand. Thus, our use of these naturalistic stimuli enabled us to assess realistic memory for stimuli that individuals were repeatedly exposed to in the real world. Furthermore, our study design allowed us to assess whether one specific modality emerged as a particularly salient memory retrieval cue for each participant while simultaneously assessing differences between groups related to age and exploratory factors, such as nostalgia-proneness (Routledge et al., 2008).

In this chapter, I review existing knowledge related to the intersection of memory, aging, emotion, and media to provide a framework for the current study. I discuss my motivations for conducting this work and how it addresses existing gaps in cognitive psychology, beginning with a brief overview of findings related to memory. I review the distinction between semantic and episodic memory, the effect of time and repeated exposure on memory, the interaction of aging and memory, how sensory cues affect memory, and the relationship between emotion and memory. I then introduce the relevance of a past-oriented emotion in this work: nostalgia. Related findings from the field of consumer psychology are incorporated throughout both sections as realistic applications and relevant examples of the aforementioned topics that are specific to marketing and advertising.

Memory

Memory has fascinated humans for centuries, from the musings of Greek philosophers like Socrates to modern day cinematic hits, like *Eternal Sunshine of the Spotless Mind* and *Memento.* Streaming services like Spotify have also capitalized on our human desire to reminisce about and relive the past by creating musical time capsules that guide users toward music-evoked remembering with descriptions like “bring on the memories". This ever-present pull toward reminiscence might be driven by the role that memories play as the building blocks which shape one’s identity (Conway, 2005). However, memories are fallible, filtered reconstructions of our subjective realities rather than perfect snapshots of our lives. They can be modified during the process of reconstructing the personal past, and various factors can affect the ability to successfully retrieve memories.

The quest to examine memory has traditionally focused on how we remember, what we remember, how much we remember, and how accurately we recall the past. When people recall

information about their past, it tends to fall into one of two categories: episodic memory and semantic memory (Tulving, 1972). This section synthesizes previous findings related to these two types of memory and how they have been measured. We then discuss the factors that affect the encoding and retrieval of episodic and semantic memory, including time, repeated exposure, aging, and various cues (e.g., words, images, and music).

Semantic and Episodic Memory

Tulving (1972) provided one of the earliest and most influential distinctions of episodic and semantic memory, which we integrated in the current research project. Semantic memory consists of factual knowledge about the world or the self which is not linked to a particular place or time, such as remembering that figure skating is a sport in the Olympics. Unlike semantic memory, episodic memory consists of autobiographical events or experiences that occurred at a *specific* time and place and may include other contextual knowledge, such as the people involved or the associated emotions. For example: "I remember going to the Culver City skating rink for Leila's 10th birthday. I wore my favorite purple sweater and was really nervous that I'd fall down in front of all my friends." Episodic memory can also involve autonoetic consciousness, or the ability to mentally place oneself in the past and relive past events (i.e., "mental time travel; Tulving, 2002). This rich form of reliving the past involves the re-experiencing of contextual details and reflection upon one's specific memories, which contributes to awareness of the self as a continuous entity over time.

Conway & Pleydell-Pearce (2000) further categorized episodic memories according to their level of specificity which they claimed affects subsequent recall. According to their account, when memories are cued, we start by retrieving knowledge that is linked to broader autobiographical periods ("lifetime periods"), followed by general knowledge about classes of

events ("general events"), and finally, "specific events." At the broadest level, lifetime periods are characterized by thematic information about a period of one's life (e.g., activities, relationships, goals, and locations) and temporal knowledge about that period. Examples of lifetime periods include "when I lived in Boston" and "when I was in middle school". Although lifetime periods sometimes have a distinct beginning and ending, they often overlap and become grouped together under broader themes that reflect personal attitudes or goals.

At the intermediate level, general events consist of single representations of repeated events or a sequence of related events, such as family dinners and holidays. General events can belong to certain lifetime periods. For instance, "volunteering at the animal shelter every Saturday" could be a repeated event that occurred during the lifetime period of "middle school". Alternatively, general events can be grouped into clusters with a common theme, such that recalling one memory of a general event can cue the recall of other related events.

Finally, event-specific knowledge consists of vivid, detailed information about individual events that occur at a particular time and place and can include visual imagery and sensory-perceptual features. It is useful to sub-categorize episodic memory in this fashion because extensive work suggests that the ability to retain or retrieve memory after a delay can depend on which level of information is involved. For instance, prior work has shown that, in contrast to general event knowledge, event specific knowledge can be lost within one week of encoding unless this information is actively rehearsed (e.g., Burt, Kemp, Grady, & Conway, 2000; Burt, Watt, Mitchell, & Conway, 1998).

A body of work has established that aging can affect semantic and episodic memory retrieval, with episodic memory retrieval being relatively more impaired than semantic retrieval in older adults compared to young adults (St. Jacques & Levine, 2007; Singer, Rexhaj, &

Baddeley, 2007; Levine et al., 2002; Craik & Jennings, 1992; Park, 2000). However, age-related memory impairment can be diminished when healthy older adults are provided with retrieval support in the form of cues or recognition tasks (Craik, 1983; Craik & McDowd, 1987). This aging effect is also mitigated for general semantic knowledge (Levine et al., 2002), implicit or habitually acquired information (Hay & Jacoby, 1999; Jennings & Jacoby, 1993), and emotional material (Carstensen & Turk-Charles, 1994). Based on these findings, we tested whether older adults correctly recalled more semantic information and fewer episodic memory details in response to the advertising stimuli in Study 2, compared to young adults.

Repetition, Time, and Memory

Most forms of memory require multiple exposures to a stimulus to aid memory retention (Morris, 2001). Frequent exposure not only increases the likelihood for associations to be stored in long-term memory (e.g., Craik & Lockhart, 1972), it can also increase familiarity and enhance subsequent recall of those items (Krishnan & Shapiro, 1996; Mandler, 1979; Obermiller, 1985; Hintzman, 1970; Underwood, 1969). This effect has been observed in the domain of consumer psychology as well. Repeated exposure to advertising campaigns has been found to increase familiarity for brand names (Krishnan & Shapiro, 1996; Mandler, 1979; Obermiller, 1985), improve the recognition and recall of brand names (Mandler, 1979; Obermiller, 1985), and facilitate the retrieval of information associated with the advertised brands (Belch, 1982; Cacioppo & Petty, 1979) This is why repetition plays an important role in the development of advertising campaigns (e.g., how much money to budget for a campaign and how frequently to air it).

Neurobiological models of memory suggest that repeated exposure to information can sometimes improve retention over time. Multiple Trace Theory (MTT; Nadel et al., 2000) offers

a mechanism through which to inhibit memory decay over time. In this framework, specific memories are encoded in a hippocampal-neocortical network, and reactivation of a specific memory leads to the creation of additional traces for that memory within the hippocampus, making it easier to retrieve that memory at a later time. Multiple traces could be formed through various associations with a memory event, repeated exposure to those associated items, or rehearsal of personal associations with that remembered event. Consistent with MTT, we tested whether multiple traces, in the form of involuntarily imagining the other advertising modalities associated with a presented product or company, increased the likelihood of retrieving the semantic knowledge associated with that advertisement. We also examined whether a particular modality was associated with enhanced recall for young adults (18 to 30 years of age) versus older adults (65 to 76 years of age).

However, it is worth nothing that repetition does not always aid memory. Multiple exposures to the same stimulus can result in inhibition or distortion during subsequent memory retrieval, because new and old associations with a particular item can compete in memory (Keppel & Underwood, 1962; Waugh & Norman, 1965). Additionally, people often remember specific details by forming associations with pre-formed concepts, and these associations can interfere with each other (McGeoch, 1942). Furthermore, repetition can lead to substantial alterations of information in memory. For instance, work by Bartlett (1932) demonstrated that repeatedly retrieving memory for a story could result in substantial alterations of the story. The experiment required British participants to read a Native American ghost story and repeat the tale back to the experimenter multiple times over a number of intervals. Bartlett found that with each repetition, participants' retellings became shorter and less detailed, and more highly structured. Furthermore, retellings omitted key details and were constructed in a way to reflect the British

participants' incorrect, culturally-informed interpretations of a story from a culture to which they lacked prior exposure. Bartlett interpreted these findings to suggest that memory is shaped by schemas.

Lastly, previous research points to the role of time in the retention of memories. Ebbinghaus (1885) found that, after one initially learns new information, there is a steep drop in successful retrieval of that information, followed by a more gradual decline in retrieval success over time. The ability to recognize and retrieve information about advertisements can also follow a decreasing exponential forgetting function over time (Lodish, 1971; Simmons, 1965). Subsequent studies on autobiographical memory, or the ability to remember our personal past (e.g., Berntsen & Rubin, 2012), have found that older autobiographical memories are more difficult to retrieve than more recent ones as well, with the exception of memories for events that occurred between the ages of 10 and 30, also known as the *reminiscence bump* (Rubin & Schulkind, 1997; Berntsen & Rubin, 2002; Crovitz & Schiffman, 1974). The enhanced autobiographical recall observed for this period of time is thought to occur for various reasons, including an increase in self-defining experiences (Conway & Holmes, 2004), novel experiences (Gluck & Bluck, 2007; Demiray et al., 2009), and identity formation (McAdams, 2001) during this stage of life development. The reminiscence bump has also been observed in autobiographical memories provided for music from early childhood and adolescence (Cady, Harris, & Knappenberger, 2008; Krumhansl & Zupnick, 2013). Thus, we were motivated to test whether these reminiscence bumps would emerge for personal memories provided in response to musical advertising stimuli (jingles) in Study 2.

Music and Memory

Various cues have been used to probe memory in an effort to better understand the

mechanisms underlying memory retrieval. Music can be a particularly useful cue for evoking autobiographical memories in healthy individuals (e.g., Cady, Harris, & Knappenberger, 2008; Schulkind, Hennis, & Rubin, 1999). Moreover, music can even evoke successful retrieval of autobiographical memories in individuals with deterioration in brain areas that are important for episodic memory, for instance, in the setting of acquired brain injury (Baird & Samson, 2014), strokes (Särkämö, Tervaniemi, & Laitinen, 2008), and Alzheimer's disease (Bartlett, Halpern, & Dowling, 1995; Foster & Valentine, 2001; Irish et al., 2006; El Haj, Fassoti, & Allain, 2012; Baird & Samson, 2009; Cuddy & Duffin, 2005; Beatty et al., 1988; Polk & Kertesz, 1993; El Haj, Postal, & Allain, 2012). Despite these promising findings, it is not well understood *how* music affects memory retrieval across the lifespan and whether it confers a *unique* advantage for this purpose (i.e., as a unique kind of "cue" for retrieval). Thus, the present work focused on findings related to three specific modalities for retrieval cues, in order to conduct a well-matched comparison of semantic and episodic memory retrieval featuring visual, verbal, and auditory musical cues.

A number of studies have compared recall for sung versus spoken information in advertisements to examine the additive effect of music within the auditory domain. Musical stimuli, in the form of jingles, have emerged as the most effective form of musical reinforcement in television commercials (Scott, 1990; Yalch, 1991), and previous research has shown that they are more effective for the implicit learning and recall of verbal and visual elements of unfamiliar advertisements, compared to spoken commercials with no music (Alexomanolaki, Loveday, & Kennett, 2007). Information for advertisements is also better retained when it is sung to a catchy melody rather than merely spoken aloud (Wallace, 1991; Wallace, 1994; Yalch, 1991). However, no studies have examined the unique contribution of *unimodal* musical stimuli (i.e., not in the

context of simultaneous visual and verbal cues in a commercial) to semantic and episodic memory for advertisements, compared to advertisements representing other isolated modalities (e.g., logos and slogans). This is particularly surprising given the frequent use of nostalgia as a marketing tool to create positive impressions and memorable bonds between consumers and brands (Holbrook & O'Shaughnessy, 1984; Pascal et al., 2002; Bambauer-Sachse & Gierl, 2009; Muehling & Sprott, 2004), and the nostalgic grip of music (Barrett et al., 2010; Janata et al., 2007; Wildschut et al., 2006; Juslin et al., 2008; Hart et al., 2011; Routledge et al., 2011; Grandjean & Scherer, 2008; Zentner et al., 2008). The current research project addresses this gap in the literature.

A musical advantage may have emerged for memory retrieval and vivid reminiscence since music is a structured stimulus which unfolds over time, engages auditory and sensorimotor processes (Froese & González-Grandón, 2020; Gordon, Cobb, & Balasubramaniam, 2018), and we are frequently exposed to it (Sloboda, O'Neill, & Ivaldi, 2001; Juslin & Laukka, 2004). This combination of factors may contribute to enhanced memory for music, compared to other modalities. For instance, Belfi and colleagues reported that memories evoked by Billboard Hot 100 year-end charts during participants' youth (15 to 30 years) were more vivid and emotional than memories evoked by famous faces, and autobiographical memories evoked by famous faces contained more semantic content, whereas music-evoked autobiographical memories (MEAMs) contained more episodic content (Belfi et al., 2016, 2018). Enhanced memory retrieval has also been observed for MEAMS compared to verbal cues, particularly among healthy older adults compared to younger adults (Schulkind & Woldorf, 2005). Moreover, MEAMS have been found to contain more motor-perceptual details than memories evoked by words representing lifetime periods or specific events (Zator & Katz, 2016).

This preservation of music-evoked remembering may also be due to the sparing of neural areas associated with musical cognition, such as the medial prefrontal cortex (mPFC) which is engaged while reminiscing to familiar music (Ford et al., 2011; Janata, 2009; Limb, 2006; Cuddy & Duffin, 2005; Polk & Kertesz, 1993). The mPFC is a key component of the default mode network (Hagmann et al., 2008) and plays a significant role in memory retrieval, social cognition, and decision making (e.g., Euston et al., 2012). It also serves as a central hub for integrating music, memory, and emotions (e.g., Janata, 2009). Neuropsychological and neuroimaging data suggest that normal aging is accompanied by structural and functional changes in the lateral prefrontal cortex (Park & Gutchess, 2006; Gutchess et al., 2007). However, the mPFC and ventromedial PFC appear intact in healthy older adults and show little structural and functional decline compared to other regions (Mather, 2016; Gutchess et al., 2007). Interestingly, the mPFC has also been shown to undergo a slower atrophy and overall decline, compared to the other neural areas affected in Alzheimer's disease (AD; Thompson et al., 2003). Thus, one possibility for the relatively higher retrieval success for MEAMs vs other memories in the context of AD is that the associations featuring structured sensory cues like music involve brain areas that are relatively spared from deterioration. Therefore, structured sensory cues like advertising jingles might also provide a basis for preserved memory retrieval in the context of aging or AD. The present study examined this possibility by using advertising jingles as the musical stimuli as a point of comparison for advertising logos and slogans, respectively representing visual and verbal stimuli.

Another factor that may contribute to the success of music-evoked memory retrieval, regardless of age or clinical diagnosis, is the inherent emotionality of musical stimuli (e.g., Koelsch, 2010; Janata et al., 2007; Juslin & Laukka, 2004). Indeed, music has been shown to

evoke emotional reactions in healthy adults as well as adults with advanced dementia (Cuddy & Duffin, 2005; Johnson et al., 2011). Moreover, the emotional salience of a song, regardless of affective valence, is positively correlated with older adults' ability to retrieve semantic information about a song (Schulkind, Hennis, & Rubin, 1999) as well as the likelihood of young adults providing an episodic memory in response to popular music from their youth (e.g., Janata, et al., 2007). These findings are consistent with prior results demonstrating enhanced memory recall for positively-valenced and arousing events (Banaji & Hardin, 1994; Bower, 1981; Christianson & Safer, 1996; Conway, 1990; Pillemer et al., 1996; Revelle & Loftus, 1990; Thompson et al., 1996; Wagenaar, 1986). Psychological mechanisms such as mood-congruency between the musical cue and the associated autobiographical memory (e.g., Baumgartner, 1992) may also facilitate music-evoked autobiographical memory retrieval. Alternatively, perhaps the engagement of areas, such as the amygdala which is engaged during music listening (Salimpoor et al., 2009; Menon & Levitin, 2005; Koelsch, Fritz, & Schlaug, 2008) and has reciprocal connections to the mPFC (Tottenham, 2015), aids the memory retrieval process through greater engagement of prefrontal areas as a form of neurocognitive scaffolding in light of age-related neurocognitive decline (Park & Reuter-Lorenz, 2009).

However, prior research also provides strong evidence that memory retrieval and content do not uniquely differ for musical cues compared to other sensory cues. For example, a study by Cady and colleagues sought to investigate the differences between autobiographical memories reported in response to listening to music, reading lyrics, or viewing an image of a musical artist (Cady, Harris, & Knappenberger, 2007). This work found no difference in the self-reported emotional content or vividness of the memories evoked by different cues. Additional work on the autobiographical memories evoked for musical events, such as attending a concert, compared to

other lifetime events (e.g., dining and holidays) did not observe a difference in the vividness and emotional characteristics of the memory reports (Halpern et al., 2018). Additionally, although the aforementioned work by Belfi and colleagues (2016) observed more vivid memories in response to musical cues compared to picture cues, they also found that music cues were less effective in generating autobiographical memories than pictures of famous people.

Various factors might explain these mixed results. For instance, when conducting a comparison of modalities for memory retrieval, the ideal scenario would be to include stimuli from each modality that are matched for associated information and length of exposure or offer an opportunity to account for these potentially confounding variables within a single analysis. Many of the studies cited above compared stimuli from modalities that participants were exposed to for varying or unknown amounts of time, and were associated with very different themes (e.g., famous faces compared to songs). Therefore, in the present work, we controlled for both of these factors in the database, study design, and analysis. Namely, we used three types of advertisements (jingles, slogans, and logos) which naturally feature three isolated modalities (auditory, verbal, and visual) that are tied to a single advertising campaign associated with the same product and company. In this way, we examined the effectiveness of these modalities as retrieval contexts and whether they aided subsequent retrieval of the associated memories. Moreover, we tracked the time span during which each advertisement was aired and included this variable as a regressor.

The methods used to characterize and code memories provided in response to different sensory cues can also affect subsequent interpretations of the observed effects. For instance, in their comparison of memory scoring techniques for music-evoked and picture-evoked memories, Belfi et al. (2021) noted that MEAMs differ from memories evoked by pictures in some respects

(e.g., perceptual and episodic content), but not others (e.g., emotional content), and the results they observed were specific to the form of analysis used. For instance, if one solely examined the proportion of internal episodic details provided in response to memories using the Autobiographical Interview annotation guide (Levine et al., 2002), they would conclude that MEAMS do not differ from picture-evoked memories. However, analysis featuring the Linguistic Inquiry Word Count tool (LIWC; Pennebaker et al., 2015) demonstrated that MEAMs evoked more auditory and physical perceptual details than pictures. Moreover, when examining the *number* of memories evoked, pictures emerged as the superior cue (Belfi et al., 2021).

Other moderating variables such as personal significance and emotional arousal might also account for differences in retrieval success between MEAMs and other cue-evoked memories. For instance, recent work points to the role of personal significance and familiarity in the success of music as a memory cue (Rathbone et al., 2017; Barrett et al., 2010; Janata et al., 2007). Additionally, previous studies of autobiographical memory have reported positive relationships between the personal salience, emotional valence, and the emotional intensity of the remembered event, as well as the likelihood that the event will be rated as vivid when it is recalled (Conway, 1990; Levine & Bluck, 1997; Rubin, 2005; Rubin & Kozin, 1984).

Lastly, results and subsequent interpretations of the findings may vary according to the study design (between versus within-subjects) and whether participants engaged in voluntary reminiscence or spontaneous remembering. For instance, Cady and colleagues (2008) did not find a significant difference with respect to the vividness, specificity, emotionality, and perceived degree of reliving the autobiographical memories evoked by popular music, song lyrics, and photographs of artists. However, participants in their study were deliberately required to report a memory for each stimulus. This form of voluntary remembering is known to require a

more effortful search (Barzykowski & Niedźwieńska, 2018; Barzykowski & Staugaard, 2016; Botzung, Denkova, Ciuciu, Scheiber, & Manning, 2008) and evoke less specific memory content as well as less emotional arousal at the time of recall, compared to involuntary memories that are evoked without a conscious or deliberate attempt to remember them (Schlagman & Kvavilashvili, 2008; Berntsen, 2010; Berntsen & Hall, 2004; Mace, 2007). Furthermore, Cady and colleagues (2008) implemented a between-subjects manipulation in their study design, which might have limited their ability to assess the effectiveness of each modality for each participant. Thus, the question of whether musical stimuli uniquely facilitate memory retrieval across the lifespan compared to other modalities is still unresolved and we aimed to address this gap in the literature with our present work.

Emotion and Memory

In this section, we explore the relationship between emotion and memory featuring non-musical cues and the role of age. Emotion has been shown to play an important role in memory retrieval across the lifespan. Prior research has demonstrated that emotional events are better remembered than neutral or less emotionally arousing events (Cahill & McGaugh, 1998; Dolcos, LaBar, & Cabeza, 2004; Talarico et al., 2004; Banaji & Hardin, 1994; Bower, 1981; Conway, 1990; Bradley et al., 1992; Christianson, 1992; Cahill & McGaugh, 1995; Cahill et al., 1996; Canli et al., 2000). Furthermore, emotional stimuli have been shown to increase recollection of details that are intrinsic to the emotional item or object, such as the colors or details in a picture (Yonelinas & Ritchey, 2015) and this emotional advantage becomes more apparent over time (e.g., Sharot, Verfaellie, & Yonelinas, 2007; Yegiyan & Yonelinas, 2011; Thompson et al., 1996).

This emotional advantage has also been observed in memory for television commercials

with higher semantic recall (e.g., product category, brand name, product characteristics) for more emotional television commercials immediately after exposure to the advertisements (Friestad & Thorson, 1985) and 6 to 8 weeks after exposure (Friestad & Thorson, 1986). We built on this work by examining long-term memory (e.g., last exposure ranging from 1 to 65 years ago) for unimodal advertising stimuli which participants were repeatedly exposed to throughout their lives, in both younger and older adults.

Many experiments on memory and aging have demonstrated that healthy older adults are particularly responsive to emotional stimuli and are more likely to retrieve emotional content. For instance, older adults recall more feelings and evaluative statements in their autobiographical memories, compared to young adults (Hashtroudi, Johnson, & Chrosniak, 1990). We also examined the interaction of emotion, aging and memory with a particular focus on the *positivity effect* (Kennedy et al., 2004; Mather & Carstensen, 2005) which appears as a greater memory advantage for positive over negative items in older versus younger adults (Mather & Carstensen, 2003; Reed & Carstensen, 2012; Reed et al., 2014; Dijkstra & Kaup, 2005; Singer, Rexhaj, & Baddeley, 2007). This attentional bias toward happier items can help close the age gap for the retrieval of positively-valenced memories in particular (Berntsen & Rubin, 2002).

The present work examined whether the positivity effect persisted for older adults in response to our database of stimuli such that advertisements and advertised products in our study were rated as happier and more positive autobiographical memories were retrieved by older adults, compared to young adults. Moreover, in light of findings which suggest that older adults demonstrate better memory for more emotional information over other types of information (e.g., Hashtroudi, Johnson, & Chrosniak, 1990; Carstensen & Turk-Charles, 1994; Carstensen & Turk-Charles, 1994; Mather & Carstensen, 2005; Levine & Bluck, 1997; Comblain et al., 2005;

Schulkind, Hennis, & Rubin, 1999), we tested whether more stimuli that were rated as more emotional were associated with greater memory recall and the retrieval of more episodic content. The emotion that we focused on for this purpose was nostalgia since its past-oriented nature makes it a particularly salient prompt for reminiscence (Batcho, 2007; Leboe & Ansons, 2006; Sedikides et al., 2008; Wildschut et al., 2006) and it is predominantly associated with positive affect (e.g., Barrett et al., 2010; Hepper, et al., 2012; Cheung, Sedikides, & Wildschut, 2016; Cheung et al., 2013).

Nostalgia

An important focus of this research project is how nostalgia affects the retention and retrieval of semantic and episodic memories across the lifespan. We selected nostalgia because it often accompanies autobiographical memories (Batcho, 2007; Leboe & Ansons, 2006; Sedikides et al., 2008; Wildschut et al., 2006) and it is frequently used as a marketing tool to create a positive attitude toward advertised brands and memorable bonds between consumers and products (Holbrook & O'Shaughnessy, 1984; Pascal et al., 2002; Bambauer-Sachse & Gierl, 2009; Muehling & Sprott, 2004).

Nostalgia is defined as "a sentimental longing or wistful affection for the past" (New Oxford Dictionary of English, 1998). This past-oriented emotion is thought to evoke a bittersweet blend of predominantly positive and wistful feelings about the past (Davis, 1979; Belk, 1990; Batcho, 1995; Best & Nelson, 1985; Peters, 1985; Holak & Havlena, 1998; Pascal, Sprott, & Muehling, 2002; Wildschut, Sedikides, Arndt, & Routledge, 2006) that are tinged by some negative affect due to the inability to return to those happier times (Wildschut et al., 2006; Hepper et al., 2012; Johnson-Laird & Oatley, 1989; Werman, 1977; Hertz, 1990).

Nostalgia is a prevalent phenomenon that most individuals have experienced at some

point in their lives regardless of age, socioeconomic status, or culture (Boym, 2008; Robertson, 2013; Routledge et al., 2013; Davis, 1979; Wildschut et al., 2006; Zhou et al., 2008; Hepper et al., 2013; Hepper et al., 2014). This rich and complex emotion pervades multiple facets of our lives, from online media platforms like Buzzfeed's "Time Machine" (Parekh, 2012) and social media posts with the hashtag #ThrowbackThursday, to the recent resurgence of analog media and growth in vinyl record sales (Nielsen Music, 2018). These virtual nostalgic prompts and physical artifacts are two examples of ways in which we seek to reintegrate the comfort and familiarity of the past into the present. However, nostalgia can be evoked through various triggers including photographs (e.g., Havlena & Holack, 1996; Belk, 1991; Belk, 1990), odors (e.g., Reid et al., 2015; Orth & Bourrain, 2008), music (e.g., Michels-Ratliff & Ennis, 2016; Barrett et al., 2010; Janata et al., 2007; Wildschut et al., 2006; Batcho, 2007), special events (Holak & Havlena, 1992), and advertisements (e.g., Bambauer-Sachse & Gierl, 2009; Muehling & Sprott, 2004).

Nostalgia can arise from social and psychological triggers as well, including strong social bonds, meaningful others, and momentous life events (Sedikides et al., 2008; Wildschut et al., 2006). It is often prompted in times of loneliness, sadness, boredom, or existential doubt (Routledge et al., 2008; Van Tilburg, Igou, & Sedikides, 2013; Wildschut et al., 2006; Zhou et al., 2008). In the context of old age, factors such as nostalgia-proneness and shorter perceived time left to live have been shown to increase the tendency to recall nostalgic experiences (Havlena & Holak, 1991). These nostalgic triggers demonstrate the positive and protective role that nostalgia can play, as well as its contribution to psychological well-being.

Nostalgia has been shown to increase positive self-regard and enhance our ability to cope with present challenges by reinterpreting the past (Sedikides et al., 2008; Wildschut et al., 2006;

Davis, 1979). It can also serve as a protective mechanism against existential threats by assigning meaning to life (Routledge et al., 2012; Wildschut, Sedikides, & Cordaro, 2011; Sedikides, Wildschut & Baden, 2004; Sedikides et al., 2008; Zhou et al., 2008), and providing cohesiveness and continuity to the self-narrative (Sedikides et al., 2015; Sedikides et al., 2016; Zhou et al., 2008; Routledge et al., 2013; Sedikides et al., 2008). Specifically, nostalgic remembrance about loved ones and social partners is thought to increase the feelings of oneness with a social circle, and these social partners act as a conduit towards personal continuity. Nostalgia has also been shown to counteract loneliness by reintroducing important figures from the past into the present (Cavanaugh, 1989), activating positive relational knowledge structures (e.g., working models of the self and others within the context of relationships; Wildschut et al., 2006; Baldwin et al., 1996; Hertz, 1990), and fostering feelings of social connectedness and social support (Wildschut, Sedikides, & Cordaro, 2011).

Although nostalgia has been associated with various benefits, it can also negatively impact individuals. The maladaptative view of nostalgia-proneness views nostalgia as an emotionally unstable, neurotic form of avoidance that arises from an inability to deal with the present (Batcho, 2013). Rumination over the past prompted by nostalgia can prevent individuals from moving on and deriving meaning or purpose from their current social bonds (Seehusen et al., 2013; Westerhof & Bohlmeijer, 2014; Zhou et al., 2008; Wong & Watt, 1991). Furthermore, striving to maintain a connection with loved ones who are no longer in our lives through nostalgic reminiscence could be a painful reminder of the unattainable past and glaring absence of desired connections that can no longer be experienced (Hawkley & Cacioppo, 2010). This nostalgic longing to return to the past can, therefore, generate feelings of loss or grief (Baumgartner, 1992; Batcho, 2007; Hepper et al., 2012; Hepper et al., 2014). The

aforementioned social benefits of nostalgia can also potentially backfire by glorifying past relationships and romanticizing the past to an extent that cannot be provided in current social relationships (Sedikides, Wildschut, Gaertner, Routledge, & Arndt, 2008; Mather, & Carstensen, 2004; Levine & Bluck, 1997), subsequently encouraging withdrawal from existing relationships and hindering the formation of new social connections in the present. These negative outcomes are thought to be mediated by one's present emotional and psychological state, including current life satisfaction and perceived self-continuity (Iyer & Jetten, 2011). Moreover, personal traits, such as the degree to which an individual is habitually worried (Verplanken, 2012; Zhao, Muehling, & Kareklas, 2014) or engages in avoidant behavior, can also prompt negative reactions to nostalgic stimuli (Wildschut et al., 2010; Juhl et al., 2012). However, despite these negative impressions, nostalgia is still considered to be predominantly positive (Barrett et al., 2010; Hepper et al., 2012; Cheung, Sedikides, & Wildschut, 2016; Cheung et al., 2013; Stephan, Sedikides, & Wildschut, 2012; Lasaleta, Sedikides, & Vohs, 2014; Sedikides et al., 2016; Wildschut et al., 2006; Zhou et al., 2012).

Nostalgia in Advertising

Although the theoretical basis and modern definition of nostalgia can be traced back to Hofer (1688), this construct has been redefined within the context of consumer psychology as a general liking or positive attitude toward items that were more common when one was younger (e.g., childhood through early adulthood) or before their birth (Holbrook & Schindler, 1991). In this section, we explore nostalgia within the context of marketing, advertising, and consumption of goods and services.

As noted earlier, advertisements are a prominent trigger of nostalgia and this is often due to an intentional integration of nostalgic themes or content in advertisements to connect with

consumers and evoke a favorable attitude toward a brand (Foley, 2013; Sujan, Bettman, & Baumgartner, 1993) in order to enhance the likelihood of purchasing the advertised products (Cosgrove & Sheridan, 2002; Ironson, 1999; Lundegaard, 2002; Poniewozik, 2002; Naughton & Vlasic, 1998). This use of nostalgia in advertisements addresses consumers' desire to return to the familiar and idealized past while undergoing rapid change and feelings of anxiety about the present or future (Naughton & Vlasic, 1998; Clarke & Schmidt, 1995). Nostalgic advertisements offer emotional mementos of youth in response to the threat of mortality. Indeed, nostalgia has been shown to influence consumer's preferences for a variety of products and services, including automobiles (Brown, Kozinets, & Sherry, 2003; Braun-LaTour, LaTour, & Zinkhan, 2007), cigarettes (Holak et al., 2007), media (Batcho, 2007; Holbrook & Schindler, 2003; Holbrook, 1993), and food and cosmetics (Loveland et al., 2010).

Within the context of product consumption, nostalgia is thought to be evoked by our subjective associations with personally or culturally valued objects (Belk, 1991; Hirsch, 1992; Holak & Havlena, 1998; Holbrook, 1993; Holbrook & Schindler, 2003; Kessous, 2015; Kessous & Roux, 2008; Ryynänen et al., 2016; Schindler & Holbrook, 2003). Nostalgic feelings can also result from feelings of success or excitement that one may derive from trying out new products or starting a new hobby (Holbrook & Schindler, 2003). Nostalgia can also be evoked by various consumer goods (Baker & Kennedy, 1994; Havlena & Holak, 1991), eating practices (Autio et al., 2013; Kauppinen-Räisänen, Gummerus, & Lehtola, 2013; Kessous & Roux, 2008; Vignolles & Pichon, 2014), and product packaging (Ryynänen, Joutsela, & Heinonen, 2016; Underwood, 2003). Exposure to an object during childhood or youth, when an individual's tastes and preferences are developing, can result in devotion toward the object and perceived nostalgia for it later in life (Schindler & Holbrook, 1993). Nostalgia can emerge from unique situations,

emotional first-time experiences, or repeated experiences (Kessous & Roux, 2008).

However, factors such as age, mere exposure, or repeated use of a particular object may not be sufficient to account for a nostalgic bond with those items (Holbrook & Schindler, 2003). Instead, there is reason to think that these objects become more valuable to us over time through our *personal associations* and meaningful experiences with them (Keller, 1993; Merchant & Ford, 2008) which become stored in long-term memory (Braun, 1999; Keller, 1993). An example of this is feeling nostalgic upon encountering a Kit Kat bar because it serves as a reminder of the Kit Kat bars once shared with a childhood friend after school.

Although nostalgia is frequently used to elicit a positive attitude toward advertised brands and create memorable bonds between consumers and products, nostalgic advertisements generate significantly more positive *and* negative thoughts than non-nostalgic advertisements (Muehling, Sprott, & Sprott, 2004). This finding overlaps with the view of nostalgia as a bittersweet emotional experience. Some advertising companies attempt to elicit more positive nostalgia for the majority of consumers by incorporating historical nostalgia or nostalgia for a time in history that was not experienced directly. Historical nostalgia appeals to consumer's desire to identify with the past (Stern, 1992; Marchegiani & Phau, 2013) and it may be used rather than nostalgia for the personally remembered past since the thoughts evoked by the latter are not always positive (Stern, 1992; Havlena & Holak, 1991). Marketing companies that choose to incorporate personal nostalgia develop predominantly positive nostalgic advertisements by targeting more positive aspects of the personally remembered past which appeal to most consumers, such as carefree days as a child. Although the thoughts and associations evoked by nostalgic advertisements are not always positive, negatively-valenced nostalgic responses to advertisements do not negatively impact attitudinal responses to the advertisements themselves

(Muehling, Sprott, & Sprott, 2004).

Cues such as pop music, jingles, and visual imagery are frequently used in advertising to convey nostalgic messages and influence consumer behavior as well (Havlena & Holak, 1991; Unger, Mcconocha, & Faier, 1991). Indeed, the use of music in advertisements has been found to to influence consumers' mood (Alpert, Alpert, & Maltz, 2005; Alpert & Alpert, 1989; Miniard, Bhatla, & Sirdeshmukh, 1992; Hedström, Högqvist, & Piri, 2015), their understanding of the advertised message (Anand & Sternthal, 1990; Kellaris, Cox, & Cox, 1993), attitude formation (Marchegiani & Phau, 2012; Park & Young, 1986; Shen & Chen, 2006), and nostalgia (e.g., Holbrook & Schindler, 1991; Khoshghadam et al., 2018; Kusumi, Matsuda, & Sugimori, 2010; Wildschut et al., 2006). However, it is not clear whether music confers a *nostalgic advantage* and uniquely promotes the retrieval of semantic and/or episodic memories associated with an item, compared to other sensory modalities.

The Present Study

We examined the effects of modality and aging on long-term retention of naturalistic stimuli that individuals have been frequently exposed to in order to determine whether music uniquely facilitates memory retrieval across the lifespan, compared to other modalities. Many of the studies cited earlier as evidence for this trend featured musical stimuli that participants were exposed to for varying or unknown amounts of time, or comparisons that were associated with different information across modalities (e.g., famous faces compared to songs). We controlled for both factors by using potential exposure time to each stimulus as a regressor in our analyses, and including three types of advertisements (jingles, slogans, and logos) representing three isolated modalities (auditory, verbal, and visual). These advertisements are paired with a single campaign which advertises the same product and company, which allowed us to examine the

effectiveness of these modalities as retrieval cues and whether they aided subsequent retrieval of the associated memories. We also examined whether repeated exposure to advertisements created remembered associations with lifetime periods, general repeated events, or specific events and whether nostalgia ratings would be higher for advertisements presented during participants' reminiscence bump (Rubin & Schulkind, 1997).

In Study 1, participants from three different age groups (young adults: 18 to 30 years of age, middle-aged adults: 31 to 64 years of age, and older adults: 65 years and older) provided ratings for familiarity and nostalgia ratings for 383 advertising campaigns presented across three modalities (auditory, visual, and verbal) to examine the effects of modality and age on subjective ratings of familiarity and nostalgia, and to identify suitable stimuli for Study 2. In Study 2, we collected responses from two age groups (young adults: 18 to 30 years of age, and older adults: 65 to 76 years of age) to examine how modality and age affect semantic and episodic memory retrieval for 55 advertising campaigns. Comprehensive lists of the specific hypotheses for both studies are provided in the following chapters.

CHAPTER II

STUDY 1: NOSTALGIA AND FAMILIARITY RATINGS FOR ADVERTISING STIMULI PRESENTED ACROSS THREE MODALITIES

Study 1 utilized behavioral data collected from individuals across the lifespan (18-89 years old) to achieve five specific objectives. First, we identified which stimuli from our assembled database of advertising campaigns could be used in a subsequent experiment examining episodic and semantic memory for these stimuli (Study 2) to avoid a confound of familiarity. Second, we examined how modality and age affect subjective familiarity and nostalgia ratings for advertising stimuli. The third aim was more exploratory. We examined how factors, such as auditory imagery and the lifetime period during which each rater was likely exposed to each advertisement, were associated with nostalgia and familiarity ratings. We also explored the relationship between familiarity ratings and other dependent variables, including emotion and nostalgia ratings for each product. Additionally, we used emotion ratings to examine whether the *positivity effect* (Mather & Carstensen, 2003; Reed & Carstensen, 2012; Reed et al., 2014) emerged in response to the advertising stimuli in this study. Lastly, we determined whether one particular modality is most effective for eliciting nostalgia among individuals from three different age groups (18-30 years old, 31-64 years old, 65 years or older), and whether higher nostalgia ratings would be provided for stimuli that aired when participants were 10 to 30 years of age, overlapping with the *reminiscence bump* (Rubin & Schulkind, 1997; Rubin, Rahal, & Poon, 1998; Rubin, Wetzler, & Nebes, 1986; Hyland & Ackerman, 1988; Jansari & Parkin, 1996). These specific aims are addressed in the hypotheses provided below.

Hypotheses

Primary Hypotheses

Hypothesis 1. Auditory stimuli (jingles) will be rated as more familiar than visual (logos) and verbal (slogans) stimuli, especially for middle-aged adults and older adults due to the greater prevalence of jingles during their adolescence and adulthood compared to young adults.

Hypothesis 2. Auditory stimuli (jingles) will evoke higher nostalgia ratings, compared to visual (logos) and verbal (slogans) stimuli, especially for middle-aged adults and older adults.

Hypothesis 3. Older adults will provide higher nostalgia ratings, compared to middle-aged adults and young adults, in line with the *positivity effect* (Mather & Carstensen, 2003; Reed & Carstensen, 2012; Reed et al., 2014).

Hypothesis 4. Older adults will rate auditory stimuli as more nostalgic than other modalities and compared to ratings for auditory stimuli provided by the other age groups.

Hypothesis 5. Nostalgia ratings will be higher for stimuli that aired when participants were 10 to 30 years of age, overlapping with the *reminiscence bump* (Rubin & Schulkind, 1997; Rubin, Rahal, & Poon, 1998; Rubin, Wetzler, & Nebes, 1986; Hyland & Ackerman, 1988; Jansari & Parkin, 1996).

Exploratory Hypotheses

Hypothesis 6. Familiarity ratings will be higher for individuals who consumed media to a greater extent across their lives, representing higher potential exposure to advertisements.

Hypothesis 7. Individuals who are more prone to experiencing nostalgia, as reflected by their score on the Southampton Nostalgia Scale (SNS; Routledge et al., 2008), will provide higher familiarity ratings and nostalgia ratings for advertising stimuli in Study 1, indicating a bias toward reporting advertisements as nostalgic and familiar.

Hypothesis 8. More familiar logos and slogans will be more likely to render the memory trace for a jingle as accessible, and prompt involuntarily imagining of the associated jingle (auditory imagery).

Hypothesis 9. Familiarity ratings will be predicted by how long each individual could have encountered the advertisement (how long exposed or "HLE") and the amount of time that has elapsed since each ad was last encountered (how long ago or "HLA") such that older advertisements which were aired for a longer span of time will be rated as more familiar.

Hypothesis 10. Nostalgia ratings for each advertisement will be higher for products that they have previously purchased due to a greater likelihood of forming an affinity for that item and identifying with the brand over time.

Hypothesis 11. Nostalgia ratings will be higher for more familiar advertisements that aired for a longer span of time and advertisements that participants were potentially exposed to earlier on in their lives.

Hypothesis 12. Advertising campaigns for fast food (Consumables) and children's toys (Child & Toddler Products) will have the highest familiarity and nostalgia ratings out of all the product categories.

Methods

Participants

A total of 1211 individuals participated in this study (932 young adults, 286 middle-aged adults, and 133 older adults; M_{age} = 45.89, range = 18-89 years; see Table 2.1 for a full list of demographics). Approximately 1% percent of our participants identified as American Indian or Alaska Native, 32% identified as Asian, 4% identified as Black, approximately 1% identified as Native Hawaiian or Other Pacific Islander, 47% identified as White, and 14% chose to not

specify their race. Fifty-two percent of our participants reported having completed some college credit (25% completed a high school degree or less, and 23% completed an Associate degree or higher).

Table 2.1

Participant demographics for each age group

Age group	Gender	N	Mean age (SD)
Young adults	F	743	19.74 (1.84)
	M	185	20.19 (1.76)
	UN	4	20.75 (1.26)
Middle-aged adults	F	99	55.65 (7.57)
	M	44	55.57 (6.81)
	UN	3	53.00 (9.54)
Older adults	F	72	70.79 (4.29)
	M	61	71.39 (3.73)

Note. F = female, M = male, and UN = unidentified gender. Standard deviation is listed in parentheses.

Younger participants (18-30 years of age) were recruited from the UC Davis SONA database and compensated with class participation credit. Individuals aged 31 years or older were recruited using a combination of online community resources (e.g., AARP discussion boards, Reddit, Prolific, the "Do You Remember?" Facebook group, and Nextdoor.com). These

participants were entered into a drawing to receive one of 12 $25 Amazon gift cards as compensation, with the exception of Prolific participants who were paid $10 for their survey responses.

All participants completed the online study remotely due to the COVID-19 pandemic and subsequent social distancing orders. Data collection was completed using PyEnsemble, a Python-backed version of the PHP/MATLAB web-based experiment system Ensemble (Tomic & Janata, 2007).

Materials

Stimuli. The stimuli for this study are from a database of 383 advertising campaigns spanning from 1872 until today (see Table 2.2 for an excerpt). The database was largely assembled through the Music Experience Research Community Initiative (UC MERCI) cross-campus initiative which launched a collaborative effort between researchers and students at UC Davis, UC Merced, and UC San Diego. Advertising campaigns were added to the database and assembled through extensive archival efforts using the following sources: American Marketing Association, Philip Morris archive, Smithsonian Archive, Library of Congress, Advertising Age 100 Top Advertisements, and Sounds of Capitalism (Taylor, 2012).

All of the advertising campaigns listed in the database were aired in the U.S., with the exception of six Canadian advertising campaigns which served as foils to test whether participants were paying attention while completing the study or distractedly guessing while responding to the online survey. Additionally, each advertising campaign in the database was associated with a minimum of three stimuli which represent the three isolated modalities examined in this work: verbal (slogans), visual (logos), and auditory (jingles). This yielded a total of 887 individual stimuli.

Table 2.2

Excerpt from the database of advertising campaign

ID	Company	Item	Product Category	First Played	Last Played	Region	Modality
001	State Farm	Insurance	Services	1975	2021	USA	Auditory
002	State Farm	Insurance	Services	1953	2021	USA	Visual
003	State Farm	Insurance	Services	1971	2021	USA	Verbal
004	Subway	Sandwich	Fast Food	2008	2015	USA	Auditory
005	Subway	Sandwich	Fast Food	2008	2013	USA	Verbal
006	Subway	Sandwich	Fast Food	2019	2021	USA	Verbal

Note. Advertising campaigns for StateFarm and Subway are used to demonstrate the associated data points for stimuli in the database.

Slogans consisted of short phrases used in advertising campaigns to advertise a particular product or brand. Jingles consisted of sung versions of slogans. Instrumental jingles which only included a melody without singing were not used because they did not include the content of the slogan as lyrics and, thus, would not allow us to examine the additive effect of music. Jingles which included the name of the product or brand sung repeatedly were also not included in the database (e.g., jingles for Meow Mix and Baby Bottle Pop). Likewise, merely speaking the tagline over a musical background (e.g., Arby's "We have the meats") did not count as a jingle in this study since they lacked a sung version of the tagline. Logos consisted of graphic marks and symbols used to aid in the recognizability of a product or brand. Iconic mascots, such as Mr.

Whipple and Colonel Sanders, associated with the product or brand were also included in this category along with print advertisements and board game covers when logos were not available.

The product and brand name were removed from all stimuli in this database. They were replaced with a blank space for slogans, silence for the duration of that phrase for jingles, and color-matched correction for all logos to remove this identifiable information. This allowed us to test how familiar the advertisements and products were without revealing what they advertise. This step was particularly important for Study 2, which required participants to recall the advertised product and company for each stimulus as a proxy for semantic memory. If any of the stimuli lost their original character or style as a result of this cleaning process and became no longer identifiable, they were removed from the database. Lastly, a product or brand had to have advertising stimuli across *all three modalities* in order to be added to the database. Otherwise, they could not be used in the study.

Advertising slogans were displayed in a 40-point font, logos were standardized to a height of 350 pixels, and the jingles were normalized to 96 dB in Audacity but participants could listen to the stimuli at a level that was comfortable to them during the experiment. Stimuli from each modality were presented for the duration of the longest jingle associated with the advertising campaign for that brand or product in order to control for the effect of duration. The average jingle duration in Study 1 was 10.87 seconds (SD = 3.67 seconds) and jingles were cut to not exceed 20 seconds. This was done by identifying the most iconic part of a jingle or an audio clip without the name of the advertised product or company prominently featured.

Surveys and Scales. The Southampton Nostalgia Scale (SNS; Routledge et al., 2008) was used to measure each participant's general proclivity for nostalgia using a series of questions regarding how important nostalgia is to them and how often they tend to experience it in their

everyday life. The SNS is a 7-item questionnaire which results in potential scores ranging from 0 to 44. This scale helped us explore the relationships between nostalgia-proneness as a trait and familiarity and nostalgia ratings in Studies 1 and 2.

Additionally, a media consumption scale was devised to measure each participant's media consumption habits and reflect their potential exposure to advertisements throughout their life. In other words, someone who watched television on a daily basis would have a higher media consumption score than someone who watched television on a weekly or monthly basis, and this increased viewing time represents greater opportunities to have been exposed to advertisements through this medium. Media consumption scores were collected for specific lifetime periods that were relevant to each participant (4 to 12 years of age, 13 to 20 years of age, 21 to 35 years of age, 36 to 64 years of age, and 65 years of age or older). These lifetime periods were chosen in order to examine whether differences may have emerged during the period of time when participants' media consumption was more likely to be driven by the adults in their lives (e.g., 4 to 12 years of age) compared to periods when they had more agency over their choice of media, greater potential for active engagement with various forms of media, and self-exploration of personal preferences and taste in media as opposed to passive consumption of what their caregivers played around them.

Participants used a 5-point Likert scale to report the extent to which they watched television, listened to the radio, read magazines and newspapers, streamed media (e.g., using YouTube, Hulu, etc.), and used social media sites or apps (e.g., Facebook, Instagram, MySpace, Twitter, etc.) for each of the aforementioned lifetime periods (0 = Not applicable/never, 1 = Less frequently than monthly, 2 = Monthly, 3 = Weekly, 4 = Daily). An average media score was

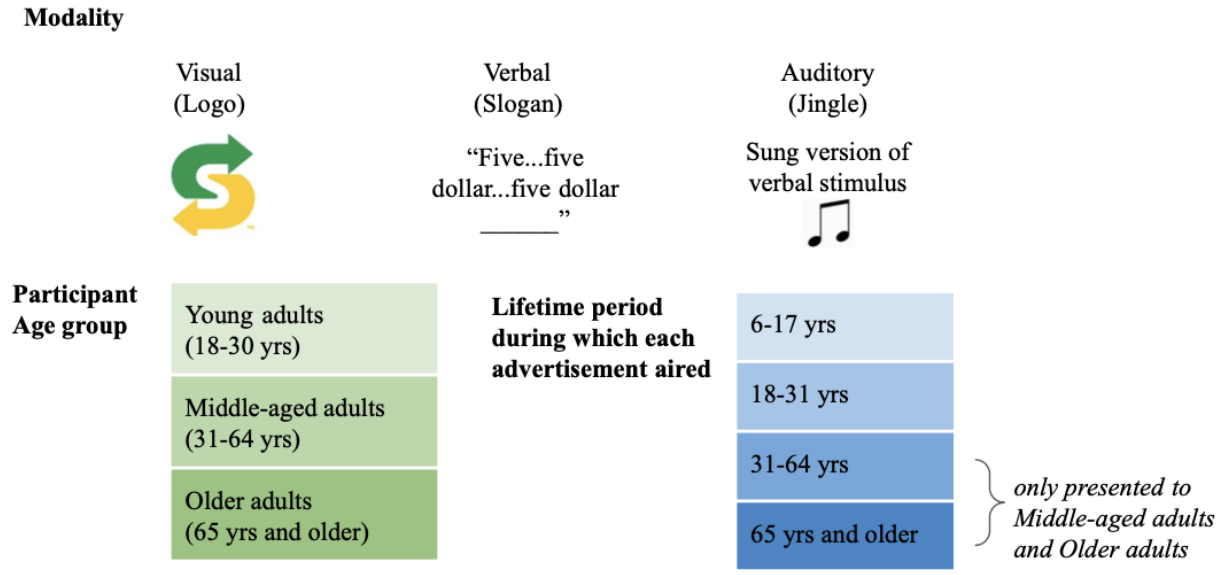
calculated for each participant by dividing the total media consumption score by the number of relevant items.

Experimental Paradigm

Stimulus Selection. As noted earlier, to ensure that participants have the opportunity to retrieve memories or associations that were initially formed in early childhood (Wang, 2001), stimuli were selected for each participant as long as the advertisements aired at any point when the participant was six years old up until today. A stimulus was selected for each trial according to two primary factors: modality and lifetime period (Figure 2.1). Although stimuli were available from three modalities for each advertising campaign in the database, participants only encountered a stimulus from one modality for each product or brand. This was done to control for a familiarity bias that would have applied to previously encountered products in the study. The first and last played dates of each stimulus were subsequently used to select a stimulus from the selected modality that played during a randomly selected lifetime period that was relevant to each participant. In other words, young adults only rated stimuli that aired when they were 6 to 16 years of age and 17 to 30 years of age, middle-aged adults additionally rated stimuli that aired when they were 31 to 64 years of age, and older adults also rated stimuli that aired when they were 65 years or older. Lastly, a Canadian advertisement was randomly presented for ten percent for all trials for each session to serve as an attention check.

Figure 2.1

Main variables for Study 1



Procedure

If participants consented to take part in the study, they completed a series of demographic questions related to their age, gender, highest level of education, and whether they were born in the U.S., and if not born in U.S., how old they were when they moved to the U.S. They were subsequently asked about how much they engaged with various forms of media (e.g., television, magazines, streaming services) throughout their lives using the media consumption scale that we devised specifically for this study. Next, their general nostalgia-proneness was assessed using the Southampton Nostalgia Scale (Routledge et al., 2008). Before beginning the experimental paradigm, participants were briefed on what the task entailed to prepare them for the questions they would receive and how the stimuli might appear.

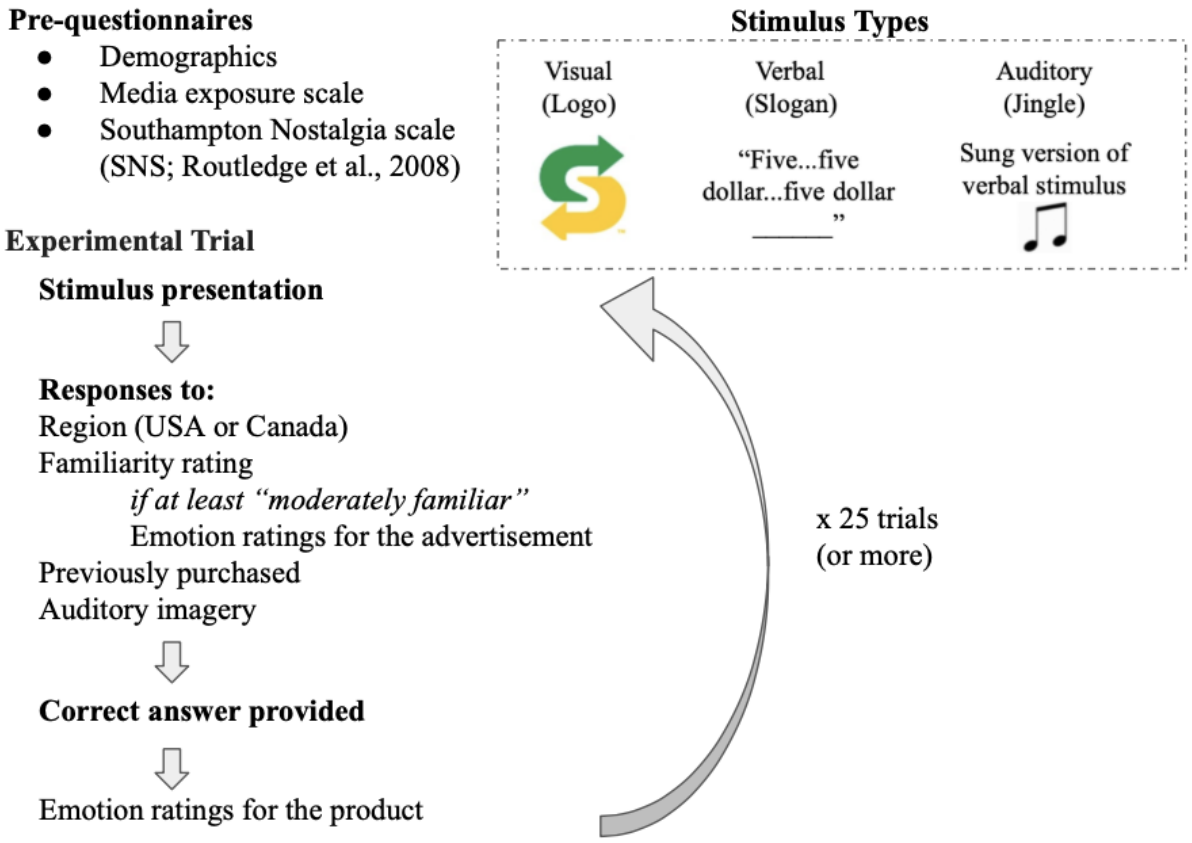
For each trial, a stimulus was selected per the logic above and presented for the duration of the longest jingle associated with that advertising campaign to account for stimulus duration as a potential confound. Next, participants selected the region where the advertisement was originally aired using a forced choice response (1 = USA, 2 = Canada), rated how familiar the advertisement was to them (0 = Not at all familiar, 1 = Vaguely familiar, 2 = Moderately familiar, 3 = Very familiar) and indicated whether they had previously purchased or used the advertised product or brand (NA = I'm not sure, 0 = No, never, 1 = Yes, a few times, 2 = Yes, regularly). If they were presented with a visual or verbal stimulus for that trial, they were asked about the extent to which they spontaneously imagined the jingle associated with the advertised item (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly) and how effortful this auditory imagery was (1 = I immediately imagined hearing it, 2 = It took a few seconds (2-6 seconds), 3 = It took a lot of time (more than 7 seconds)). If they previously indicated that the stimulus was at least somewhat familiar (2 or 3 on a 5-point Likert scale), participants were asked to rate the extent to which the advertisement typically makes them feel nostalgic, happy, and sad (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly). They were then told which specific company and product were advertised in the stimulus and asked to rate the extent to which the advertised product or brand typically makes them feel nostalgic, happy, and sad (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly). This was repeated for a minimum of 25 trials (Figure 2.2).

After completing 25 trials, participants had the option to complete the study or continue providing ratings for up until one hour. This minimum threshold of trials was selected based on the number of ratings that would be necessary from each participant in order for each stimulus in

the database to have a minimum of ten ratings. The experiment took an average of 30.93 minutes to complete (SD = 19.07 minutes).

Figure 2.2

Experimental flow for Study 1



Analyses and Results

Descriptive Statistics

Participants. The Southampton Nostalgia Scale was used to measure the extent to which each participant is generally prone to nostalgia (SNS; Routledge et al. 2008). Participants scored an average of 24.93 on nostalgia proneness (SD = 9.17, range = 0 to 42) out of a maximum

possible score of 49. Media consumption scores were also calculated for each participant as a reflection of their potential exposure to advertisements throughout their life. An average media score was calculated for each participant by dividing the total media consumption score by the number of relevant items. Participants scored an average of 12.73 on media consumption (SD = 2.31, range = 3 to 19). On average, participants completed 31 trials and took 55.88 minutes to complete the experiment.

Database. We analyzed our database of 802 advertisements to achieve our primary aim of identifying which stimuli could be used in Study 2. We began by examining how many ratings were provided for each advertisement in the database. A total of 427 stimuli from the database were encountered and rated at least 10 times, 375 stimuli were rated fewer than 10 times, and 86 stimuli from the database were not encountered because they were aired before our oldest participant was 6 years of age (Figure 2.3).

We then calculated an average familiarity score across all three modalities for each stimulus to avoid a familiarity bias which could otherwise confound the observed effects of modality on semantic and episodic memory in Study 2. Advertising campaigns that featured at least two stimuli with an average familiarity score of 1.5 ("Moderately Familiar") or higher out of a total of three points were deemed appropriate for use in Study 2 (Figure 2.4), and 165 stimuli advertising 55 unique products met these criteria. The average familiarity rating for the stimuli was 1.11 (range = 0 to 3; SD = 0.83).

Figure 2.3

Histogram featuring the number of times that stimuli in the database were rated

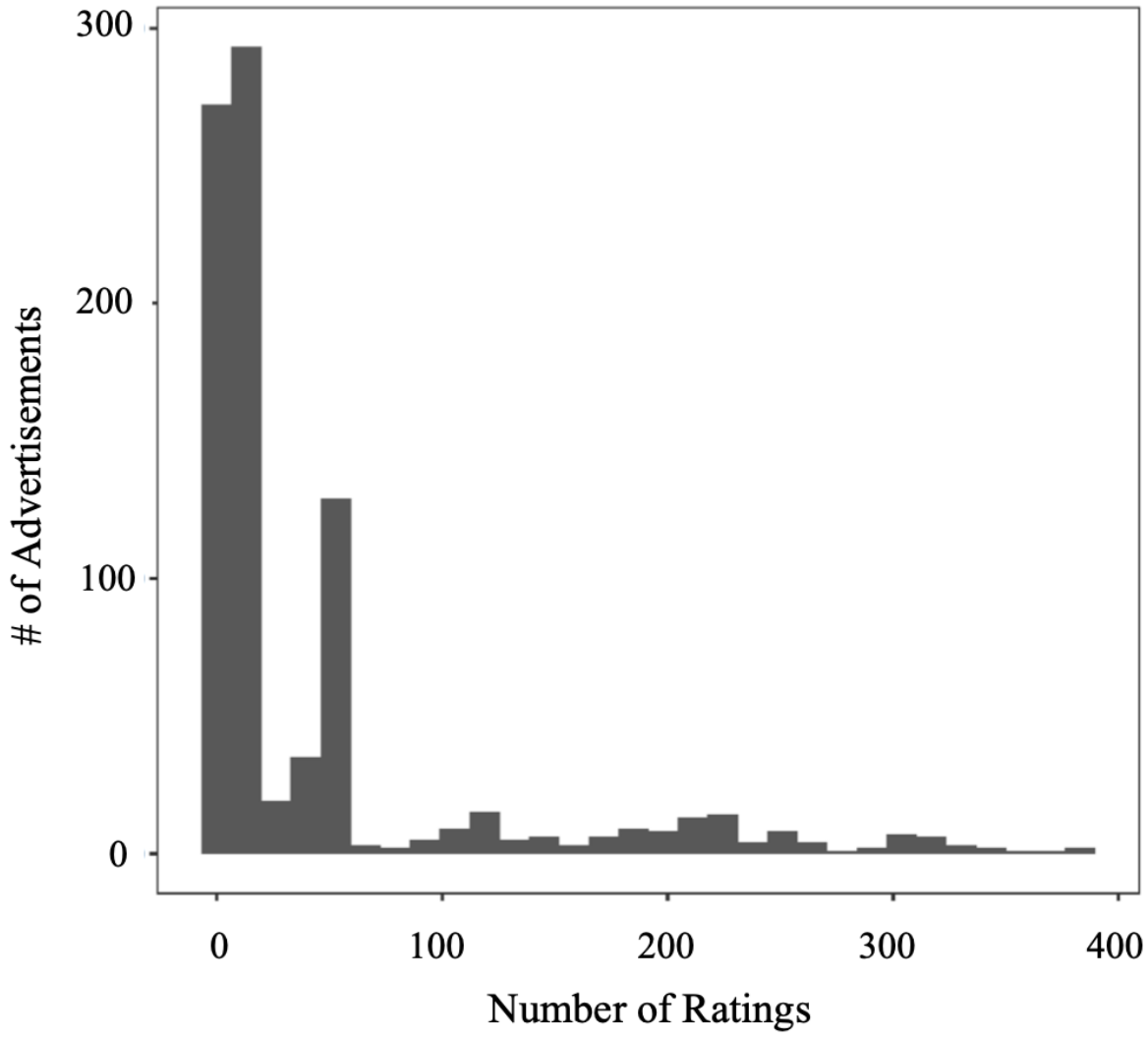


Figure 2.4

Calculating the composite average familiarity rating for each advertising campaign

	Modality		
	Visual (Logo)	Verbal (Slogan)	Auditory (Jingle)
Stimulus		"Five...five dollar...five dollar ____"	 Sung version of verbal stimulus
Avg familiarity rating	3	1	2.24

Note. A Subway advertising campaign is used to demonstrate how the composite familiarity score is calculated for each advertising campaign using the average familiar rating for each stimulus belonging to a campaign.

Foil Analysis

A set of 18 Canadian advertisements were used as catch trials to confirm whether participants were paying attention or guessing during the experiment. These stimuli were used under the assumption that the majority of participants would not have been exposed to them throughout their lifetime. There was a 10% likelihood of viewing or hearing one of these stimuli on each trial, which equated to an average of 4 Canadian advertisements presented to each participant.

Accuracy of region ratings. Participants correctly guessed the region where an advertisement was aired for 76.69% of trials (SD = 0.42). Specifically, Canadian advertisements

were correctly guessed for 41% of trials (SD = 0.49, N_{trials} = 4203) and American advertisements were correctly guessed for 80% of trials (SD = 0.39, N_{trials} = 36,882, Table 2.3). The subsequent analyses provide additional insight into what this higher rate of accuracy ratings for American advertisements suggests with respect to the attention paid during the study.

Table 2.3

Percent of correctly and incorrectly identified trials for each region

Region	*% Correct*	*% Incorrect*
Canada	41.35% (0.49)	58.65% (0.49)
USA	80.71% (0.39)	19.29% (0.39)

Note. Standard deviation is provided in parentheses for each region.

d-prime (d') for region ratings. d-prime (d') was calculated to assess participants' sensitivity to accurately identifying the region of Canadian advertisements. "Hits" were defined as correctly identified Canadian advertisements, "correct rejections" consisted of correctly identified American advertisements, "misses" were defined as misidentified Canadian advertisements, and false alarms consisted of misidentified American advertisements. This analysis yielded a d' value denoting low sensitivity for the discrimination and identification of Canadian advertisements, compared to American advertisements (d' = 0.65, B =1.42, c = 0.54, A'= 0.68). The poor discriminability we observed suggests that the participants were biased toward reporting advertisements as American. This also explains why we observed a lower accuracy rate for Canadian advertisements. These results could have been due to inattention

during the study or the lack of familiarity we observed with a large number of American and Canadian ads (M = 1.11, SD = 0.83, range = 0 to 3).

Familiarity ratings for each region. A linear mixed model was used to predict familiarity ratings according to the region in which each stimulus was aired (USA or Canada). Familiarity ratings were measured using a four-point Likert scale in response to the question "How familiar is this advertisement?" (0 = "Not at all familiar", 1 = "Vaguely familiar", 2 = "Moderately familiar", 3 = "Very familiar"). The data for this model consisted of all responses in the dataset (N_{Trials} = 38,299, $N_{Participants}$= 1,211). Random effects of subject and advertised item were included to account for by-subject and by-item variation. As predicted, region predicted familiarity ratings, $F(1, 143.83) = 11.10$, $p < .01$, with stimuli aired in the USA (M = 1.19, CI = [1.10, 1.29]) rated as more familiar than advertisements aired in Canada (M = 0.39, CI = [-0.09, 0.85], $p < .001$).

Statistical Models

Linear regression models were fit with restricted maximum likelihood (REML) to account for repeated measurements within subjects and between groups when analyzing familiarity, nostalgia, and emotion ratings for American advertisements. Imputation was used to account for instances of missing data using the average value for the continuous outcome variable where appropriate. Random effects of subject and advertised item were included to account for by-subject and by-item variation. Post hoc comparisons were conducted with pairwise *t* tests using the Tukey correction to adjust for multiple comparisons. The two-tailed significance level was set at $\alpha = .05$ and findings that met this significance level are reported below. Significant comparisons are provided with means and 95% confidence intervals. All statistical analyses were performed using RStudio, Version 1.4.1106 (RStudio Team, 2020).

Familiarity Ratings. The data for all models in this section predicted familiarity with the advertisement (0 = Not at all familiar, 1 = Vaguely familiar, 2 = Moderately familiar, 3 = Very familiar) using various factors described in detail below. Stimulus duration was included as a continuous covariate in each model to account for the effect of how long each advertisement was presented during the study due to varying stimulus durations across advertising campaigns.

Familiarity ratings predicted by age and modality. A mixed effects model was run to determine whether auditory stimuli were rated as more familiar than visual and verbal stimuli for middle-aged adults and older adults. This model featured familiarity ratings for American advertisements predicted by modality (visual, verbal, and auditory) and age. Age was treated as a categorical variable with participants assigned to one of three groups based on their birth date: young adults (18-30), middle-aged adults (31-64 years of age), and older adults (65 years of age and older).

We observed an effect of the duration covariate, $F(1, 3222.4) = 13.56$, $p < .001$, in addition to modality after controlling for duration, $F(2, 2426.7) = 244.58$, $p < .001$. Visual stimuli (M = 1.55, CI = [1.45, 1.66]) were rated as more familiar than verbal (M = 0.97, CI = [0.86, 1.07], $p < .001$) and auditory stimuli (M = 1.00, CI = [0.90, 1.11], $p < .001$) (Figure 2.5). An interaction of age and modality also predicted familiarity ratings, $F(4, 2397.1) = 6.73$, $p < .001$. Post-hoc pairwise comparisons showed that middle-aged adults rated visual stimuli (M = 1.59, CI = [1.46, 1.72]) as more familiar than auditory (M = 1.01, CI = [0.94, 1.19], $p < .001$), and verbal stimuli (M = 1.04, CI = [0.91, 1.17], $p < .001$). The same pattern emerged for older adults who rated visual stimuli (M = 1.45, CI = [1.31, 1.58]) as more familiar than auditory (M = 1.02, CI = [0.99, 1.15], $p < .001$), and verbal stimuli (M = 1.01, CI = [0.88, 1.13], $p < .001$). Young adults also rated visual stimuli (M = 1.63, CI = [1.52, 1.73]) as more familiar than

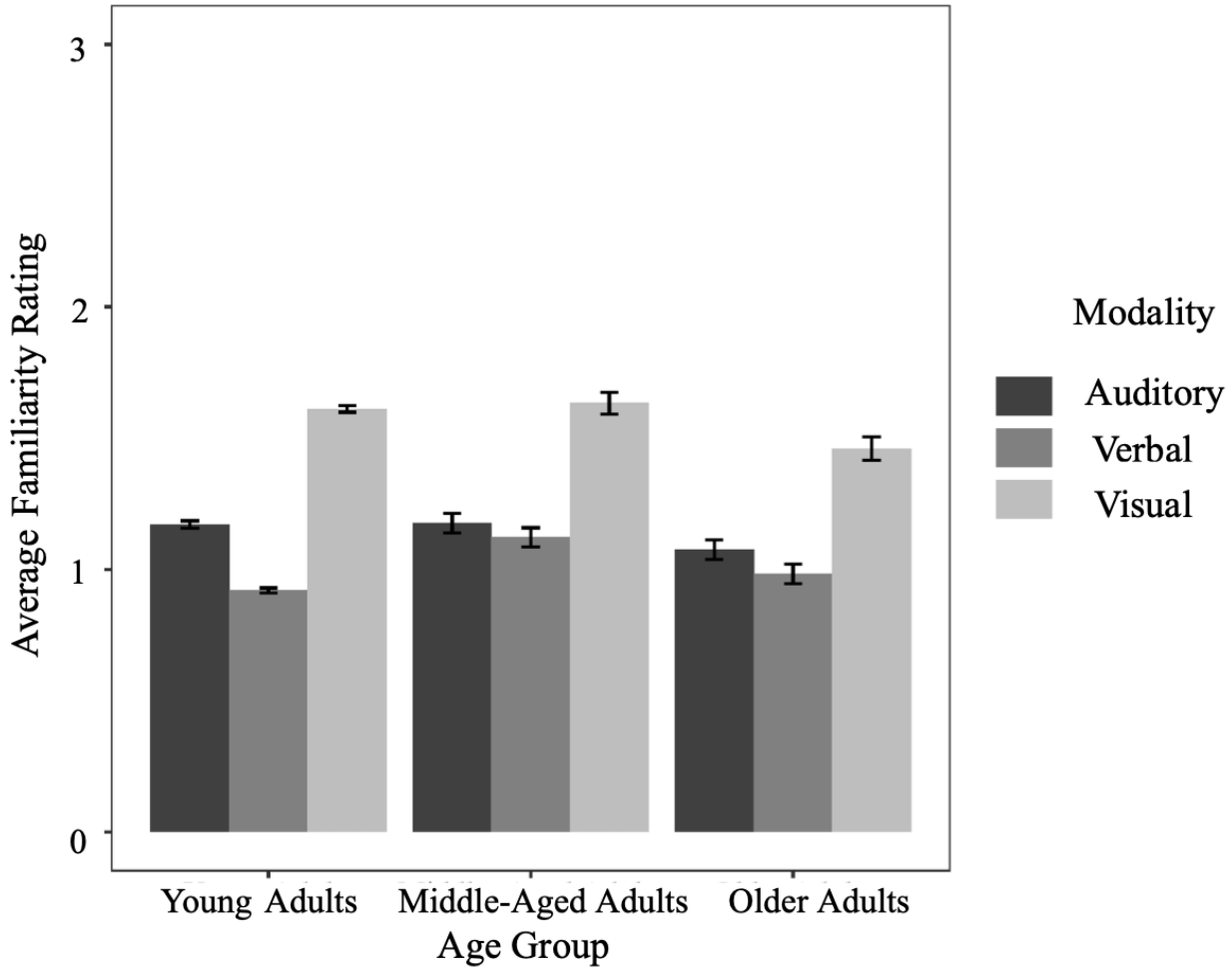
auditory (M = 0.93, CI = [0.82, 1.03], $p < .001$) and verbal stimuli (M = 0.86, CI = [0.76, 0.96], $p < .001$). Additionally, this age group rated auditory stimuli (M = 0.93, CI = [0.82, 1.03], $p < .05$) as more familiar than verbal stimuli (M = 0.86, CI = [0.76, 0.96]) (Figure 2.5). A post hoc pairwise comparison of age groups demonstrated that middle-aged adults provided higher familiarity ratings than young adults for auditory (MA: M = 1.07, CI = [0.94, 1.19]; YA: M = 0.93, CI = [0.82, 1.03], $p < .001$) and verbal stimuli (MA: M = 1.04, CI = [0.91, 1.17]; YA: M = 0.86, CI = [0.76, 0.96], $p < .001$). Additionally, older adults (M = 1.01, CI = [0.88, 1.13]) provided higher familiarity ratings than young adults (M = 0.86, CI = [0.76, 0.96], $p < .01$) for verbal stimuli. However, younger adults (M = 1.63, CI = [1.52, 1.73]) rated visual stimuli as more familiar than older adults (M = 1.44, CI = [1.31, 1.58], $p < .001$) (Figure 2.5).

Familiarity predicted by HLE and HLA. A linear regression model was run to predict familiarity ratings for American advertisements based on how long ago each individual had the potential to be exposed to a stimulus (HLA) and how long they were potentially exposed to the stimulus (HLE). HLE and HLA are both continuous variables that were measured using each participant's date of birth and the dates of when each stimulus was first and last aired).

Familiarity ratings were predicted by the duration covariate, $F(1, 3104.7) = 8.30$, $p < .01$. and HLE, $F(1, 3057.8) = 78.54$, $p < .001$. Longer potential exposure to advertisements was associated with higher familiarity ratings. We also observed a main effect of HLA after controlling for duration, $F(1, 3250.6) = 17.22$, $p < .001$. Older advertisements were associated with higher familiarity ratings.

Figure 2.5

Average familiarity ratings for each modality and age group



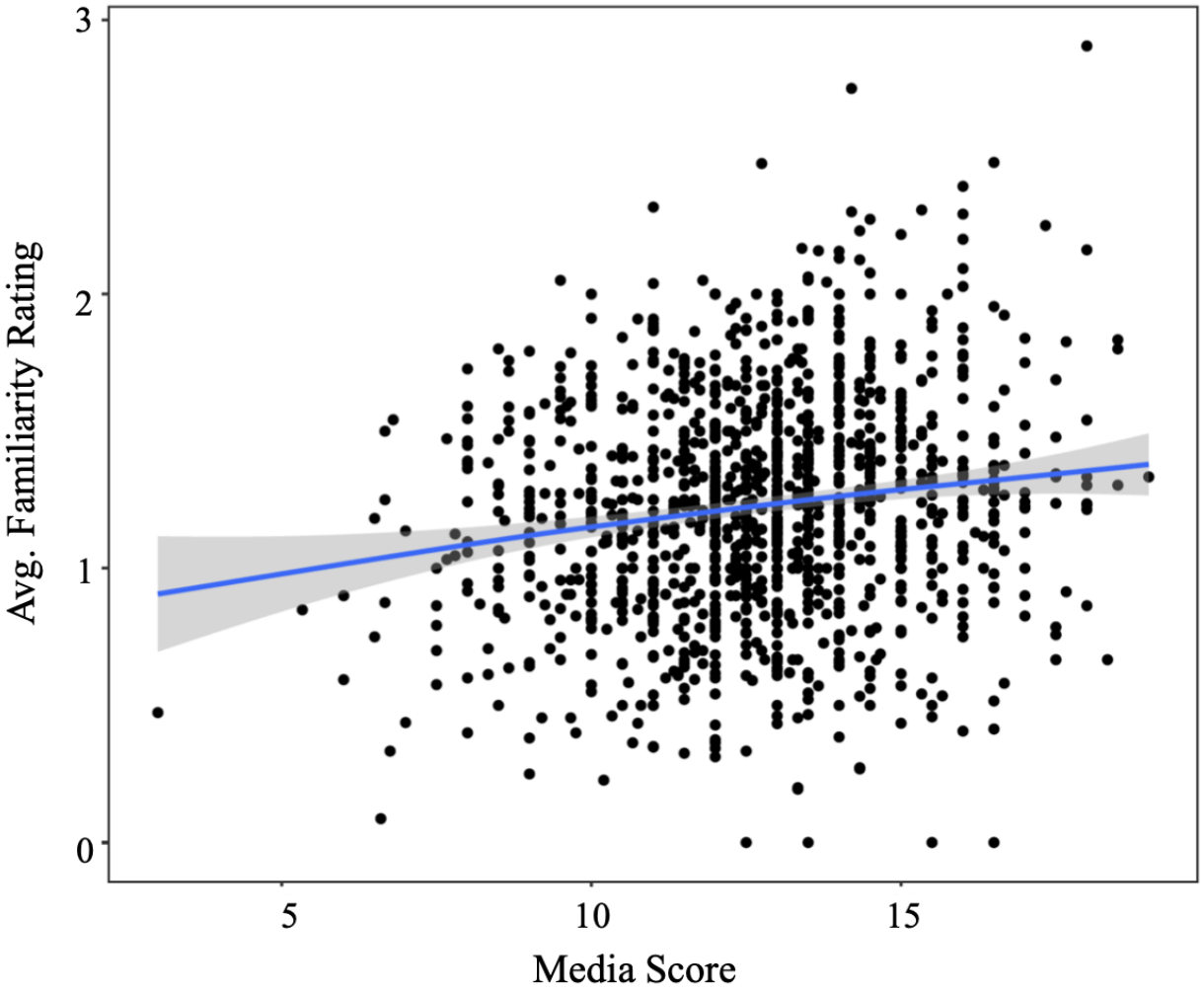
Note. Error bars represent one standard error from the mean.

Familiarity predicted by media consumption. A linear regression model was used to determine whether familiarity ratings for American advertisements were predicted by the extent to which participants engaged with various forms of media throughout their lives. The model included a fixed effect of media score, which was operationalized by participants' responses for the media consumption survey. The resulting score was a continuous variable ranging from a

possible score of 0 to 25 (M = 7.28, SD = 2.31, range = 1 to 17). We observed a main effect of media consumption after controlling for duration, $F(1, 1187) = 30.82$, $p < .001$. Namely, a higher media score, indicating greater exposure to different forms of media across the lifespan, was associated with higher familiarity ratings on average (Figure 2.6).

Figure 2.6

Scatterplot of media scores for each participant and their average familiarity rating



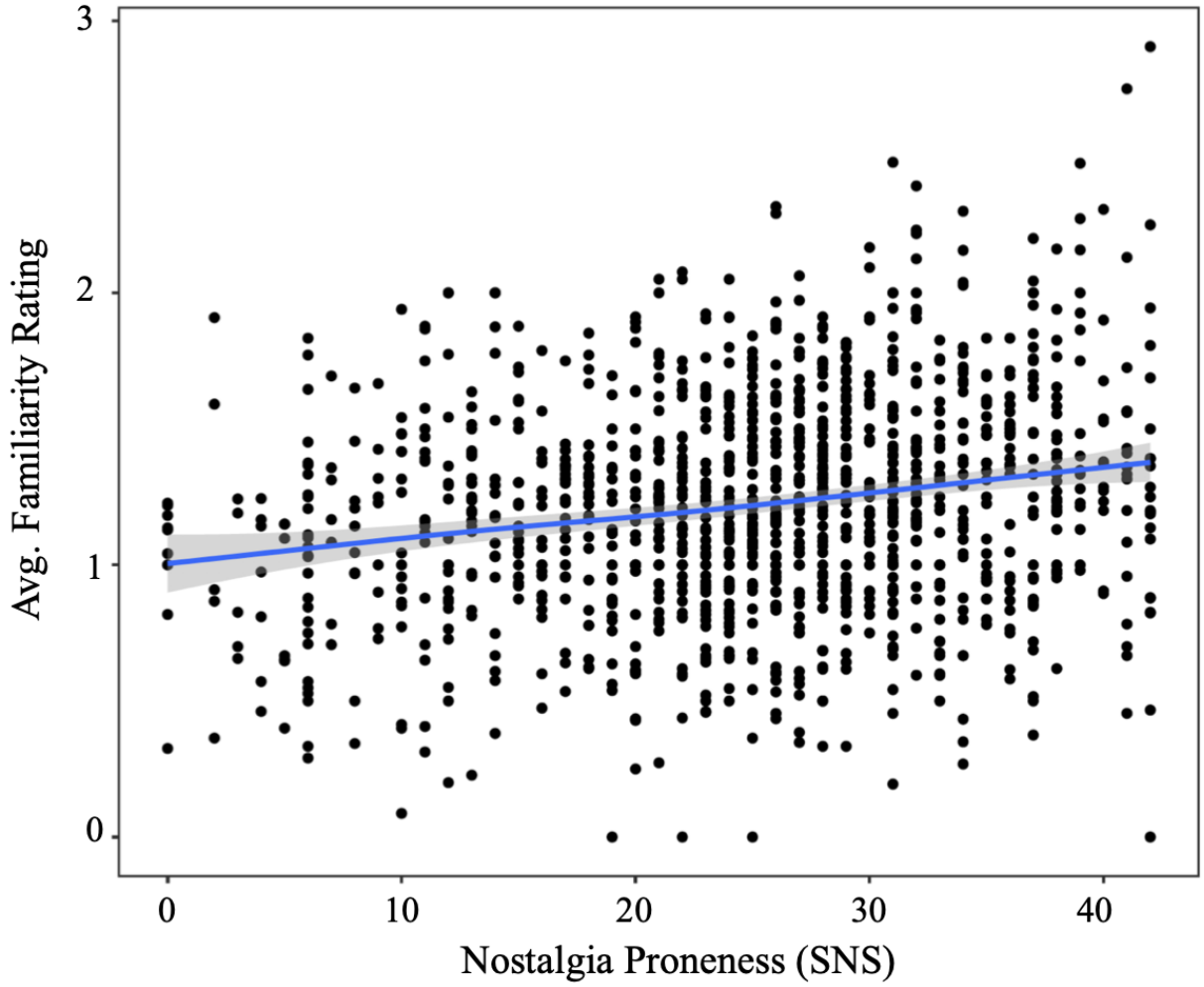
Note. The regression line features a 95% confidence interval.

Familiarity predicted by proclivity toward nostalgia. We tested whether individuals who are more prone to experiencing nostalgia, as reflected by their score on the Southampton Nostalgia Scale (SNS; Routledge et al., 2008), provided higher familiarity ratings for American advertisements and demonstrated a bias toward rating them as more familiar in general. The continuous variable of SNS score was used as the predictor and familiarity ratings were included as the dependent variable in a linear regression model. We observed an effect of the duration covariate, $F(1, 4712.3) = 7.99$, $p < .01$, and nostalgia-proneness after controlling for duration, $F(1, 4011.9) = 271.24$, $p < .001$. Greater proneness to nostalgia was associated with higher familiarity ratings (Figure 2.7).

Familiarity predicted by product category. A linear regression model with familiarity predicted by product category was run to determine whether American advertisements for food (consumables) and toys (Child & Toddler products) received the highest familiarity ratings out of the five total product categories represented in our database (Tobacco & Alcohol, Consumables, Nonconsumables & Services, Technology & Entertainment, Child & Toddler Products). We observed an effect of the duration covariate, $F(1, 4712.3) = 7.99$, $p < .01$, and product category after controlling for duration, $F(4, 4011.9) = 271.24$, $p < .001$. Advertisements for products belonging to the Consumables category ($M = 1.33$, $CI = [1.20, 1.47]$) were rated as more familiar than Tobacco & Alcohol products ($M = 0.63$, $CI = [0.28, 0.99]$, $p < .01$).

Figure 2.7

Scatterplot of nostalgia proneness for each participant and their average familiarity rating



Note. The regression line features a 95% confidence interval.

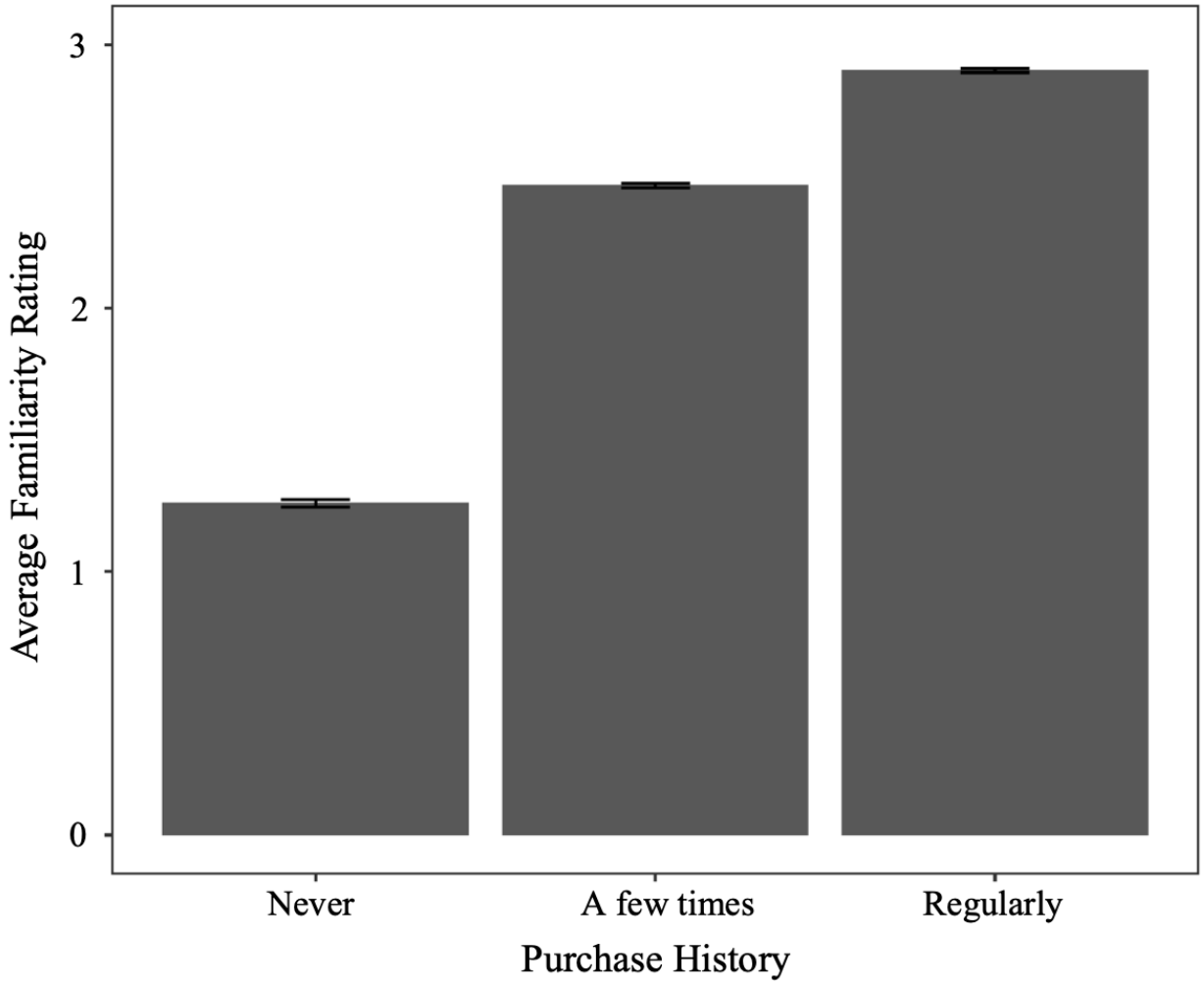
Familiarity ratings predicted by purchase history. We also tested our hypothesis that products which were previously purchased or used by participants would be rated as more familiar due to a higher likelihood of forming an affinity for those items or brands and identifying with them over time. A linear regression model was constructed with purchase history as a predictor of familiarity ratings for American advertisements. Purchase history is a

categorical variable that consists of three levels: Never used or purchased (0), used or purchased a few times (1), and used or purchased regularly (2).

The duration covariate predicted familiarity ratings, $F(1, 3120.3) = 53.06$, $p < .001$. We also observed a main effect of purchase history after controlling for duration, $F(2, 2140.6) = 1774.98$, $p < .001$, such that regularly using or purchasing the advertised item ($M = 2.68$, CI = [2.61, 2.76]) predicted higher familiarity ratings than having never used or purchased the advertised item ($M = 1.16$, CI = [1.09, 1.23], $p < .001$) or only doing this a few times ($M = 2.31$, CI = [2.24, 2.38], $p < .001$). Additionally, using or purchasing the advertised item a few times ($M = 2.31$, CI = [2.24, 2.38]) was associated with higher familiarity ratings than having never used or purchased it ($M = 1.16$, CI = [1.09, 1.23], $p < .001$) (Figure 2.8).

Figure 2.8

Average familiarity ratings for each level of purchase history.



Note. Error bars represent one standard error from the mean.

Nostalgia Ratings. Nostalgia for advertisements was measured using a five-point Likert scale to endorse the extent to which each advertisement makes participants feel nostalgic (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very Strongly). Participants were only asked to provide nostalgia ratings for an advertisement if they rated it as at least somewhat familiar. Thus, the data used in all models featuring this dependent variable consist of

responses that met this criterion. Additionally, familiarity was included as a covariate in all of the models below to account for its role in perceived nostalgia.

Nostalgia ratings predicted by modality and age group. A mixed effects model featuring modality and age as predictors was used to test whether older adults rated auditory stimuli as more nostalgic than the two other modalities, and if their nostalgia ratings for jingles were higher than the ratings provided by middle-aged adults and young adults for the same modality. We observed an effect of familiarity, $F(1, 4016.2) = 1333.77$, $p < .001$. There was also a main effect of age group after controlling for familiarity, $F(2, 1172.2) = 3.45$, $p < .05$, such that older adults ($M = 2.84$, CI = [2.69, 2.99]) provided lower nostalgia ratings than young adults ($M = 3.05$, CI = [2.99, 3.11], $p < .05$). A main effect of modality also emerged after controlling for familiarity, $F(2, 4002) = 66.36$, $p < .001$. Auditory stimuli ($M = 2.30$, CI = [2.20, 2.40]) were rated as more nostalgic than visual ($M = 1.93$, CI = [1.83, 2.03], $p < .001$) and verbal stimuli ($M = 1.96$, CI = [1.86, 2.06], $p < .001$).

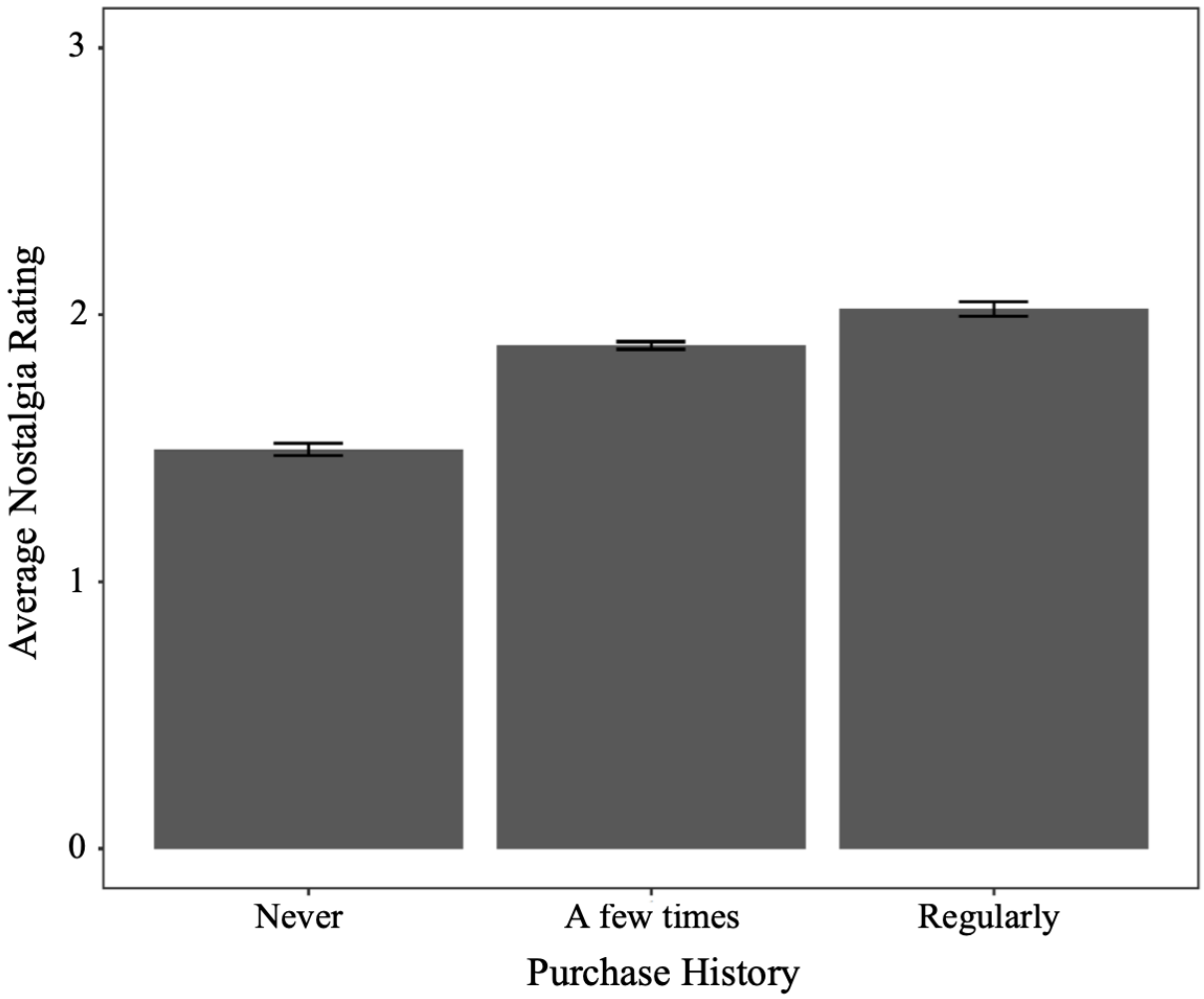
Nostalgia ratings predicted by purchase history. A linear regression model was used to determine whether nostalgia ratings for each advertisement were higher for products that participants had previously used or purchased. Participants' history of purchasing or using an item was used as a predictor of nostalgia ratings for advertisements. Purchase history was measured using a four-point Likert scale in response to the following question: "Have you ever used or purchased the product featured in the advertisement?" (NA = I'm not sure, 0 = No, never, 1 = Yes, a few times, 2 = Yes, regularly).

We observed an effect of the familiarity covariate, $F(1,3193.2) = 512.14$, $p < .001$, and purchase history after controlling for familiarity, $F(2, 3167.1) = 179.17$, $p < .001$. Regularly using or purchasing the advertised item ($M = 2.56$ CI = [2.47, 2.64]) was associated with higher

nostalgia than never having used or purchased the advertised item (M = 1.75, CI = [1.66, 1.83], p < .001) or only doing this a few times (M = 2.16, CI = [2.08, 2.24], p < .001). Additionally, using or purchasing the advertised item a few times (M = 2.16, CI = [2.08, 2.24]) was associated with higher nostalgia ratings than having never used or purchased it (M = 1.75, CI = [1.66, 1.83], p < .001) (Figure 2.9).

Figure 2.9

Average nostalgia ratings for each level of purchase history



Note. Error bars represent one standard error from the mean.

Nostalgia ratings predicted by HLA and HLE. A linear regression model was run to determine whether nostalgia ratings were higher for more familiar advertisements that aired for a longer span of time (HLE) and advertisements that participants were potentially exposed to earlier on in their lives (higher HLA value, signifying that more time has passed since they last saw this particular advertisement). Once again, the continuous HLE and HLA variables were measured using each participant's date of birth and the dates of when each stimulus was first and last aired.

The familiarity covariate predicted nostalgia ratings, $F(1, 1142.5) = 1084.56$, $p < .001$. We also observed a main effect of HLE after controlling for familiarity, $F(1, 2156.3) = 10.19$, $p < .01$, such that advertisements that participants had not encountered for longer spans of time were associated with higher nostalgia ratings, as opposed to advertisements that may have been encountered more recently.

Nostalgia ratings predicted by lifetime period and HLE. In an effort to explore whether the nostalgia ratings in our study overlapped with findings related to the reminiscence bump (e.g., Rubin & Schulkind, 1997), we constructed a linear regression model featuring lifetime period and HLE as predictors of nostalgia ratings for advertisements. Lifetime period was calculated using each participant's date of birth and the first and last played dates of each stimulus to determine the lifetime period during which they would have been exposed to each stimulus: birth to 9 years of age, 10 to 30 years of age, 31 to 64 years of age, and 65 years of age and older (Figure 2.10).

These lifetime periods were used specifically for this analysis, as opposed to the original lifetime periods used for stimulus selection in the experimental design (6 to 16 years of age, 17 to 30 years of age, 31 to 64 years of age, and 65 years or older; Figure 2.11), because they serve

as a more useful grouping of lifetime periods for the research questions examined in this section. Namely, this breakdown allowed us to more accurately analyze findings related to the reminiscence bump. All of the stimuli presented to participants in this study were retroactively categorized as belonging to one of the 4 modified lifetime periods. HLE was also included as a continuous predictor in the model to account for the potential role of exposure time.

Figure 2.10

Histogram featuring the number trials for the modified lifetime periods

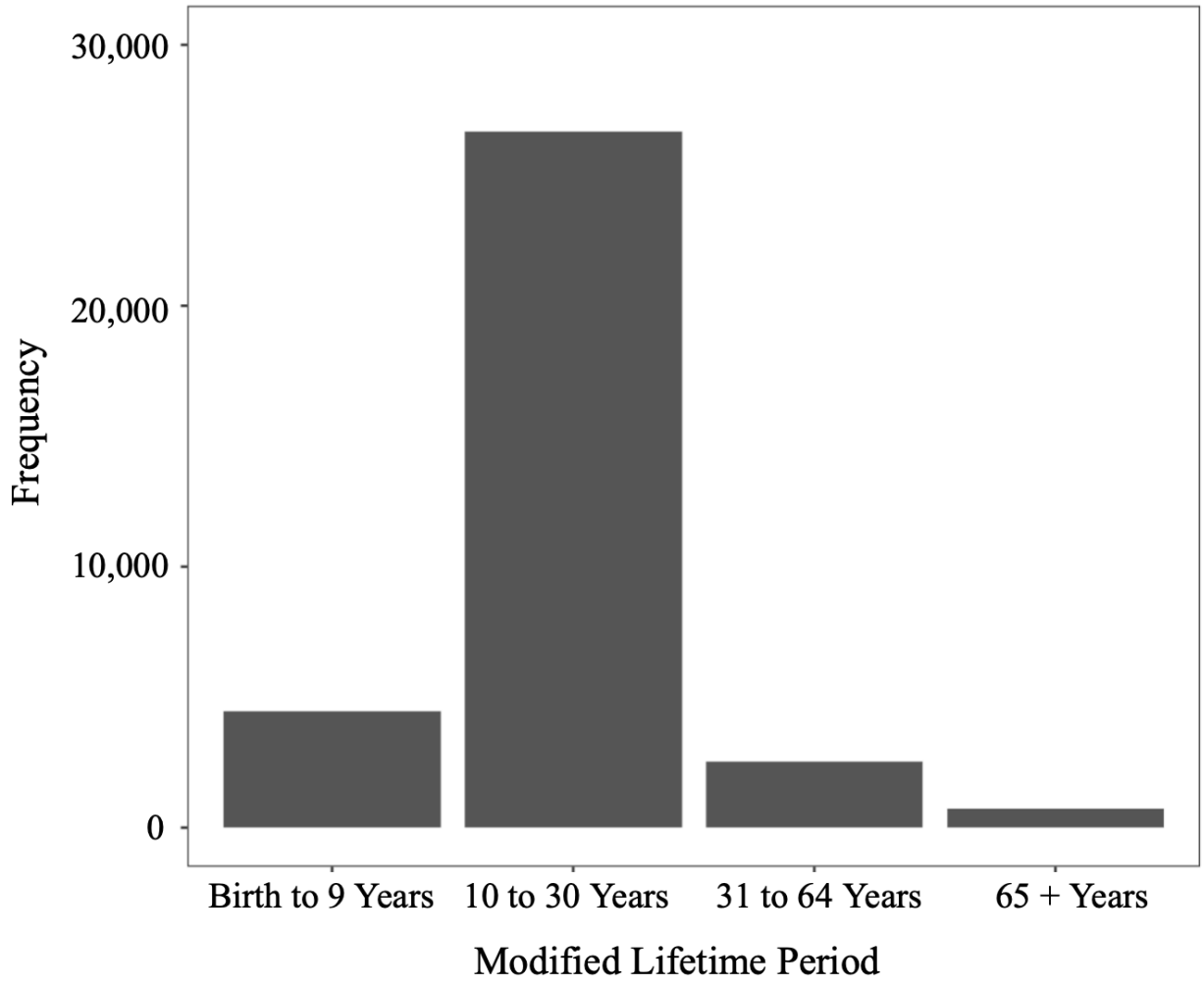
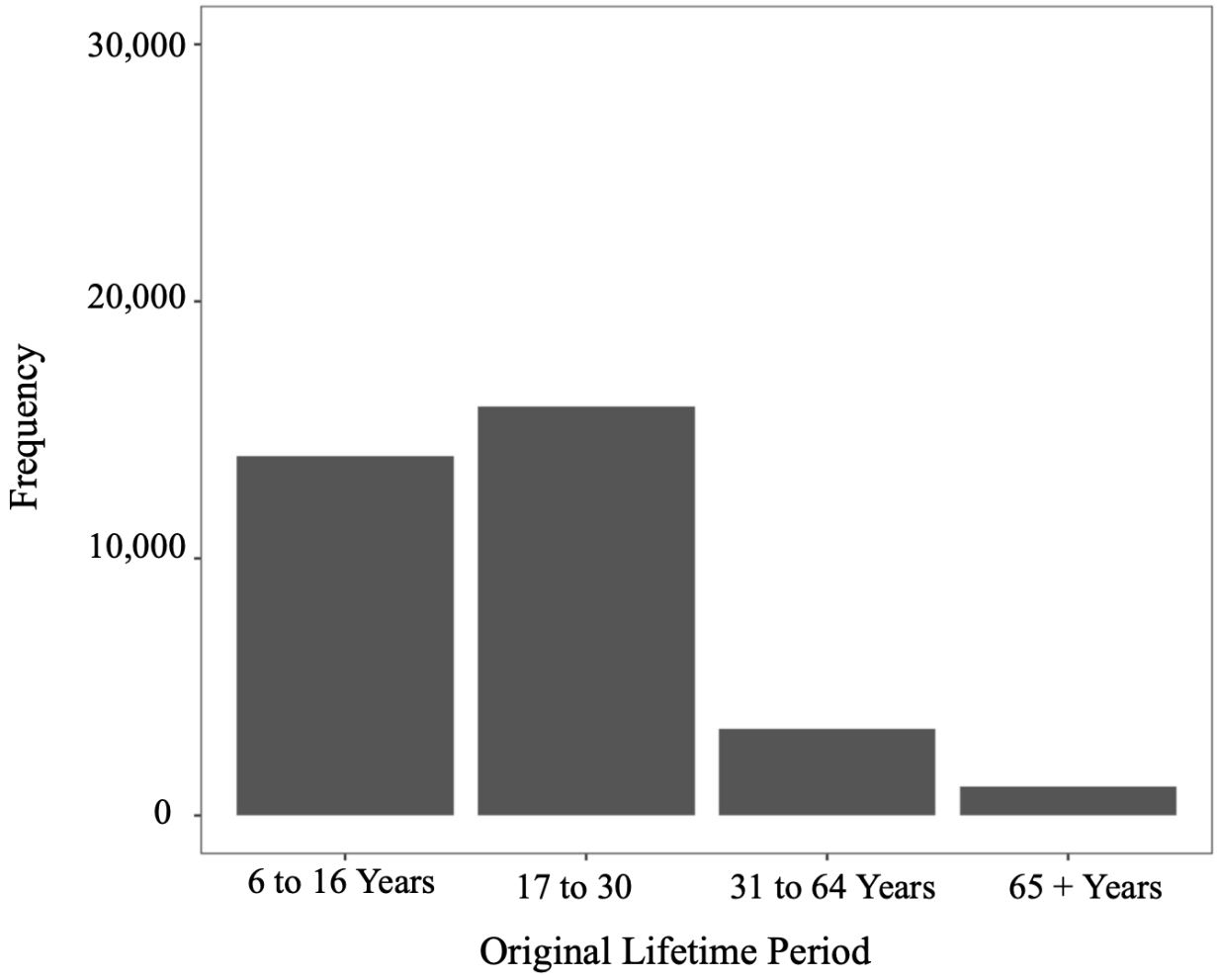


Figure 2.11

Histogram featuring the number trials for the original lifetime periods

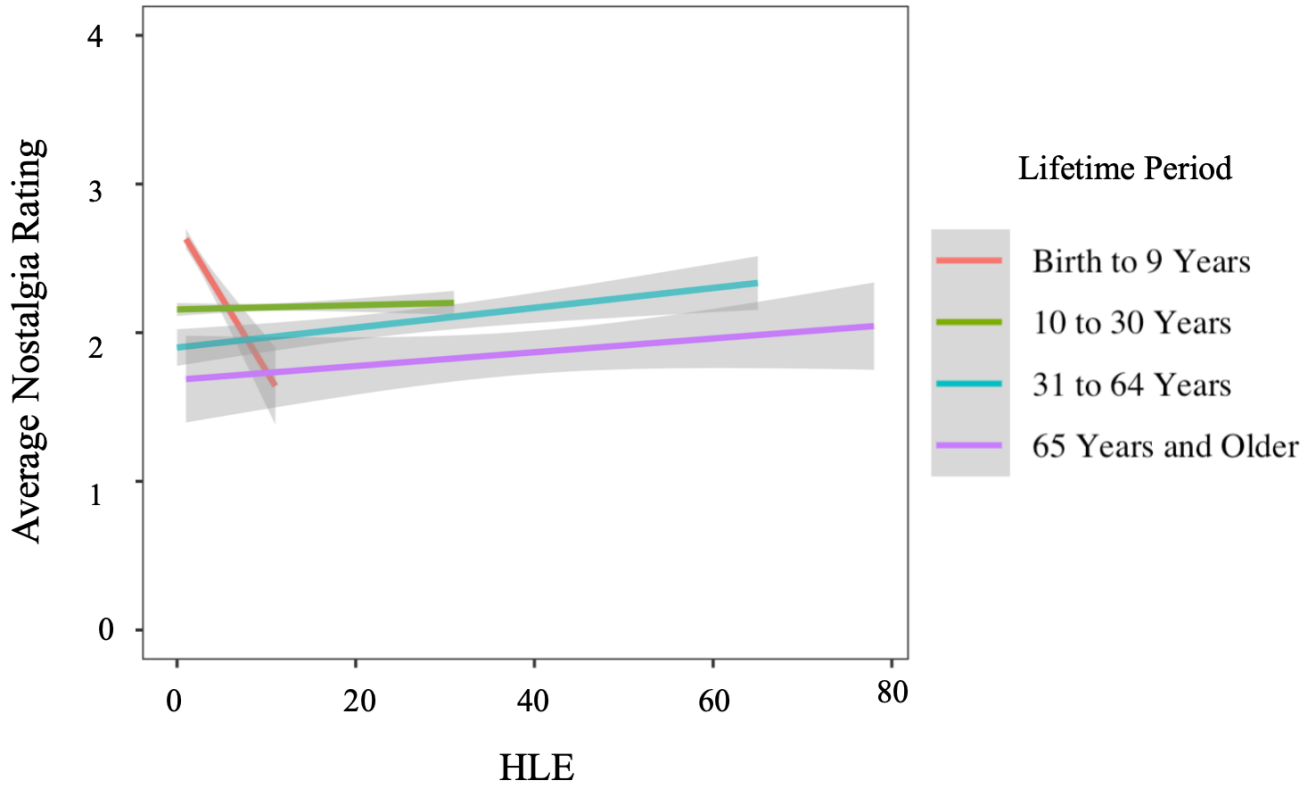


Our covariate of familiarity predicted nostalgia, F(1, 2551.7) = 1067.92, $p < .001$. We also observed a main effect of lifetime period after controlling for familiarity, F(3, 2756.9) = 44.10, $p < .001$. Advertisements that aired when participants were 10 to 30 years of age (M = 2.07, CI = [2.00, 2.15]) were rated as more nostalgic than advertisements that aired when participants were 31 to 64 years or age (M = 1.89, CI = [1.77, 2.01], $p < .01$) and 65 years or older (M = 1.73, CI = [1.52, 1.94], $p < .01$). A main effect of HLE demonstrated that longer

exposure time was associated with higher nostalgia ratings for advertisements, $F(1, 3111.7) = 36.01$, $p < .001$. The interaction of lifetime period and HLE also predicted nostalgia ratings, $F(3, 2919.2) = 16.18$, $p < .001$. Longer exposure to advertisements was generally associated with little variation in nostalgia ratings for advertisements that aired when participants were 31 years of age or older, with the exception of advertisements from participant's early childhood (birth to 9 years) which were associated with lower nostalgia ratings over longer periods of exposure (Figure 2.12).

Figure 2.12

Interaction of lifetime period and HLE predicting nostalgia across all age groups



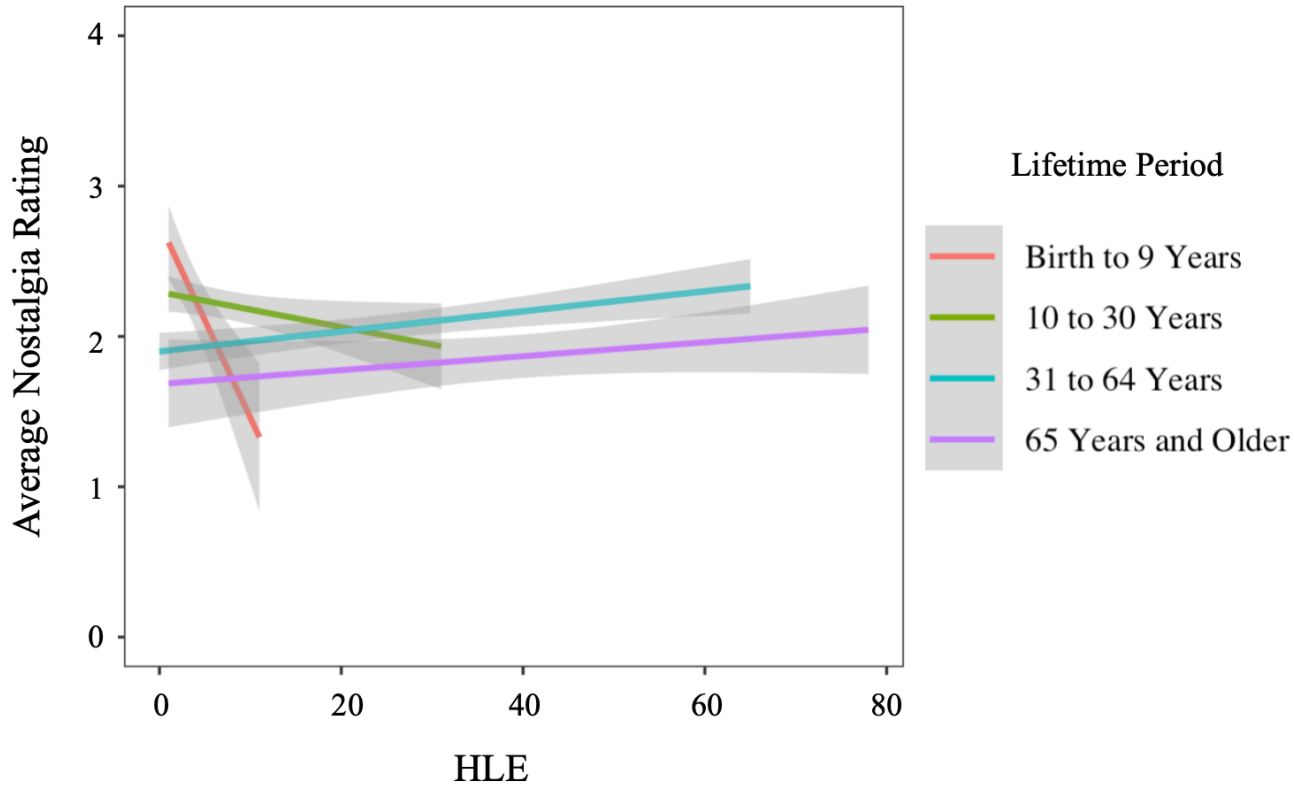
Note. Regression lines are plotted with a 95% confidence interval.

This regression model was replicated and solely applied to data collected from middle-aged adults and older adults in order to test whether this result was driven by a larger proportion of young adults in Study 1 (N = 932) whose entire lives largely consisted of the reminiscence bump period at the time of the experiment, compared to middle-aged adults (N = 146) and older adults (N = 133). Once again, we observed an effect of the familiarity covariate, $F(1, 772.93) = 198.17$, $p < .001$. Lifetime period also predicted nostalgia, $F(3, 784.89) = 13.87$, $p < .001$, such that advertisements which aired during participants' early childhood (birth to 9 years of age: M = 0.58, CI = [-0.23, 1.40]) were rated as less nostalgic than advertisements that aired when they were 10 to 30 years of age (M = 1.96, CI = [1.78, 2.14], $p < .01$), 31 to 64 years of age (M = 1.94, CI = [1.81, 2.07], $p < .01$), and 65 years or older (M = 1.86, CI = [1.67, 2.05], $p < .05$). We also observed a main effect of HLE, $F(1, 809.84) = 9.74$, $p < .01$. Longer exposure time was associated with higher nostalgia ratings for advertisements.

We also observed an interaction of lifetime period and HLE, $F(3, 801.61) = 7.91$, $p < .001$, with the same pattern persisting from the aforementioned model featuring young adults. Once again, longer exposure to advertisements was generally associated with little variation in nostalgia ratings for advertisements that aired when participants were 31 years of age or older, with the exception of advertisements from participant's early childhood (birth to 9 years) which were associated with lower nostalgia ratings over longer periods of exposure. However, an effect that uniquely emerged in this dataset featuring middle-aged adults and older adults is that longer exposure time was also associated with lower nostalgia ratings for advertisements from participants' reminiscence bump as well (Figure 2.13).

Figure 2.13

Interaction of lifetime period and HLE predicting nostalgia for middle-aged and older adults

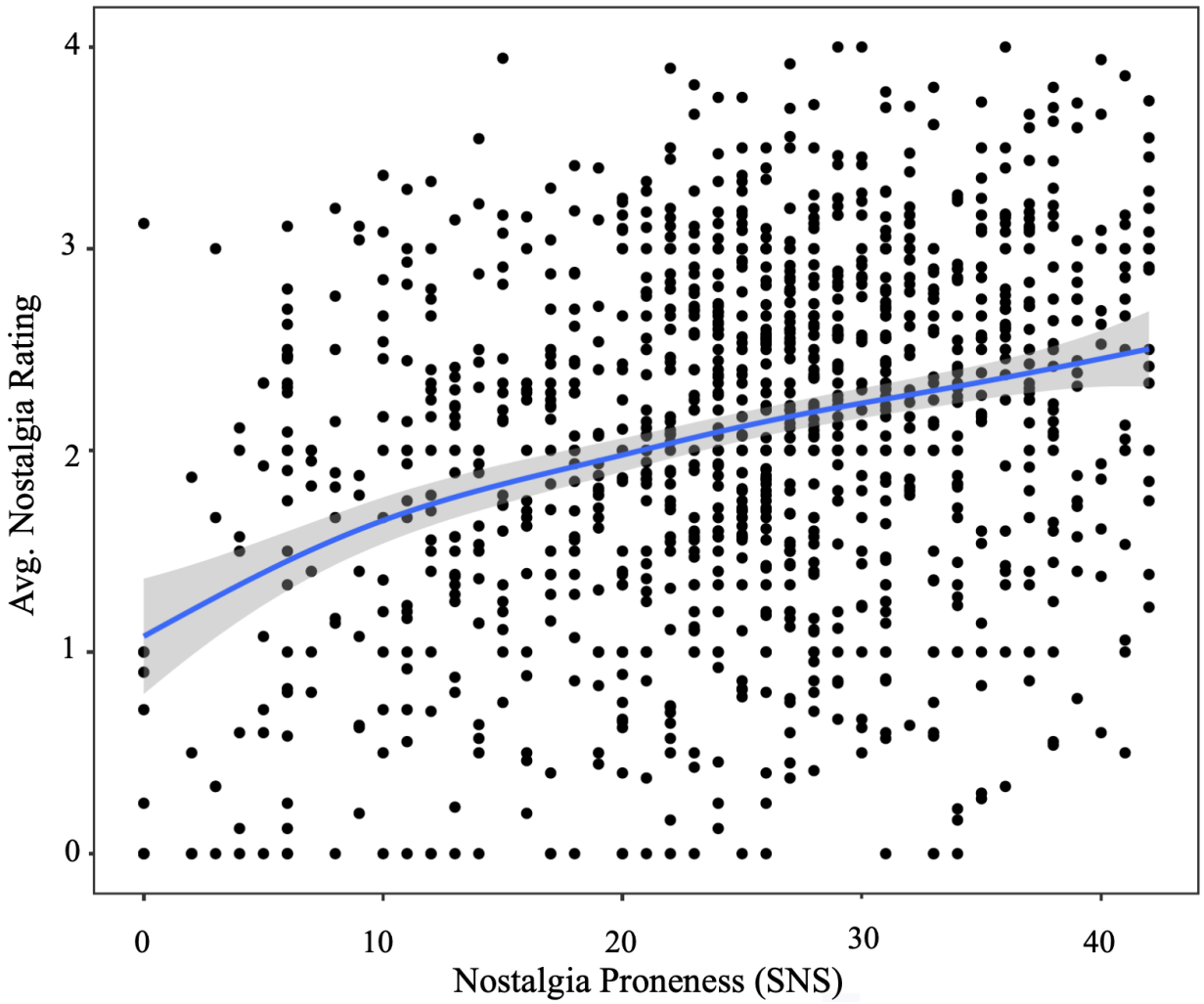


Note. Regression lines are plotted with a 95% confidence interval.

Nostalgia and proclivity toward nostalgia. A linear regression model was constructed with Southampton Nostalgia Scale (SNS) scores as a continuous predictor to determine whether individuals who are more prone to experiencing nostalgia (Routledge et al., 2008) provided higher nostalgia ratings for advertisements and demonstrated a general bias toward rating those items as more nostalgic. We observed an effect of the familiarity covariate, $F(1, 1119.3) = 1129.53$, $p < .001$, and general proclivity for nostalgia, $F(1, 1187.2) = 101.35$, $p < .001$. Namely, greater nostalgia-proneness was associated with higher nostalgia ratings. (Figure 2.14).

Figure 2.14

Average nostalgia ratings plotted for each participant and their SNS score



Note. A regression line with a 95% confidence interval is plotted in blue.

Nostalgia and product category. A linear regression model was constructed with product category as a predictor to determine whether advertisements for food (Consumables) and toys (Child & Toddler products) received the highest nostalgia ratings out of the five total product categories represented in our database (Tobacco & Alcohol, Consumables, Nonconsumables & Services, Technology & Entertainment, Child & Toddler Products).

The familiarity covariate predicted nostalgia ratings, $F(1, 4240.4) = 1124$, $p < .001$. We also observed a main effect of product category after controlling for familiarity, $F(4, 4213.6) = 151.45$, $p < .001$. Advertisements for Child & Toddler products (M = 2.45, CI = [2.28, 2.62]) were rated as more nostalgic than advertisements for Consumables (M = 2.14, CI = [2.06, 2.23], $p < .01$), Nonconsumables & Services (M =1.87, CI = [1.76, 1.97], $p < .001$), and Tobacco and Alcohol (M = 1.79, CI = [1.56, 2.01], $p < .001$). Advertisements for Consumables (M = 2.14, CI = [2.06, 2.23]) received higher nostalgia ratings than Nonconsumables & Services (M = 1.87, CI = [1.76, 1.97], $p < .001$) and Tobacco and Alcohol (M = 1.79, CI = [1.56, 2.01], $p < .05$). Lastly, advertisements for Technology and Entertainment (M = 2.50, CI = [2.09, 2.90]) were rated as more nostalgic than Nonconsumbles and Services (M =1.87, CI = [1.76, 1.97], $p < .05$) and Tobacco and Alcohol (M = 1.79, CI = [1.56, 2.01], $p < .05$).

Affective Ratings. Emotion ratings (specifically, happiness and sadness) were also collected for advertisements using a five-point Likert scale to measure the extent to which each advertisement made participants feel happy and sad (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very Strongly). Participants were only asked to provide these emotion ratings if they rated a particular advertisement as at least somewhat familiar. Thus, the data used in all models featuring this dependent variable consist of responses that met this criterion. Critically, these ratings were collected before participants were told which product was advertised. Additionally, we could confirm that these emotion ratings were for the advertisements as opposed to the advertised products since separate responses were collected for both types of emotions ratings.

Happiness and sadness ratings predicted by age. Given prior findings on a positivity bias in older adults (e.g., Mather & Carstensen, 2005; Levine & Bluck, 1997; Comblain et al.,

2005; Berntsen & Rubin, 2002), we expected to see middle-aged adults and older adults provide higher happiness ratings and lower sadness ratings for the advertisements in Study 1, compared to young adults. We constructed two mixed effects models for this purpose with a fixed effect of age. One model predicted the happiness ratings for advertisements, and the other model predicted sadness ratings.

The familiarity covariate, $F(1, 1084.8) = 1245.76$, $p < .001$, and age predicted happiness ratings, $F(2, 1171.7) = 7.80$, $p < .001$. As predicted, older adults ($M = 1.94$, $CI = [1.78, 2.10]$, $p < .05$) and middle-aged adults ($M = 1.95$, $CI = [1.79, 2.10]$, $p < .05$) provided higher happiness ratings than young adults ($M = 1.74$, $CI = [1.65, 1.82]$). Sadness ratings were also predicted by familiarity, $F(1, 1070.8) = 65.03$, $p < .001$, and age, $F(2, 1161.8) = 7.72$, $p < .001$. Namely, young adults ($M = 0.32$, $CI = [0.28, 0.36]$) provided higher sadness ratings than older adults ($M = 0.16$, $CI = [0.08, 0.25]$, $p < .01$).

Auditory Imagery. The final set of exploratory analysis in Study 1 examined auditory imagery, or imagining the jingle associated with an advertisement. Specifically, we focused on whether auditory imagery was evoked or not, how vividly it occurred, and how effortful this process was. Additional details regarding the scales used for each measure are provided below.

Auditory imagery predicted by familiarity and modality. To test our hypothesis that more familiar logos and slogans will be more likely to render the memory trace for a jingle as accessible and prompt involuntarily imagining the associated jingle (auditory imagery), we used a logistic regression model to predict auditory imagery for American advertisements using familiarity and modality, while controlling for duration. Auditory imagery was a binary measure which consisted of two levels: experienced auditory imagery and did not experience imagery. Responses from the conditions featuring visual and verbal stimuli were used for this model since

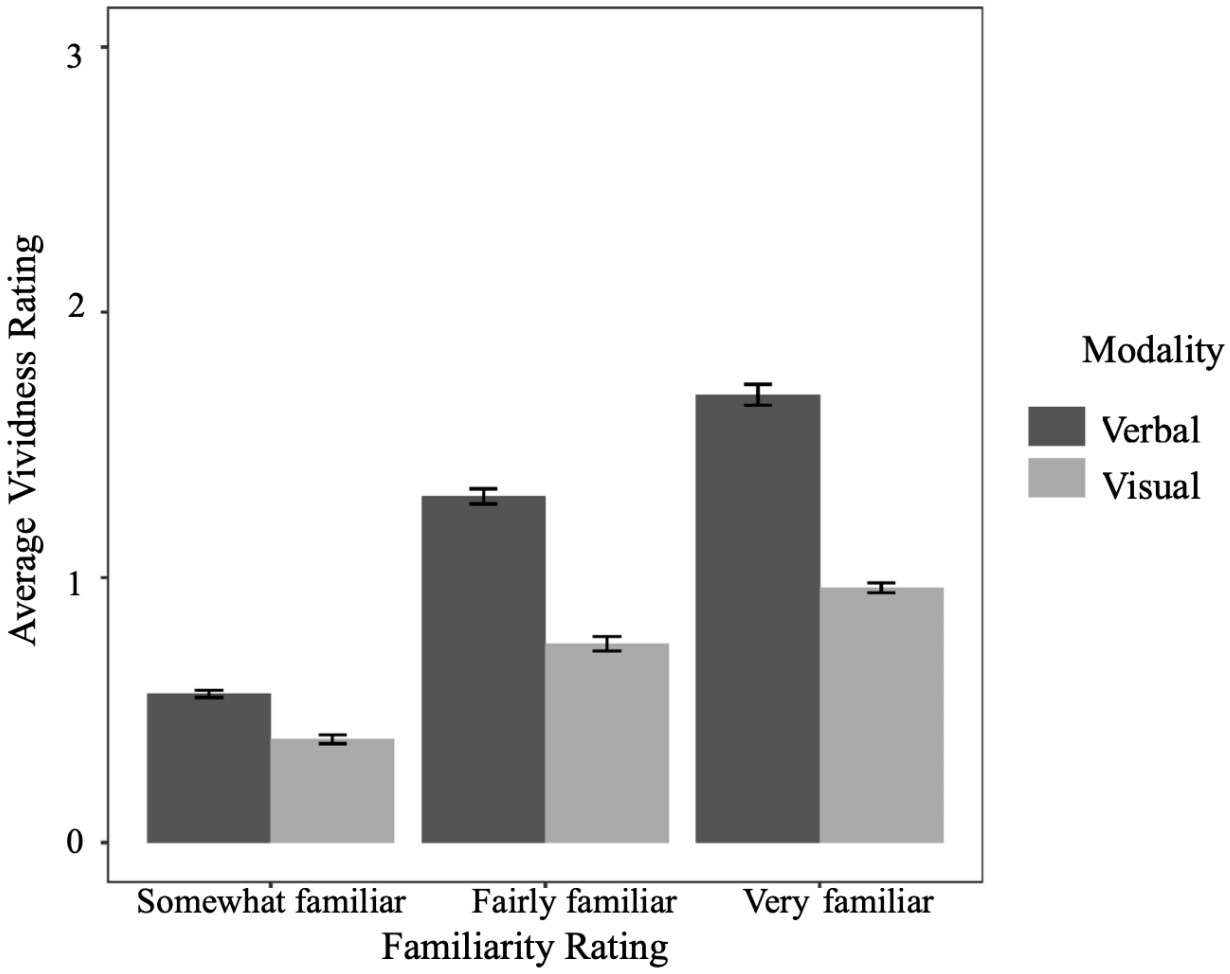
participants listened to the actual jingle in the auditory condition rather than engaging in auditory imagery. However, none of the variables predicted auditory imagery ($p > .05$ for all variables).

Vividness of auditory imagery predicted by familiarity. A linear regression model using modality and familiarity was used to predict the vividness of auditory imagery. If participants reported auditory imagery, they were asked to rate how vividly they imagined the associated jingle. Vividness of the auditory imagery was measured using a five-point Likert scale in response to the question, "To what extent did you imagine the jingle associated with this item when you saw this advertisement?" (1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very Strongly). We observed an effect of the duration covariate, $F(1, 4834.3) = 38.43$, $p < .001$, in addition to modality after controlling for duration, $F(1, 4454.2) = 805.66$, $p < .001$. Namely, verbal stimuli ($M = 1.38$, CI = [1.30, 1.46]) prompted more vivid auditory imagery than visual stimuli ($M = 0.95$, CI = [0.87, 1.03], $p < .001$).

Familiarity ratings also predicted the vividness of involuntary auditory imagery, $F(2, 4501.1) = 2113{,}13$, $p < .001$, such that more familiar stimuli were associated with more vivid auditory imagery. The interaction of familiarity and modality also predicted the vividness of auditory imagery, $F(2, 4457.4) = 165$, $p < .001$. More familiar stimuli predicted more vivid auditory imagery for visual stimuli and verbal stimuli, and verbal stimuli evoked more vivid imagery than visual stimuli at each level of perceived familiarity (Figure 2.15). All possible contrasts were significant ($p < .05$).

Figure 2.15

Average vividness of auditory imagery for verbal and visual advertisements predicted by familiarity



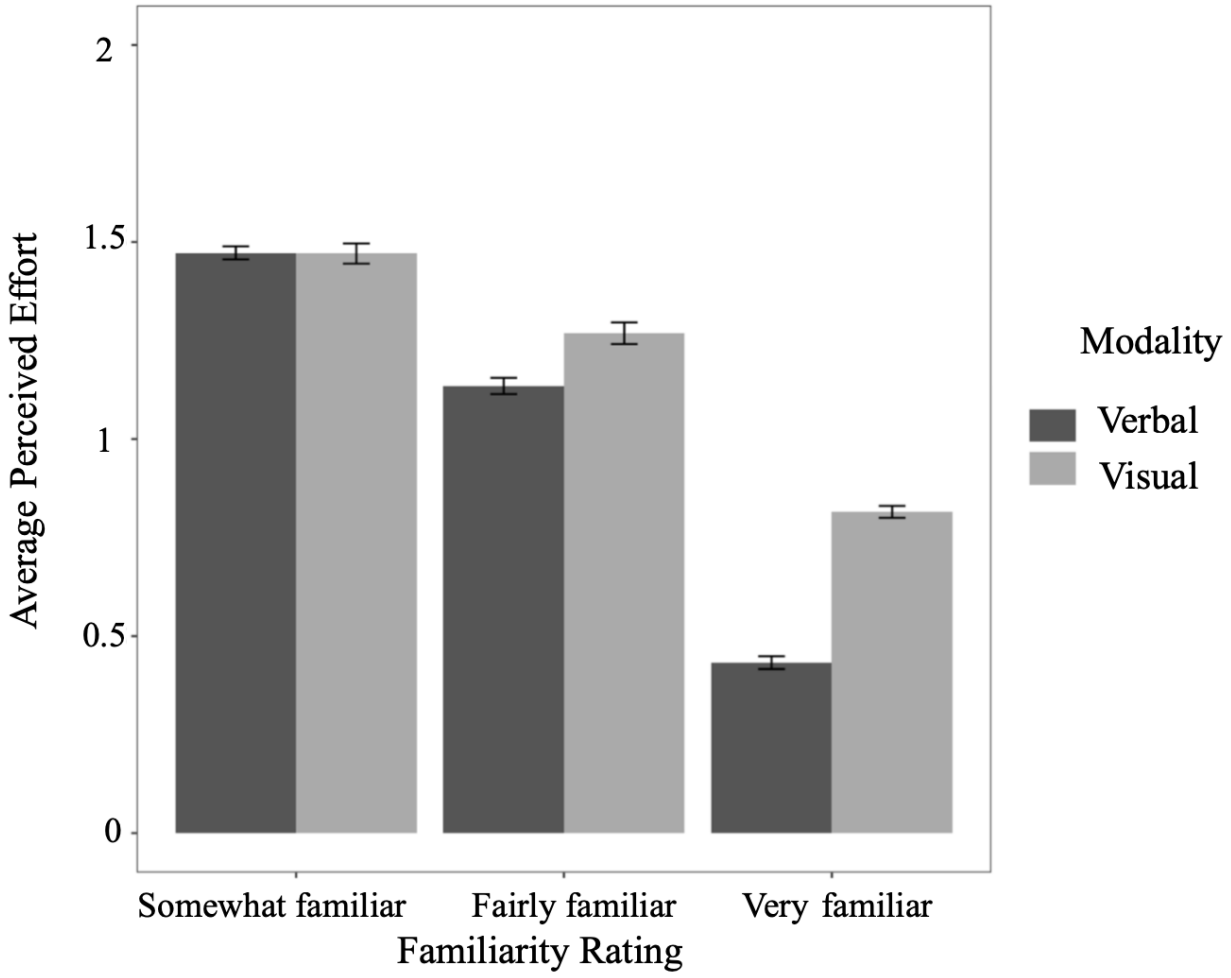
Note. Error bars represent one standard error from the mean. Participants only provided responses for familiar stimuli. Therefore, unfamiliar stimuli (0) are not plotted above.

Effort associated with auditory imagery predicted by familiarity. We subsequently predicted how effortful it was to prompt auditory imagery in a linear regression model featuring fixed effects of modality and familiarity. Effort was defined as the amount of time it took to retrieve the associated jingle (0 = I immediately imagined hearing it, 1 = It took a few seconds

(2-6 seconds), 3 = It took a lot of time (more than 7 seconds)). Once again, we observed an effect of the duration covariate, $F(1, 3326.6) = 39.94$, $p < .001$. Modality also predicted the perceived level of effort after controlling for duration, $F(1, 2919.4) = 142.52$, $p < .001$, such that visual stimuli ($M = 1.26$, $CI = [1.22, 1.31]$ required more effort to prompt auditory imagery than verbal stimuli ($M = 1.10$, $CI = [1.06, 1.14]$, $p < .001$). Familiarity also predicted perceived effort of the auditory imagery, $F(2, 3034.4) = 740.65$, $p < .001$, such that less familiar stimuli required greater effort to prompt auditory imagery (Figure 2.16). Familiarity also interacted with modality to predict auditory imagery, $F(2, 2879.3) = 40.27$, $p < .001$, such that logos required more effort to prompt auditory imagery compared to slogans for stimuli that were rated as moderately or very familiar (Figure 2.16).

Figure 2.16

Average perceived effort of auditory imagery for verbal and visual advertisements predicted by familiarity



Note. Error bars represent one standard error from the mean. Participants only provided responses for familiar stimuli. Therefore, unfamiliar stimuli (0) are not plotted above.

Discussion

Familiarity Ratings

Contrary to our hypothesis, visual advertisements were rated as more familiar, on average, than auditory and verbal advertisements for each age group. However, our initial hypothesis was partially supported by the result that young adults rated auditory stimuli as more familiar than verbal stimuli, indicating a potential auditory advantage among this age group. We examined whether this auditory advantage enhanced semantic and autobiographical memory retrieval compared to the other modalities in Study 2.

Slogans consistently received the lowest familiarity ratings within each age group which could have been influenced by factors such as the use of vague language (Example: Ford's "Drive one", Windows' "Do more with less") or common phrases and idioms ("The natural choice", "Simply the best"). Indeed, prior research on memory for brand names suggests that less common brand names (e.g., "Infiniti") are easier to remember than brand names containing frequently used words or words with multiple associations (e.g., "American"; Meyers-Levy, 1989). Future studies would benefit from performing additional analysis of verbal advertisements to yield helpful measures (e.g., linguistic similarity) that would shed light on the linguistic features that contribute to more memorable slogans for different age groups.

We also found that longer potential exposure to advertisements was associated with higher familiarity ratings. These results are in line with previous findings regarding the positive effect of repeated exposure in the memory literature, such as increased likelihood of associations stored in long-term memory due to frequent exposure (e.g., Craik & Lockhart, 1972) and enhanced familiarity and subsequent recall of repeated items (Krishnan & Shapiro, 1996; Mandler, 1979; Obermiller, 1985; Hintzman, 1970; Underwood, 1969). These findings support

existing work on repetition in advertisements which cites an increase in familiarity for brand names and greater recognition and recall of repeated items (Mandler, 1979; Obermiller, 1985) as well as the information that is associated with the advertised brand (Belch, 1982; Cacioppo & Petty, 1979). We also found that advertisements that participants had not recently encountered were rated as more familiar. We examined whether these trends persisted in Study 2 and if advertisements that participants were exposed to for longer amounts of time (higher HLE value) and had not recently encountered (lower HLA value) were associated with better memory for the associated semantic details.

As hypothesized, higher familiarity ratings were provided by individuals who consumed media to a greater extent across their lives, representing higher potential exposure to advertisements. One explanation for this finding is that more media exposure across the lifespan might encourage individuals to attune more to information provided through the media over time, and potentially lead to better retention of this information. However, an alternative account of this result is that participants who engaged in greater media consumption were biased toward falsely reporting advertisements as familiar or perhaps they misrecognized the stimuli as advertisements that they know. We explored this further in Study 2 by using media consumption as a predictor of semantic memory for advertisements to objectively measure whether greater media consumption improved memory retention and recall for details associated with the advertisements and the advertised products and brands.

Nostalgia Ratings

As predicted, auditory musical stimuli were rated as more nostalgic compared to other modalities in this experiment. This finding confirmed our original hypothesis and supported prior findings regarding the potential for music to evoke nostalgia (Barrett et al., 2010; Janata et al.,

2007; Juslin et al., 2008; Hart et al., 2011; Routledge et al., 2011; Grandjean & Scherer, 2008; Zentner et al., 2008; Batcho, 2009). However, contrary to our original hypothesis, young adults provided higher nostalgia ratings than older adults. Likewise, we did not observe an interaction of age and modality. Both of these findings may have been due to leaving out some of the most iconic and potentially nostalgic advertisements that pertain to middle-aged adults and older adults from the database since they did not meet the criteria for inclusion (e.g., Calgon bath soap: "Calgon take me away", Alka Seltzer: "I can't believe I ate the whole thing"). These reduced opportunities to present highly memorable older advertising campaigns could have affected older adults' reported levels of perceived nostalgia and masked the potential for jingles to uniquely prompt higher levels of nostalgia in older adults.

Nostalgia has been shown to occur relatively frequently among people of all ages (Batcho, 1995; Sedikides et al., 2015). For instance, university students report having frequent feelings of nostalgia (Routledge, Wildschut, Sedikides, & Juhl, 2013; Davis, 1979; Wildschut et al., 2006). However, an experience-sampling study on the daily incidence of nostalgia through an adult life-span model, found that young adults (18-34 years) were 60% less likely to report nostalgia compared to middle-aged adults (40-60 years), and older adults (61-78 years) were three times more likely than middle-aged adults to report nostalgia (Turner & Stanley, 2021). Prior research has also demonstrated that various factors, including whether testing is done in the lab versus the real world and whether nostalgia is spontaneously experienced or intentionally retrieved (Newman & Sachs, 2020; Newman et al., 2020; Turner & Stanley, 2021), contribute to differences in reported nostalgia. In short, additional research is needed to reconcile these findings and help us understand the complexity of nostalgic experiences through a lifespan framework.

Participants also reported higher levels of nostalgia for advertisements that were aired for a shorter span of time (lower HLE value). This result provides an intriguing example of the role that rarity can play in nostalgic experiences, in line with previous research which cites nostalgia for single and unique situations as well as continuously experienced or repeated events (Kessous & Roux, 2008). Perhaps subjective nostalgia ratings for older advertisements that were aired for a shorter period of time run a lower risk of becoming semanticized through repeated exposure, compared to advertising campaigns that have spanned generations. Further research should examine nostalgia for experiences that occurred at varying degrees of frequency during youth and childhood to help determine the role of paucity in nostalgia for the personal past.

We also examined the relationship between lifetime period and nostalgia ratings. As noted earlier, this analysis was performed using modified lifetime periods which better matched the typical division of lifetime periods with respect to the reminiscence bump. Given the resulting mismatch between the lifetime periods used for stimulus presentation (6 to 16 years, 17 to 30 years, 31 to 64 years, and 65 years and older) and stimulus analysis (birth to 9 years, 10 to 30 years, 31 to 64 years, and 65 years and older), we recommend approaching these findings as predictive results which would ideally be confirmed with a modification of our procedure to account for this discrepancy.

Consistent with our hypothesis, we found that nostalgia ratings followed the trajectory of the reminiscence bump (Rubin & Schulkind, 1997), such that advertisements aired during the period when participants were 10 to 30 years of age were perceived as more nostalgic than advertisements from other lifetime periods. Previous literature has also addressed this temporal component of nostalgic experiences. Namely, nostalgia may emerge through exposure to objects during childhood or youth when our tastes and personal preferences are developing (Schindler &

Holbrook, 1993) or unique situations and first-time emotional experiences (Kessous & Roux, 2008). Indeed, much of the literature on nostalgia and uses of nostalgia draws from events encountered during childhood or youth. However, nostalgia is not exclusive to that time period.

We can also experience nostalgia for the recent past (Ryynänen & Heinonen, 2017; Cho, Tan, & Chiu, 2020). Salient examples of this also occurred during the pandemic, when social media and news sites were inundated with shared posts of pre-pandemic lives and routines that people felt nostalgic for (Legay, 2021; Letters, 2020; Wise, 2020). This trend emerged as a functional way to strengthen social connectedness (Wildschut, Sedikides, & Cordaro, 2011) and deal with the stress, loneliness, sadness, and existential threats of this extended period (Routledge et al., 2008; Van Tilburg, Igou, & Sedikides, 2013; Wildschut et al., 2006; Zhou et al., 2008). These results contribute to our growing understanding of how time affects nostalgia, and additional research should be conducted on the temporal trajectory of nostalgia across the lifespan.

Potential exposure time (HLE) also interacted with lifetime period to predict nostalgia ratings. In line with the aforementioned interaction between HLA and HLE, longer potential exposure time to the advertisements in the real world was associated with lower nostalgia ratings for advertisements from participant's early childhood (birth to 9 years). However, longer exposure time was associated with higher nostalgia ratings for advertisements that aired during the span of time when participants were 31 to 64 years of age, and 65 years and older. Our analysis featuring only middle-aged and older adults indicated that this was likely driven by responses from participants who fit the age groups that would have received stimuli for these two lifetime periods (middle-aged adults and older adults). Indeed, a larger HLE value was generally associated with higher nostalgia ratings for advertisements among these two age groups.

Interestingly, the opposite pattern was observed for memories from their reminiscence bump. This subset of older participants provided lower nostalgia ratings for items that aired when they were 10 to 30 years of age and that they were exposed to for a longer period of time, which provides another compelling reason for conducting additional research on how frequency of exposure affects nostalgia across the lifespan.

Familiarity and Nostalgia Ratings

We discuss results that apply to nostalgia and familiarity in this section, beginning with the effect of proclivity toward nostalgia. Participants who are more prone to experiencing nostalgia, as reflected by their score on the Southampton Nostalgia Scale (SNS; Routledge et al., 2008), provided higher familiarity and nostalgia ratings. Based on these results, it is unclear whether these participants generally attend more to nostalgic and familiar stimuli and retain them better as a result or if they demonstrate a general bias toward rating items as more familiar and nostalgic. We examined this in more detail by using nostalgia-proneness to analyze the retention and retrieval of semantic and autobiographical memories in Study 2.

In line with our hypothesis, familiarity and nostalgia ratings were also higher for advertisements featuring products and brands that participants had previously used or purchased. This result could have been driven by a greater affinity for those repeatedly purchased items as well a greater identification with the advertised brands over time through alignment of the consumers' self-concept and the brand personality (Wolter et al., 2016) or memorable experiences with the advertised brands (Stokburger-Sauer et al., 2012). Previous work has shown that products and brand identities can embody and represent rich emotional profiles that trigger reminiscence and re-experiencing of those past emotions and experiences in the present (Belk, 1990; Richins, 1994; Ryynänen & Heinonen, 2017). Moreover, seminal research on the mere-

exposure effect (Zajonc, 1968) demonstrates that prior exposure to a stimulus elicits greater liking, stronger preference, and a more positive attitude toward that item (Hansen & Wanke, 2009; Kunst-Wilson & Zajonc, 1980; Fang, Singh, & Rohini, 2007). These positive associations could, in turn, enhance memory retention and retrieval of the associated information, such as the advertised product and company or memorable personal experiences with the product, in line with previous findings which cite better recognition of emotional items compared to neutral items following a delay (Yonelinas & Ritchey, 2015). Study 2 probed how purchase history and emotion affect memory retrieval by examining semantic and autobiographical memory for more emotional and nostalgic advertisements which participants have interacted with or previously purchased.

Although advertisements for items belonging to the category of Consumables received higher familiarity ratings than Tobacco & Alcohol products, this finding was likely driven by the greater proportion of advertisements for Consumables (47.4% of the database), compared to advertisements for Tobacco & Alcohol products (7.3%) in the database. However, more meaningful conclusions may be drawn from the nostalgia ratings provided for advertisements from each product category. Namely, we observed higher nostalgia ratings for Child & Toddler products compared to most of the other product categories. Advertisements for Technology & Entertainment products and Consumables were also associated with higher nostalgia ratings. Since objects often become more valuable to us over time through our personal associations and meaningful experiences with them (Keller, 1993; Merchant & Ford, 2008; Holbrook & Schindler, 2003), these results might indicate that advertised items from these categories were more personally relevant to participants in this study and potentially played a stronger role in their identity, compared to the advertisements for products from other categories. We examined

this further using metrics of personal relevance in Study 2. We also examined whether these nostalgia ratings were associated with better memory retrieval in Study 2.

Affective Ratings

In line with the often cited "positivity effect" in which older adults remember more positive events or reframe negative events to be positive (Carstensen & Mikels, 2005; Field, 1981; Kennedy, Mather, & Carstensen, 2004; Reed & Carstensen, 2012; Levine & Bluck, 1997; Schlagman, Schulz, & Kvavilashvili, 2006), we found that middle-aged adults and older adults provided higher happiness ratings on average, compared to young adults. Likewise, young adults provided higher sadness ratings, compared to older adults and middle-aged adults. This result demonstrates that advertising stimuli can elicit similar emotional responses from participants across the lifespan that are consistent with previously observed patterns regarding aging and affect.

Auditory Imagery

We also examined how familiarity and modality affect auditory imagery or imagining the jingle associated with a visual (logo) or verbal (slogan) stimulus from the same advertising campaign. Although these factors did not predict the likelihood of prompting auditory imagery, they predicted how vividly participants would experience auditory imagery. In line with our hypothesis, more familiar logos and slogans prompted more vivid auditory imagery and required less effort for retrieval of the associated jingle. Verbal stimuli were also associated with more vivid and less effortful auditory imagery than visual stimuli, which can be explained by the fact that jingles often consist of the tagline sung to music. Thus, the mental effort required to retrieve a jingle from a slogan may not feel as substantial as imagining the jingle based on seeing the

logo. Modality also interacted with familiarity such that logos had to be more familiar in order to trigger the same level of vivid auditory imagery as slogans.

Perhaps the paired association of verbal and auditory information was stronger and more reinforced over time for slogans and jingles, in line with Multiple Trace Theory (Nadel & Moscovitch, 1997), which could have aided recognition memory in our study. We examined this effect further in Study 2 by looking at how involuntarily imagining the logo, slogan, or jingle associated with the presented modality affected semantic and episodic memory retrieval, as opposed to solely focusing on auditory imagery, to help determine whether this assistive effect is unique to auditory imagery.

Summary

Study 1 provided initial findings regarding the effects of modality and age on subjective familiarity, nostalgia, and emotion ratings. Exploratory factors, including length of exposure to the advertising campaigns and previous use of the advertised brands and items, provided additional insight into how these factors influence emotion as well. This was done in addition to identifying appropriate stimuli for Study 2 using a minimum criterion of familiarity ratings from Study 1. Lastly, the findings from this study informed the hypotheses and experimental design for Study 2.

CHAPTER III

STUDY 2: EPISODIC AND SEMANTIC MEMORY FOR NOSTALGIC STIMULI PRESENTED ACROSS THREE MODALITIES

Study 2 delved into semantic and episodic memory with a focus on aging and nostalgia. Namely, we included participants from two age groups, young adults (18-30 years) and older adults (65-76 years), in order to derive meaningful insight regarding the effect of age on perceived nostalgia, semantic memory performance, and autobiographical reminiscence. This experiment employed behavioral measures to achieve four specific objectives. First, we determined whether one modality serves as a more effective memory retrieval cue for a particular age group. This was done by comparing the number of autobiographical memories and semantic details (the advertised product and company) retrieved by young adults and older adults in response to 165 advertisements presented across three different modalities. We also examined whether one modality uniquely facilitates richer, more perceptually vivid episodic reminiscence for a particular age group by analyzing memory content using a modified version of the Autobiographical Interview scoring manual (Levine et al., 2002). Additionally, we established whether a particular modality evoked less rehearsed or less frequently retrieved memories using subjective ratings of the last time they thought of each memory and how frequently they bring it to mind. The final aim was more exploratory. We examined how factors, such as how long each participant was potentially exposed to an advertisement and nostalgia-proneness (SNS; Routledge et al., 2008), affected semantic and episodic memory recall. These aims are addressed in the hypotheses provided below.

Hypotheses

Primary Hypotheses

Hypothesis 1. Visual stimuli (logos) will prompt the retrieval of more correct semantic knowledge for the advertising stimuli (advertised company and product), compared to auditory (jingles) and verbal (slogans) stimuli due to their more static nature and consistent use across multiple advertising campaigns (Sylvester & Sutherland, 2000).

Hypothesis 2. Older adults will correctly recall more semantic information for the advertising stimuli compared to young adults, based on previous findings regarding the preservation of semantic memory in old age (e.g., Levine et al., 2002; Piolino et al., 2002) with older adults performing within the young adult range on semantic memory tasks (Craik & Jennings, 1992; Park, 2000).

Hypothesis 3. Auditory stimuli (jingles) will evoke more autobiographical memories than visual (logos) and verbal (slogans) stimuli, particularly for older adults due to the greater prevalence of jingles during their adolescence and adulthood compared to young adults.

Hypothesis 4. Based on previous findings that older adults retrieve fewer episodic memory details compared to young adults (St. Jacques & Levine, 2007; Singer, Rexhaj, & Baddeley, 2007; Levine et al., 2002; Craik & Jennings, 1992; Park, 2000), we predict that older adults will produce fewer internal details, which are directly related to a specific memory event and reflect episodic reminiscence, and more external details (e.g., semantic statements or information not pertaining to the present memory) compared to young adults.

Hypothesis 5. Autobiographical memories evoked by auditory stimuli (jingles) will contain more episodic details, reflecting more vivid reminiscence, compared to visual (logos) and verbal (slogans) stimuli.

Hypothesis 6. Nostalgia will predict autobiographical memory retrieval, such that more nostalgic stimuli will evoke more autobiographical memories than less nostalgic stimuli.

Hypothesis 7. More nostalgic stimuli will be associated with more internal details in the reported autobiographical memories, compared to less nostalgic stimuli. This will be particularly true for older adults because prior research demonstrates that they respond more strongly to emotional stimuli than younger adults (e.g., Mather & Carstensen, 2005; Levine & Bluck, 1997; Comblain et al., 2005; Schulkind, Hennis, & Rubin, 1999).

Hypothesis 8. In line with the positivity effect (Kennedy et al., 2004; Mather & Carstensen, 2005), older adults will retrieve more positive autobiographical memories, compared to young adults.

Exploratory Hypotheses

Hypothesis 9. More semantic information will be retained and retrieved for advertisements that were rated as more emotional, based on prior findings of enhanced semantic recall for emotionally arousing television commercials (Friestad & Thorston, 1985; Friestad & Thorston, 1986).

Hypothesis 10. Spontaneously imagining advertisements from other modalities that are associated with the presented advertising campaign will increase the amount of correctly recalled semantic information. This will be moderated by how vividly participants imagined the associated advertisements from other modalities.

Hypothesis 11. Semantic memory will be better for items that have been frequently used or purchased by participants.

Hypothesis 12. Participants will retrieve more autobiographical memories in response to advertisements and advertised products that they rated as more personally important or meaningful.

Hypothesis 13. Participants will retrieve more autobiographical memories in response to advertising stimuli that aired when they were 10 to 30 years of age, coinciding with the reminiscence bump (Rubin & Schulkind, 1997).

Hypothesis 14. Individuals who are more prone to nostalgia, operationalized by their score on the Southampton Nostalgia Scale (SNS; Routledge et al., 2008) will retain and retrieve more personal autobiographical memories associated with the advertising stimuli.

Hypothesis 15. Advertisements for items that were previously used or purchased will evoke more autobiographical memories.

Hypothesis 16. Auditory musical stimuli (jingles) will prompt more references to social relationships, compared to visual (logos) and verbal (slogans) stimuli since we often experience music with others and music is known to play an important role in our social interactions across the lifespan (Juslin & Sloboda, 2011).

Hypothesis 17. Participants will provide stronger affective ratings for advertising campaigns that they were exposed to for longer periods of time because repeated exposure to advertisements is thought to grant additional opportunities to process the messages conveyed and make the emotions that we associate with those stimuli more accessible (Cacioppo & Petty, 1979).

Methods

Participants

A total of 115 individuals from two age groups participated in this study: 51 young adults (M_{age} = 19.98 years, SD = 2.02 years, range = 18-27 years) and 64 older adults (M_{age} = 71.15 years, SD = 2.32, range = 66-75 years; see Table 3.1 for a full list of demographics). Individuals were included from these age ranges in order to derive meaningful insight regarding the effect of age on perceived nostalgia, semantic memory performance, and autobiographical reminiscence. One percent of our participants identified as American Indian or Alaska Native, approximately 21% identified as Asian, 16% identified as Black, 60% identified as White, and 3% chose to not specify their race. Approximately 34% of our participants reported having completed some college credit (23% completed a high school degree or less, and 42% completed an Associate degree or higher).

As noted in Study 1, individuals had to have been born in the U.S. or have lived in the U.S. since six years of age or earlier in order to participate in the study. This criterion maximized the likelihood that they would have been exposed to the stimuli in our database, and that they would have been old enough to recall memories or associations that were initially formed in early childhood (Wang, 2001). Approximately 99% percent of participants were born in the USA or moved to the USA before they were three years of age, while the remaining 1% percent reported moving to the USA between three and six years of age.

Participants were also required to have a device that could play audio and video and could be used to complete the study. Older adults with a history or diagnosis of neurological disorder (e.g., traumatic brain injury, stroke, Alzheimer's disease, or epilepsy) were excluded from the study in order to control for a potential confound of cognitive impairment in the

memory responses provided by participants. Lastly, individuals who participated in Study 1 were excluded from this study since they were already exposed to these stimuli and had provided ratings.

Table 3.1

Participant demographics for each age group in Study 2

Age group	*Gender*	*N*	*Mean age (SD)*
Young adults	F	43	19.72 (1.88)
	M	8	21.38 (2.39)
Older adults	F	24	71.50 (1.87)
	M	40	70.80 (2.67)

Note. F = female, M = male, and standard deviation is listed in parentheses.

All participants completed the study online remotely due to the ongoing COVID-19 pandemic and social distancing orders. Data were collected using a Python-backed version of the PHP/MATLAB web-based experiment system Ensemble (Tomic & Janata, 2007). Young adults (18-30 years of age) were recruited from the UC Davis SONA database and compensated with class participation credit. Older adults (65-76 years of age) were recruited using a combination of online community resources and survey platforms (Prolific, Nextdoor.com, Davis Senior Center, Novato Senior Citizens Club, and the Ethel MacLeod Hart Senior Center in Sacramento) and compensated with $10 or a $10 Amazon gift card to thank them for their time.

Materials

Stimuli. As noted earlier, the stimuli consisted of 55 advertising campaigns from our original database which were selected if they were associated with stimuli from at least two modalities which received an average familiarity score of 1.5 ("Moderately familiar") or more (Figure 3.1). This was done to control for a familiarity bias in the semantic and episodic memory responses. If more than one advertisement met the average familiarity threshold for a modality for a single advertising campaign, the most familiar advertisement was selected for that modality. Thus, each advertising campaign was associated with *only three stimuli*, each of which represented the three isolated modalities examined in this work: verbal (slogans), visual (logos), and auditory (jingles). This yielded a total of 165 advertisements which aired at any point from 1926 to 2021.

Advertising slogans were displayed in a 40-point font, logos were standardized to a height of 350 pixels, and the jingles were normalized to 96 dB in Audacity, but participants could listen to the stimuli at a level that was comfortable to them during the experiment. Stimuli from each modality were presented for the duration of the jingle associated with that advertising campaign in order to control for the effect of stimulus duration across modalities. The average jingle duration was 9.14 seconds (SD = 3.83 seconds). Lastly, all of the advertising campaigns were aired in the U.S.

Figure 3.1

An example of stimulus selection for Study 2

	Modality		
	Visual (Logo)	Verbal (Slogan)	Auditory (Jingle)
Stimulus		"Five...five dollar...five dollar ____"	 Sung version of verbal stimulus
Avg familiarity rating	1.5	1	2

Note. Stimuli were selected for Study 2 based on an average familiarity rating of 1.5 for at least 2 modalities associated with that advertising campaign.

Surveys and Scales. As in Study 1, the Southampton Nostalgia Scale (SNS; Routledge et al., 2008) was utilized to measure each participant's general proclivity for nostalgia using a series of questions regarding how important nostalgia is to them and how often they tend to experience it in their everyday life. Likewise, the media consumption scale from Study 1 was used to measure each participant's media consumption habits and reflect their potential exposure to advertisements throughout their life. Media consumption scores were collected for specific lifetime periods that were relevant to each participant (4 to 12 years of age, 13 to 20 years of age, 21 to 35 years of age, 36 to 64 years of age, and 65 years of age or older). As noted in Study 1, these lifetime periods were chosen in order to examine whether differences may have emerged during the period of time when participants' media consumption was more likely to be driven by the adults in their lives (e.g., 4 to 12 years of age) compared to periods when they had more

agency over their choice of media, greater potential for active engagement with various forms of media, and self-exploration of personal preferences and taste in media as opposed to passive consumption of what their caregivers played around them.

Participants used a 5-point Likert scale to report the extent to which they watched television, listened to the radio, read magazines and newspapers, streamed media (e.g., using YouTube, Hulu, etc.), and used social media sites or apps (e.g., Facebook, Instagram, MySpace, Twitter, etc.) for each of the aforementioned lifetime periods. An average media score was calculated for each participant by dividing the total media consumption score by the number of relevant items for their age.

Experimental Paradigm

Stimulus Selection. As in Study 1, stimuli were selected for each participant based on whether the advertisements aired at any point when they were six years of age up until today to ensure that participants could potentially retrieve memories or associations that were initially formed in early childhood (Wang, 2001). A stimulus was selected for each trial according to two primary factors: lifetime period and modality (Figure 3.2). The dates for when each advertisement in the database was first played and last played were used to select a stimulus which aired during a lifetime period that was relevant to each participant. Although stimuli from four lifetime periods were available, only two of these lifetime periods were relevant to young adults (6 to 16 years of age and 17 to 30 years of age). A stimulus modality was then randomly selected for the chosen lifetime period. As noted earlier, a jingle, slogan, and tagline were available for each advertising campaign in the database. However, only *one* of these modalities was presented to a participant for each relevant advertising campaign. This was done to control for a familiarity bias that could otherwise influence ratings for other modalities that advertise

products that were already encountered in the study. A total of two stimuli were presented for each combination of modality (3 levels: verbal, visual, and auditory) and lifetime period (4 levels: 6-16 years, 17-30 years, 31-64 years, 65 years and older), which yielded a total of 12 trials for young adults and 24 trials for older adults (Figure 3.2).

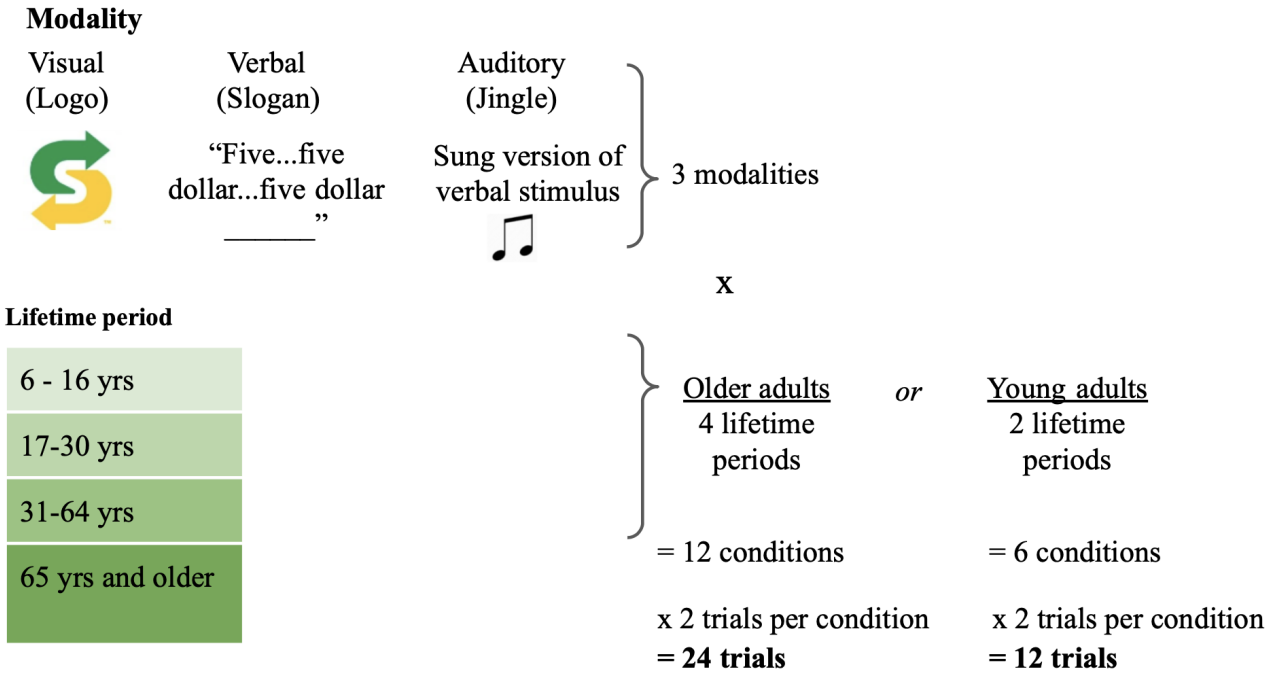
Stimuli were presented in random order to young adults. However, to match the experience of young adults and control for potential fatigue due to the completion of more trials, older adults rated the stimuli in pseudo randomized order. Namely, older adults were presented with stimuli from the earliest and most recent lifetime periods (6 to 16 years of age, 65 years of age and older) in random order, and they were subsequently presented with stimuli from the two remaining lifetime periods in random order (17 to 30 years of age, 31 to 64 years of age). This trial presentation design helped provide uniform sampling of modalities while ensuring equal trial distribution across modalities and lifetime periods.

Procedure

After voluntarily consenting, participants were prompted to answer a series of questions related to demographics, nostalgia-proneness (Southampton Nostalgia Scale; Routledge et al., 2008), and the extent to which they've been exposed to different forms of media throughout their lives (e.g., print media, television & radio, social media, and streaming services). The experimental trial loop followed this series of questionnaires.

Figure 3.2

Trial calculations and counterbalancing for Study 2



Each experimental trial began with presentation of a stimulus for the selected condition, followed by a subjective familiarity rating for the advertisement (0 = Not at all familiar, 1 = Vaguely familiar, 2 = Moderately familiar, 3 = Very familiar) and two questions used to probe semantic memory which required typed answers ("Which specific product was advertised?" and "Which specific company was advertised?"). If participants indicated that the stimulus was at least moderately familiar, they were subsequently prompted to rate the extent to which the advertisement is personally meaningful for them as well as how nostalgic, happy, and sad it typically makes them feel (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly).

Next, they were provided with the correct company and product name for the advertisement in order to assess how familiar the product is (0 = Not at all familiar, 1 = Vaguely

familiar, 2 = Moderately familiar, 3 = Very familiar) and whether they've used it in the past (NA = I'm not sure, 0 = No, never, 1 = Yes, a few times, 2 = Yes, regularly). If they indicated that the advertised product was at least moderately familiar, participants were asked to rate the extent to which the advertised product is personally meaningful or important to them (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly) as well as how nostalgic, happy, and sad it typically makes them feel (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly). All participants were then asked whether the product or advertisement triggered a personal memory (0 = No, 1 = Yes).

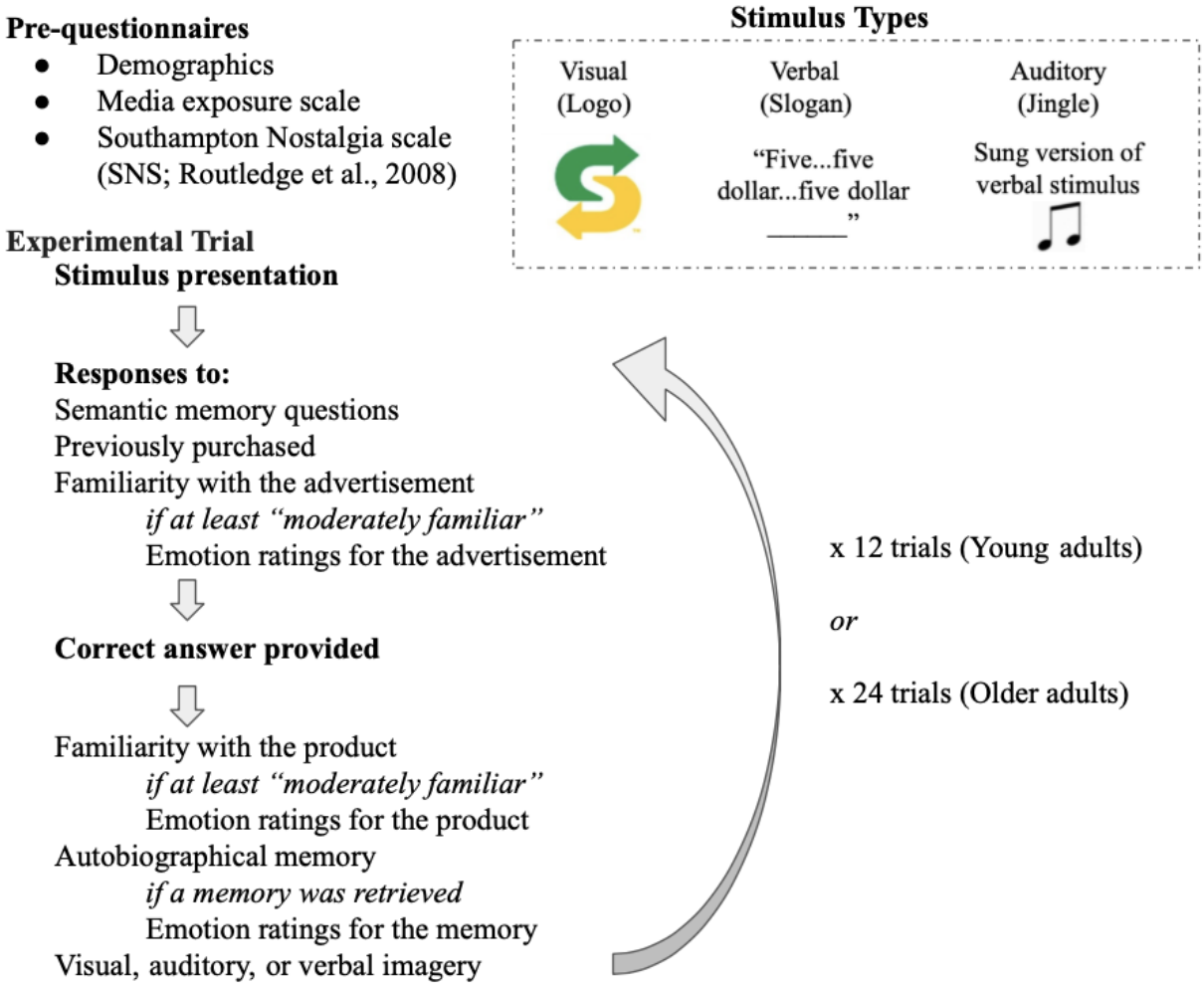
If they reported that the stimulus was associated with an autobiographical memory, participants were asked to describe the memory with as many associated details as possible. They then used a five-point Likert scale to rate how happy, sad, and nostalgic the memory makes them feel (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very Strongly) as well as the last time they thought about this memory (0 = Never, 1 = Over 5 years ago, 2 = Over 1 year ago, 3 = Within the past year, 4 = Within the past month, 5 = Within the past week) and how often they typically think of this memory (0 = Never, 1 = Once every few years, 2 = Once a year, 3 = Once a month, 4 = At least once a week).

Regardless of whether they provided an autobiographical memory, participants who reported that the advertised product is at least moderately familiar were asked about the extent to which they imagined the other two advertising modalities associated with this product. For instance, if presented with a jingle, they were asked "To what extent did you imagine the advertising logo associated with this item when you saw or heard this advertisement?" (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4= Very strongly) and "To what extent did you imagine the advertising slogan associated with this item when you saw or heard this

advertisement?" (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4= Very Strongly). Thus, they had the opportunity to select that none, one, or both of the associated modalities were cued by the stimulus (Figure 3.3). An attention check was provided at the end of one in five trials to ensure that participants were not distracted while completing the study remotely and that they were carefully reading the questions provided during the study. Namely, the question text instructed participants to select a particular number (e.g., "If you are reading this question, please select the number '2' below."). Two participants failed the attention check and their responses were not included in our final analysis.

Figure 3.3

Experimental flow for Study 2



Analyses and Results

Descriptive Statistics

Participants. The Southampton Nostalgia Scale was used to measure the extent to which each participant is generally prone to nostalgia (SNS; Routledge et al., 2008). Participants scored an average of 23.69 on nostalgia proneness (SD = 9.66) out of a maximum possible score of 49. Media consumption scores were also calculated for each participant as a reflection of their potential exposure to advertisements throughout their life. An average media score was calculated for each participant by dividing the total media consumption score by the number of relevant items. Participants scored an average of 10.2 on media consumption (SD = 4.47, range = 2.5 to 19.25) out of a maximum possible score of 20. Lastly, it took participants an average of 45 minutes to complete the experiment (SD = 27.26 minutes).

Database. We first calculated the nostalgia and familiarity ratings for the advertisements and advertised products across all 165 stimuli to determine whether they were indeed familiar enough to potentially prompt semantic and episodic autobiographical memory retrieval and serve as a comparison to the familiarity ratings from Study 1. The average nostalgia rating for the advertising stimuli was 1.74 (range = 0 to 4; SD = 1.22) and the average nostalgia rating for the advertised products and brands was 1.49 (range = 0 to 4; SD = 1.22). The average familiarity rating for the advertising stimuli was 1.45 (range = 0 to 3; SD = 1.18) and the average familiarity rating for the advertised products and brands was 1.85 (range = 0 to 3; SD = 1.14).

Stimulus duration and memory retrieval. An ordinary least squares (OLS) linear regression model was used to examine memory retrieval as a function of stimulus duration in the study. Memory retrieval consisted of two levels: no memory retrieved and memory retrieved. However, stimulus duration did not significantly predict memory retrieval ($p > .05$).

Statistical Models

Analysis of variance (ANOVA) was used to determine whether a familiarity bias emerged in the data which needed to be accounted for and included as a covariate in subsequent analyses. Analysis of covariance (ANCOVA) with type III error was used to compare semantic and episodic memory scores using categorical independent variables, including modality and age group. Levene's test and normality checks were carried out and the assumptions were met. Linear regression models were used to predict dependent variables related to memory using continuous independent variables.

All analyses featured random effects of subject and advertised item to account for by-subject and by-item variation. The two-tailed significance level was set at $\alpha = .05$ for all analyses and findings that met this significance level are reported in the sections below. Post hoc comparisons were conducted in cases where significant results emerged ($p < .05$). Pairwise *t* tests were run using the Tukey correction to adjust for multiple comparisons. Significant comparisons are provided with means and 95% confidence intervals. All statistical analyses were performed using RStudio, Version 1.4.1106 (RStudio Team, 2020).

Familiarity Ratings. A two-way ANOVA was used to determine whether a single modality or age group was associated with higher subjective familiarity ratings for advertisements or advertised products and brands, which would indicate a familiarity bias. Both familiarity ratings were categorical responses featuring the following options: 0 = Not at all familiar, 1 = Vaguely familiar, 2 = Moderately familiar, 3 = Very familiar.

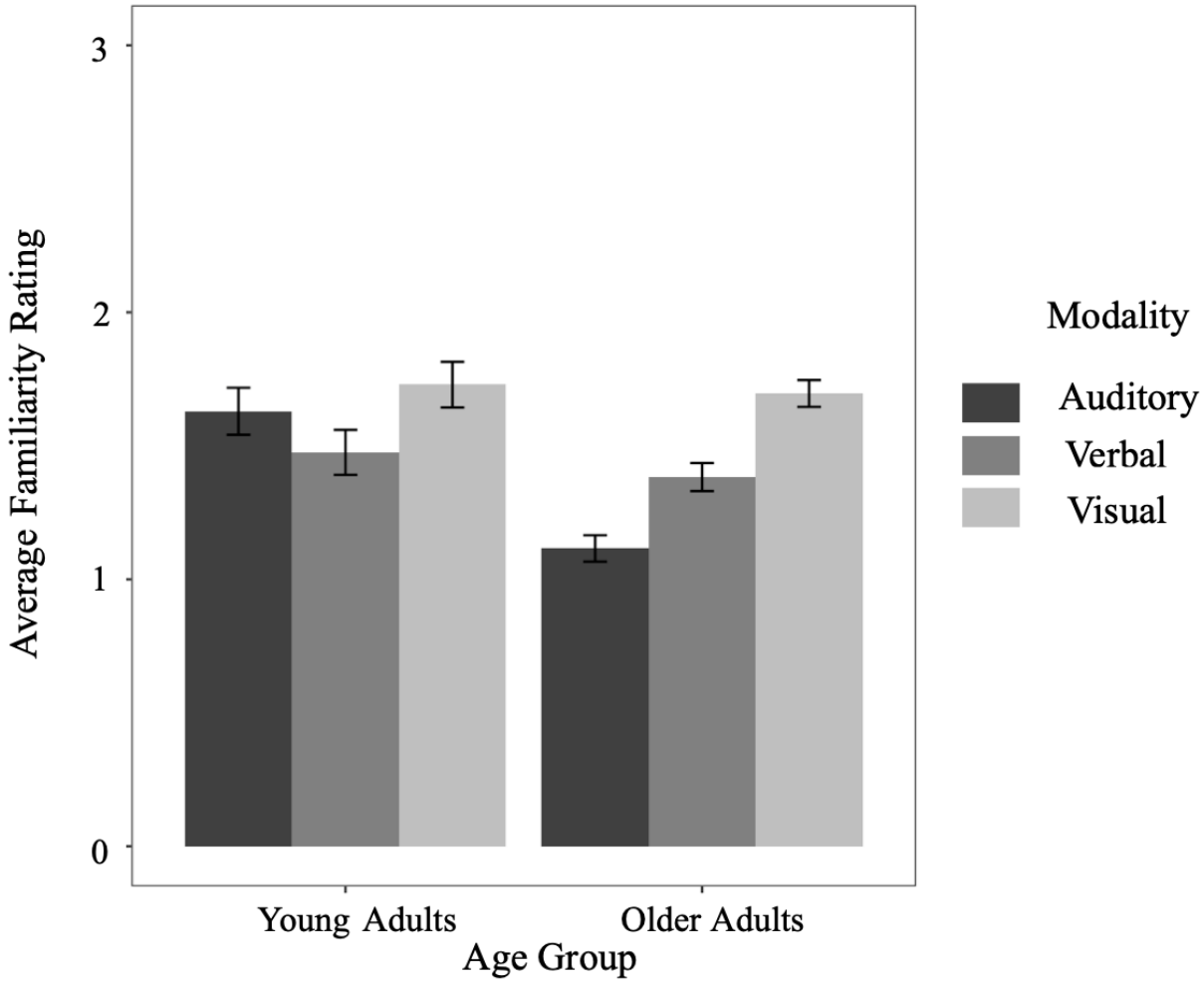
Familiarity with advertisements predicted by age and modality. We conducted a two-way repeated measures ANOVA with familiarity ratings for the advertisements predicted by age group and modality of the presented stimuli, which consisted of three levels: visual, verbal, and

auditory stimuli. There was a main effect of modality, $F(2, 219.53) = 18.66$, $p < .001$, such that visual stimuli (M = 2.72, CI = [2.59, 2.84]) were rated as more familiar than auditory (M = 2.37, CI = [2.23, 2.52], $p < .001$) and verbal stimuli (M = 2.43, CI = [2.29, 2.57], $p < .001$). We also observed an interaction of age and modality, $F(2, 219.53) = 9.06$, $p < .001$. A post hoc comparison of age groups also demonstrated that young adults rated auditory ($M_{Young\ adults} = 1.22$, $CI_{Young\ adults} = [1.08, 1.35]$, $M_{Older\ adults} = 1.07$, $CI_{Older\ adults} = [0.93, 1.22]$, $p < .05$) and visual stimuli ($M_{Young\ adults} = 1.65$, $CI_{Young\ adults} = [1.53, 1.78]$, $M_{Older\ adults} = 1.50$, $CI_{Older\ adults} = [1.35, 1.64]$, $p < .05$) as more familiar than older adults (Figure 3.4). Therefore, familiarity ratings for advertisements were included as a covariate in the statistical models examining semantic memory recall to control for a potential bias.

Familiarity with advertised products and brands predicted by age and modality. After examining familiarity ratings for the advertisements in the previous model, we conducted a two-way ANOVA with familiarity ratings *for the advertised products and brands* predicted by age group and modality. This was done to examine ratings on a higher order than the stimulus level by assessing the familiarity of the products and brands that were advertised in various campaigns. We observed a main effect of modality, $F(2, 210.44) = 3.77$, $p < .05$, such that verbal stimuli (M = 3.01, CI = [2.85, 3.17]) were associated with higher familiarity ratings for the advertised products and brands, compared to auditory stimuli (M = 2.86, CI = [2.70, 3.02], $p < .01$). As a result, familiarity for the advertised products and brands was included as a covariate in statistical models featuring autobiographical memory recall to control for a potential familiarity bias.

Figure 3.4

Average familiarity ratings for stimuli for each age group and modality



Note. Error bars represent one standard error from the mean.

Semantic Memory. The data for all models in this section predicted semantic memory scores for the stimuli in this study. Semantic memory scores were provided for typed responses to the following questions for each advertisement: "Which company/brand was being advertised? (for example: Southwest)" and "Which product was being advertised? (for example: airline)". These typed responses were evaluated by trained research assistants who used an answer sheet to mark every response as correct or incorrect. No points were deducted for misspelling the name of the company or product. Each correct semantic memory response earned one point. Therefore, a participant could earn a total of two points for each advertisement: one for identifying the correct product and one for identifying the correct company.

Semantic memory predicted by modality and age. A mixed effects model was constructed with the average number of correctly recalled semantic details predicted by age and modality. This model was used to determine whether visual stimuli prompted better retrieval of the semantic information associated with advertising stimuli, compared to auditory and verbal stimuli, and whether older adults recalled more semantic information than young adults.

We found a main effect of the familiarity covariate on semantic recall $F(1, 328.78) = 314.85$, $p < .001$). Modality also predicted the amount of correctly recalled semantic information after controlling for familiarity, $F(2, 226.15) = 9.56$, $p < .001$, such that visual stimuli ($M = 0.89$, $CI = [0.82, 0.96]$) prompted more semantic details than auditory ($M = 0.75$, $CI = [0.68, 0.82]$, $p < .001$) and verbal stimuli ($M = 0.81$, $CI = [0.74, 0.89]$, $p < .05$). We did not observe a significant difference between older adults and younger adults in the retrieval of semantic information ($p > .05$). However, there was an interaction of modality and age, $F(2, 222.19) = 5.54$, $p < .01$. Older adults provided more semantic details for visual stimuli ($M = 0.93$, $CI = [0.83, 1.02]$) than

auditory (M = 0.68, CI = [0.59, 0.78], $p < .001$) and verbal stimuli (M = 0.93, CI = [0.65, 0.84], $p < .001$).

Semantic memory predicted by affective ratings. Based on prior research by Friestad and Thorston who found better short term (1985) and delayed semantic memory recall (1986) for more emotionally arousing television commercials, we tested whether long-term semantic memory would be better for advertisements which evoked stronger emotional responses among participants in our study. A three-way ANCOVA model was created to predict semantic memory retrieval using subjective ratings of happiness, sadness, and nostalgia. Participants were asked to indicate the degree to which they endorse the following statement after being presented with a stimulus if they rated it as at least moderately familiar: "This advertisement typically makes me feel happy." (0 = Not at all, 1 = Very little, 2 = Somewhat, 3= Fairly strongly, 4 = Very strongly). This question was repeated for sadness and nostalgia, and the resulting categorical responses were included as predictors in the model. However, we only observed an effect of the familiarity covariate, $F(1, 506.46) = 98.35$, $p < .001$.

Semantic memory predicted by imagery and vividness. We then examined how involuntarily cuing the other advertising modalities associated with presented product or company aided semantic memory retrieval and whether it was moderated by the vividness of this imagery. As noted earlier, if participants reported that the advertised product was at least moderately familiar, they were asked about the extent to which they imagined the other two advertising modalities associated with the product and how vividly they imagined them. For instance, if presented with a jingle, they were asked "To what extent did you imagine the advertising logo associated with this item when you saw or heard this advertisement?" (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4= Very strongly) and "To what extent

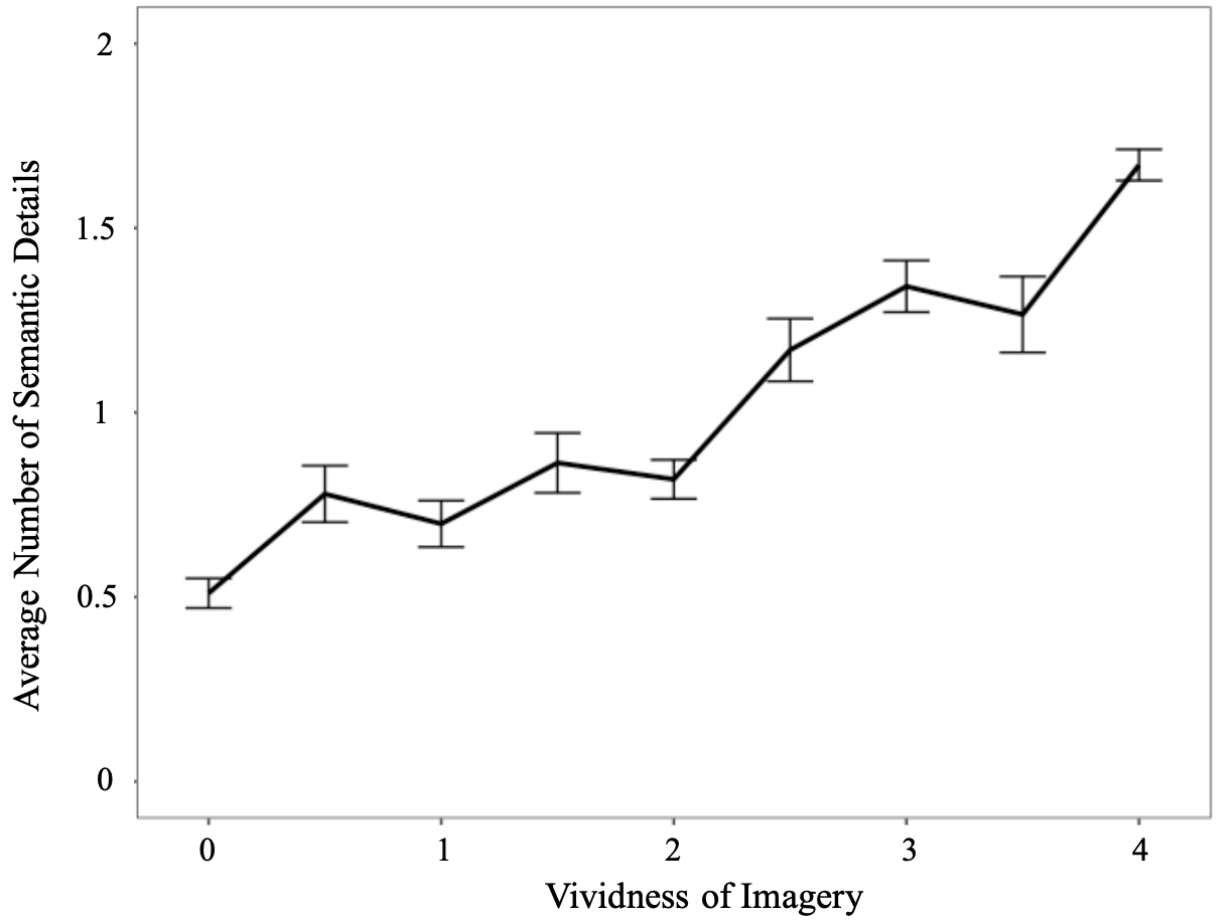
did you imagine the advertising slogan associated with this item when you saw or heard this advertisement?" (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4= Very strongly). Thus, participants had the opportunity to select that none, one, or both of the associated modalities were cued by the stimulus. However, we observed that they only reported that neither of the modalities or both of the modalities were cued by the stimulus.

A one-way ANCOVA with semantic scores as the dependent variable and imagery as the predictor was used to determine whether imagery occurred and how vividly it was experienced using the continuous scale provided above. Involuntary imagery vividness was calculated by averaging the vividness scores across both modalities. There was an effect of the familiarity covariate, $F(1, 535.34) = 384.17$, $p < .001$. We also observed a main effect of vividness, $F(1, 513.45) = 21.39$, $p < .001$, such that more vivid imagery was associated with retrieval of more semantic details (Figure 3.5).

Semantic memory predicted by purchase history. A one-way ANCOVA was used to test our hypothesis that semantic memory would be better for advertisements of items that were previously purchased by participants. Purchase history was a categorical predictor with three levels: never used or purchased, used or purchased a few times, and regularly used or purchased. We observed an effect of the familiarity covariate, $F(1, 270.49) = 331.78$, $p < .001$, in addition to a main effect of purchase history after controlling for familiarity, $F(2, 189.88) = 6.75$, $p < .01$. Having regularly purchased the advertised item was associated with greater semantic recall ($M = 1.09$, $CI = [1.00, 1.18]$) than having never used or purchased the advertised item ($M = 0.87$, $CI = [0.79, 0.96]$, $p < .001$) or having used or purchased it a few times ($M = 0.97$, $CI = [0.89, 1.05]$, $p < .05$).

Figure 3.5

Average semantic memory scores for each level of imagery for the associated modalities



Note. Error bars represent one standard error from the mean.

Autobiographical Memory. The data for models in this section analyzed the likelihood and frequency of autobiographical memory retrieval as well as the memory content provided in response to the following question for each advertisement: "Does this advertised product or advertisement trigger a personal memory?" (0 = No, 1 = Yes). If participants selected "Yes", they were prompted to "tell us more about the memory you associate with this advertisement or advertised product. Please provide as many details as possible below." They also rated how happy, sad, and nostalgic the memory makes them feel (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very Strongly), the last time they thought about this memory (0 = Never, 1 = Over 5 years ago, 2 = Over 1 year ago, 3 = Within the past year, 4 = Within the past month, 5 = Within the past week) and how often they typically think of this memory (0 = Never, 1 = Once every few years, 2 = Once a year, 3 = Once a month, 4 = At least once a week).

Twenty three percent of the total number of 2122 trials were accompanied by an autobiographical memory. Typed memory responses were evaluated by trained research assistants who used a modified version of the annotation scheme from the Autobiographical Interview (Levine et al., 2002). Each memory was segmented into informative segments or details ($M_{\text{Details per memory}}$ = 3.51, SD = 2.25, range = 0 to 15) and coded using mutually exclusive categories belonging to four groups of details: internal, external, lifetime period/general repeated event, and social knowledge. The first two groups, internal and external details, are from the original scheme by Levine and colleagues (2002). Internal details were directly related to the main memory event described by the participant. They were specific to a particular time and place and reflected episodic reminiscence. Internal details were separated into five mutually exclusive categories: (1) events, (2) places, (3) times, (4) perceptual details, and (5) emotions/thoughts related to the memory (Table 3.2). The group of external details broadly

consisted of information that was external to episodic reminiscence and it was separated into four mutually exclusive categories: (1) semantic statements (factual information, general knowledge, or events that did not include any temporal or spatial markers), (2) repetitions, (3) external events (information or details not pertaining to the present memory), and (4) other details that were not related to the memory (e.g., metacognitive statements; Table 3.2).

We added the last two groups, lifetime period/general repeated event (LTP/GRE) and social knowledge, to include other relevant categories from Conway and Pleydell-Pearce's self-memory system (2000). Namely, the LTP/GRE group of categories allowed us to track the autobiographical details for memories that were less specific than episodic memories, but more specific and personal than semantic memories due to their inclusion of temporal, spatial, or personally meaningful themes as anchors. This group of annotations reflects the perceptual richness and vivid detail or autonoetic consciousness which is only applied to episodic internal events in the classic scheme by Levine and colleagues (2002). A more nuanced examination of lifetime period and repeated general event memories was particularly important in this study, given the repeated exposure which participants had to the advertisements throughout their lives, which would likely make it harder for them to retrieve specific episodic memories. Details belonging to the LTP/GRE group were separated into five mutually exclusive categories: (1) LTP events, (2) GRE events, (3) places, (4) perceptual details, and (5) emotions/thoughts related to the memory (Table 3.2). The final group of social knowledge consists of one category (people) which tracks the number of distinct individuals mentioned in the memory to characterize the social component of reminiscence.

Table 3.2

Description of Scoring Categories

Category	Description
Internal	
Event	Happenings (including an action performed or witnessed), individuals present, weather conditions, physical/emotional actions, or reactions in others
Time	Year, season, month, day of week, time of day
Place	Localization of an event including the city, street, building, room, part of room
Perceptual	Auditory, olfactory, tactile, taste, visual and visual details, body position, duration
Thought/Emotion	Emotional state, thoughts, implications
External	
Event	Specific details from other incidents (from all of the above categories) external to the main event recalled
Semantic	General knowledge or facts, ongoing events, extended states of being. Factual information or extended events that did not require recollection of a specific time and place
Repetition	Unsolicited repetition of details
Other	Metacognitive statements, editorializing, personal appraisals or ratings
Lifetime Period/General Repeated Event (LTP/GRE)	
Lifetime period (LTP) event	Lifetime periods (e.g., when I was at school, when the children were little, when I lived with Y) that represent general knowledge of significant others, common locations, actions, activities, plans, and goals, characteristic of a period
General repeated (GRE) event	More specific than lifetime periods and less specific than event-specific knowledge. These include repeated events like family dinners or holidays
Place	Localization of an event including the city, street, building, room, part of room
Perceptual	Auditory, olfactory, tactile, taste, visual and visual details, body position, duration
Thought/Emotion	Emotional state, thoughts, implications
Social Knowledge	
People	Number of distinct people mentioned in the memory, not including themselves (e.g., my husband, my grandchildren, my best friend)

Note. Based on Levine et al. (2002) and Conway & Pleydell-Pearce (2000).

Similar to Levine et al. (2002) and Belfi et al. (2016), we tallied and summed the details for each group to form LTP/GRE, internal, and external composite scores. We also calculated the ratio of internal-to-total details, external-to-total details, and LTP/GRE-to-total details provided per memory for an unbiased proportion of episodic, semantic/external memory, and lifetime period/general repeated event details that were not skewed by the total number of details.

Memories from 12 participants were coded by all three raters for training purposes and Fleiss's Kappa was calculated to assess interrater reliability. Scores for the internal composite measure, received a Kappa of .925, scores for the LPT/GRE composite received a Kappa of 1, and the external composite had a Kappa of .893. All three values reflect high agreement among the three raters. The remaining memories were rated by two coders and the final scores for each memory consisted of an average of the scores provided by both raters.

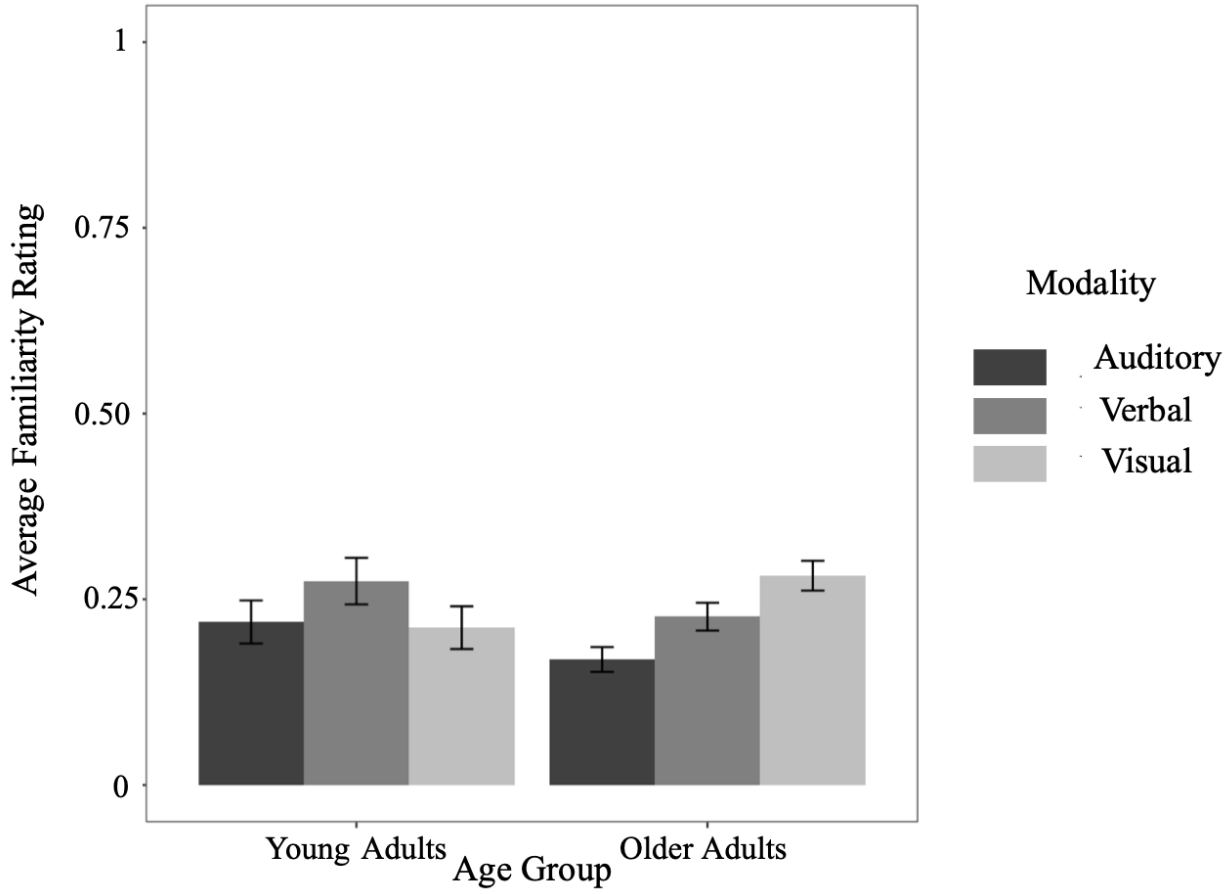
The statistical models in the section below were applied to two datasets: all hypotheses related to the likelihood of eliciting a memory were analyzed using the full dataset of responses (N_{Trials} = 2146), and any hypotheses related to the characteristics of memories (e.g., the number of internal episodic details) were tested with the subset of trials accompanied by a memory (N_{Trials} = 481). As noted earlier, stimulus duration and familiarity ratings for the advertised products and brands were included as covariates in all of the statistical models in this section to account for their contribution to memory retrieval.

Autobiographical memory retrieval predicted by modality and age. A logistic regression model with modality and age as predictors was used to determine whether auditory stimuli evoked more autobiographical memories than visual and verbal stimuli, particularly for older adults. Memory retrieval was a binary measure that consisted of two levels: no memory retrieved and memory retrieved.

The covariate of familiarity predicted memory retrieval, $F(1, 262.72) = 43.24$, $p < .001$. An interaction of modality and age also predicted memory retrieval, $F(2, 213.77) = 4.14$, $p < .05$. Among older (but not younger) adults, visual stimuli were more likely to evoke an autobiographical memory (M = 0.28, CI = [0.24, 0.31]) compared to auditory stimuli (M = 0.20, CI = [0.16, 0.23], $p < .01$). Additionally, older adults (M = 0.27, CI = [0.24, 0.31]) were more likely to provide an autobiographical memory in response to visual stimuli, compared to young adults (M = 0.21, CI = [0.15, 0.26], $p < .05$) (Figure 3.6).

Figure 3.6

Autobiographical memory retrieval predicted by modality and age



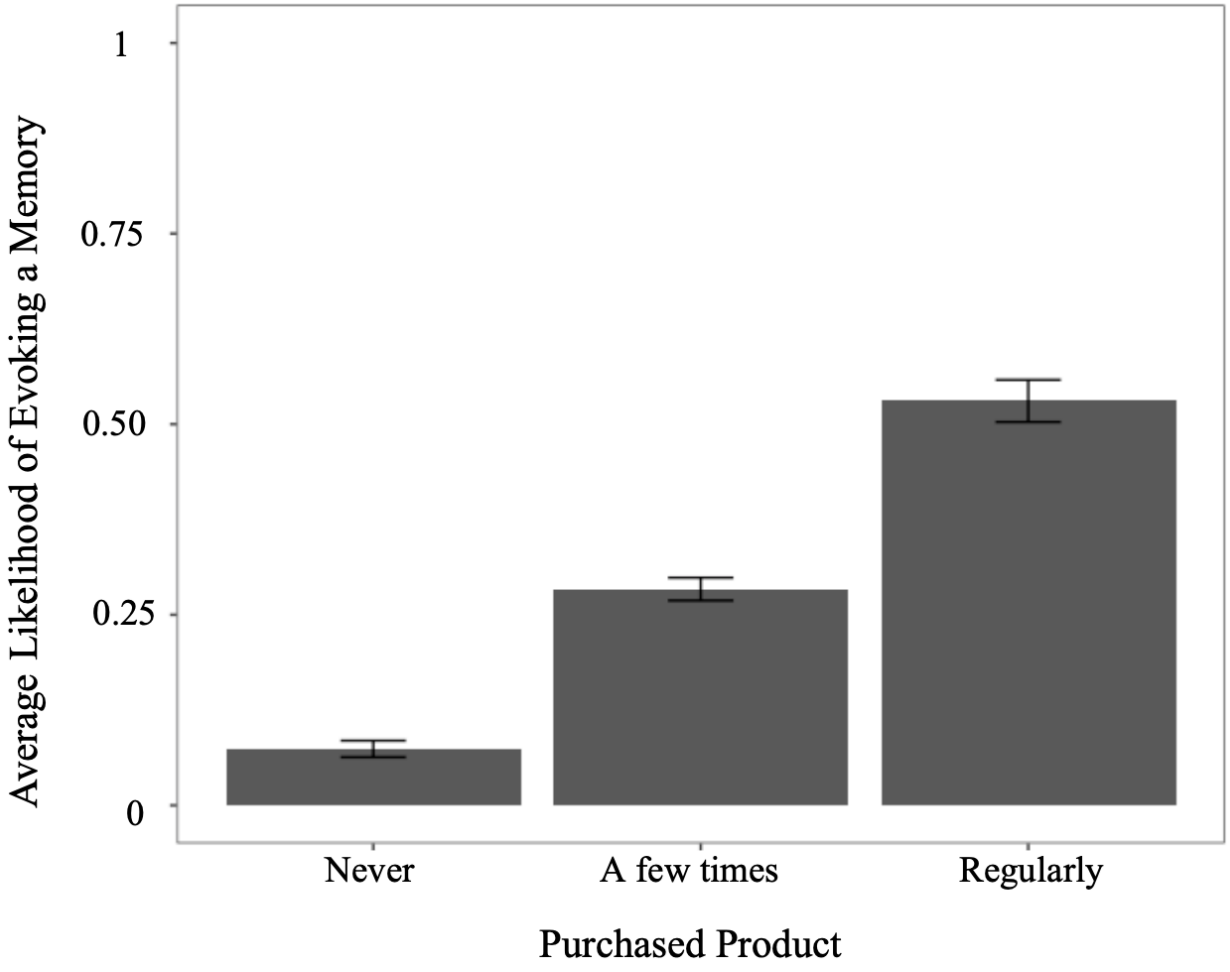
Note. Error bars represent one standard error from the mean.

Autobiographical memory retrieval predicted by age and nostalgia-proneness. A linear regression model was used to determine how age and nostalgia-proneness predict autobiographical memory retrieval. The model included fixed effects of age group and SNS score (Routledge et al., 2008), which is a continuous variable used to operationalize nostalgia-proneness in this model. The familiarity covariate predicted memory retrieval, $F(1, 100) = 17.24$, $p < .001$. We also observed a main effect of nostalgia-proneness, $F(1, 100) = 5.72$, $p < .001$, such that individuals who were more prone to nostalgia were also more likely to retrieve a memory.

Autobiographical memory retrieval predicted by purchase history. A one-way ANCOVA model was used to determine whether advertisements for previously used or purchased items were more likely to evoke autobiographical memories. Purchase history is a categorical variable that consists of three levels: Never used or purchased (0), used or purchased a few times (1), and used or purchased regularly (2). Familiarity with the advertised product or brand predicted memory retrieval, $F(1, 363.06) = 18.91$, $p < .001$. There was also an effect of having previously purchased or used the advertised product after controlling for familiarity, $F(3, 300.41) = 10.55$, $p < .001$. Having purchased the product regularly ($M = 0.45$, $CI = [0.40, 0.50]$, $p < .001$) predicted a greater likelihood of memory retrieval than having purchased it a few times ($M = 0.26$, $CI = [0.24, 0.29]$, $p < .001$) and both of these levels were more likely to prompt an autobiographical memory than products that were never used or purchased ($M = 0.16$, $CI = [0.12, 0.19]$, $p < .001$ for both comparisons) (Figure 3.7).

Figure 3.7

Autobiographical memory retrieval predicted by previous use or purchase of the advertised product



Note. Error bars represent one standard error from the mean.

Ratio of internal memory details predicted by modality. A one-way ANCOVA model was used to test our hypothesis that autobiographical memories evoked by auditory stimuli would contain more episodic details, reflecting more vivid reminiscence. Once again, the ratio of internal-to-total memory details was included as an unbiased dependent variable. Modality was included as a fixed effect. However, no significant predictors emerged from this model (ps > .05)

Autobiographical memory retrieval predicted by lifetime period and HLE. A linear regression model was used to test our hypothesis that participants would retrieve more memories for advertising stimuli that aired when they were 10 to 30 years of age, coinciding with the reminiscence bump (Rubin & Schulkind, 1997). Stimuli were categorized into one of four lifetime periods based on the participant's date of birth and the first and last dates that each stimulus they encountered in the study was aired: birth to 9 years of age, 10 to 30 years of age, 31 to 64 years of age, and 65 years of age and older (Figure 3.8). These lifetime periods were used specifically for this analysis, as opposed to the original lifetime periods used for stimulus selection in the experimental design (6 to 16 years of age, 17 to 30 years of age, 31 to 64 years of age, and 65 years or older; Figure 3.9), because they provide a more useful grouping of lifetime periods for the research questions examined in this section. Namely, this breakdown allowed us to more accurately analyze findings related to the reminiscence bump. All of the stimuli presented to participants in this study were retroactively categorized as belonging to one of the 4 modified lifetime periods.

Figure 3.8

Histogram featuring the number trials for the modified lifetime periods

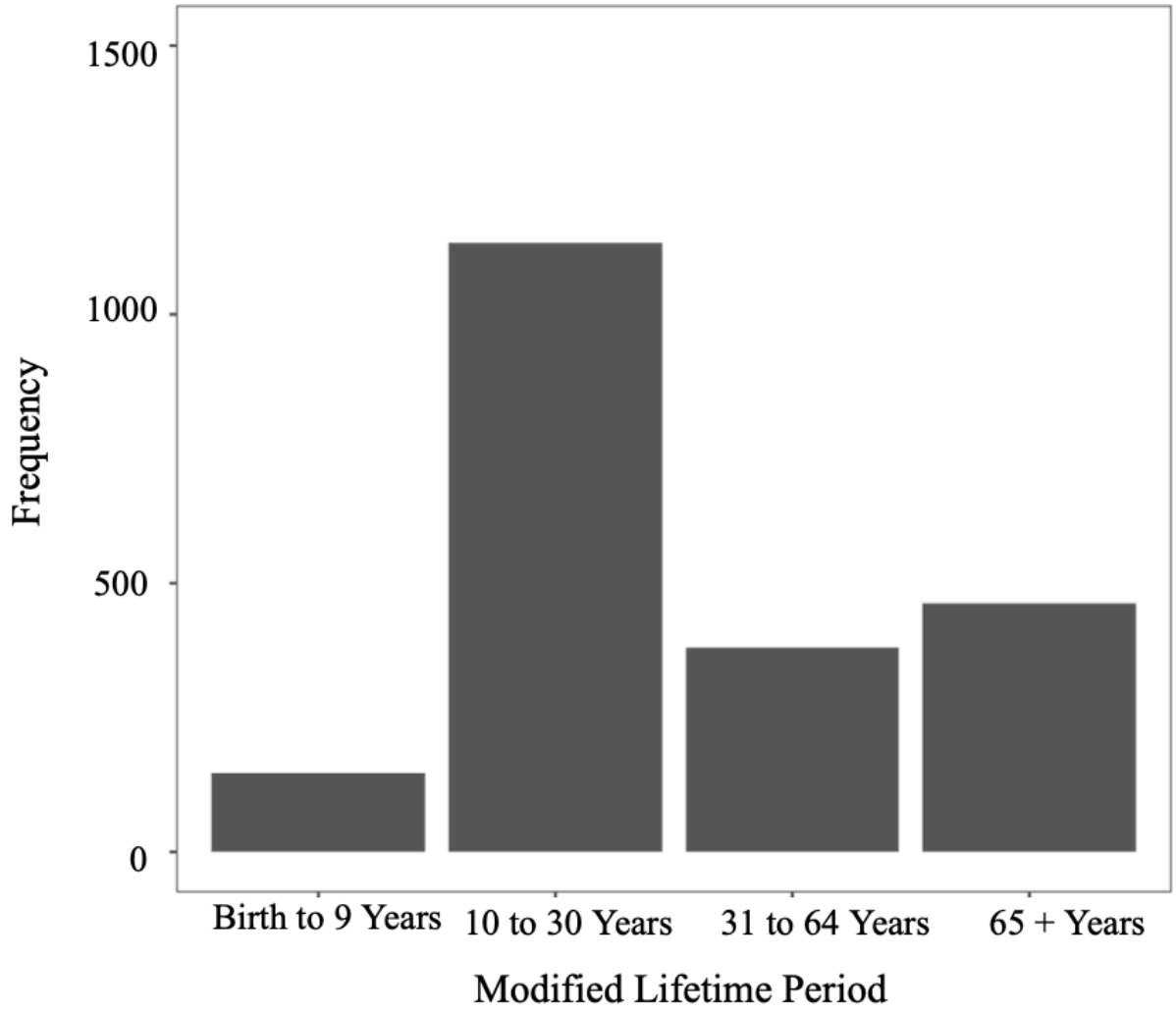
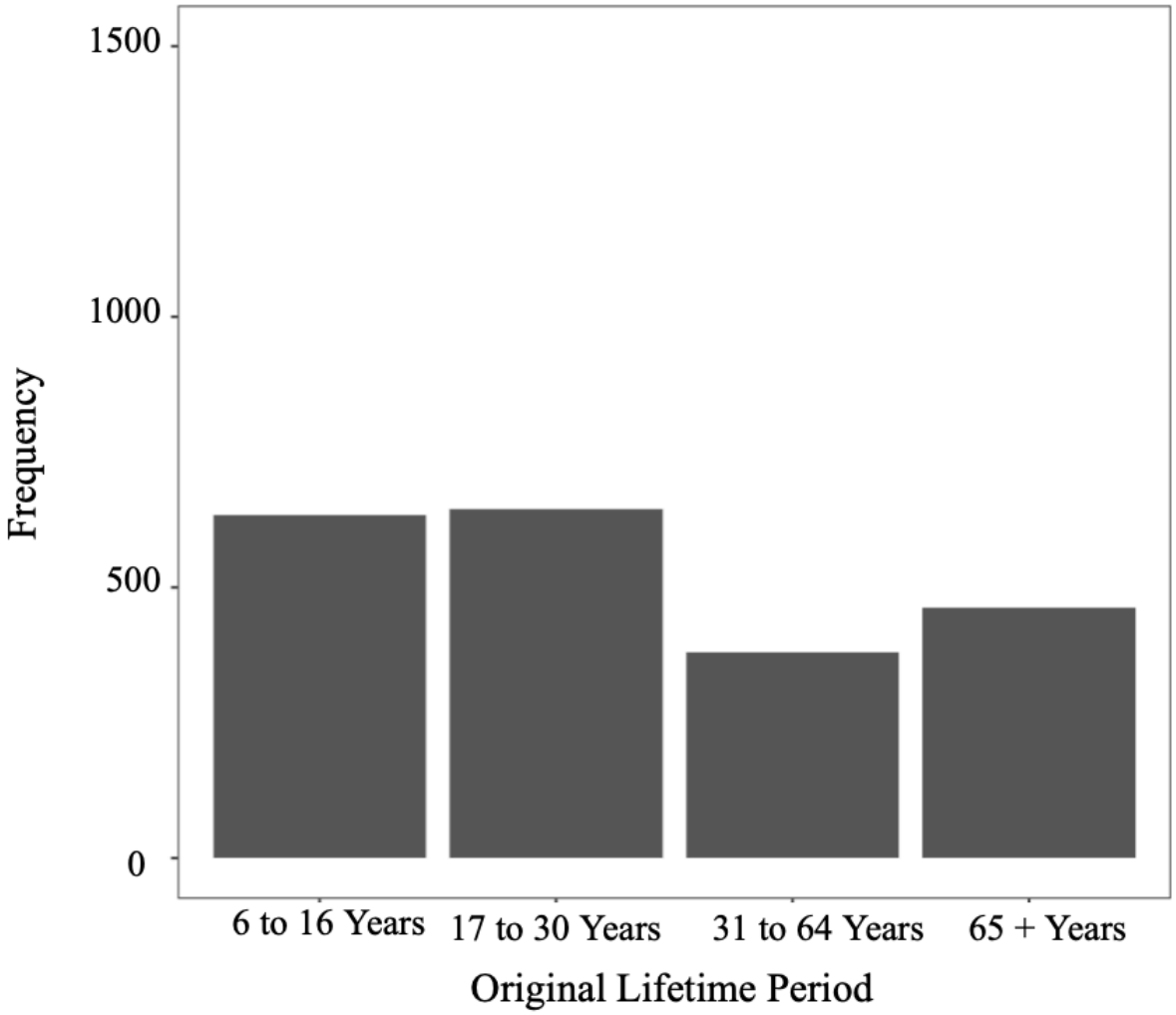


Figure 3.9

Histogram featuring the number trials for the original lifetime periods



These categorical modified lifetime periods were included in the regression model in addition to the continuous measure of HLE in order to account for the role of exposure time on memory retrieval. We observed an effect of the familiarity covariate, $F(1, 253.59) = 88.69$, $p < .001$. There was also a main effect of lifetime period, $F(3, 237.69) = 5.90$, $p < .001$. Fewer memories were retrieved for advertisements that aired during the span of time from birth to nine years of age ($M = -0.04$, $CI = [-0.25, 0.17]$) compared to 10 years of age through 30 years of age

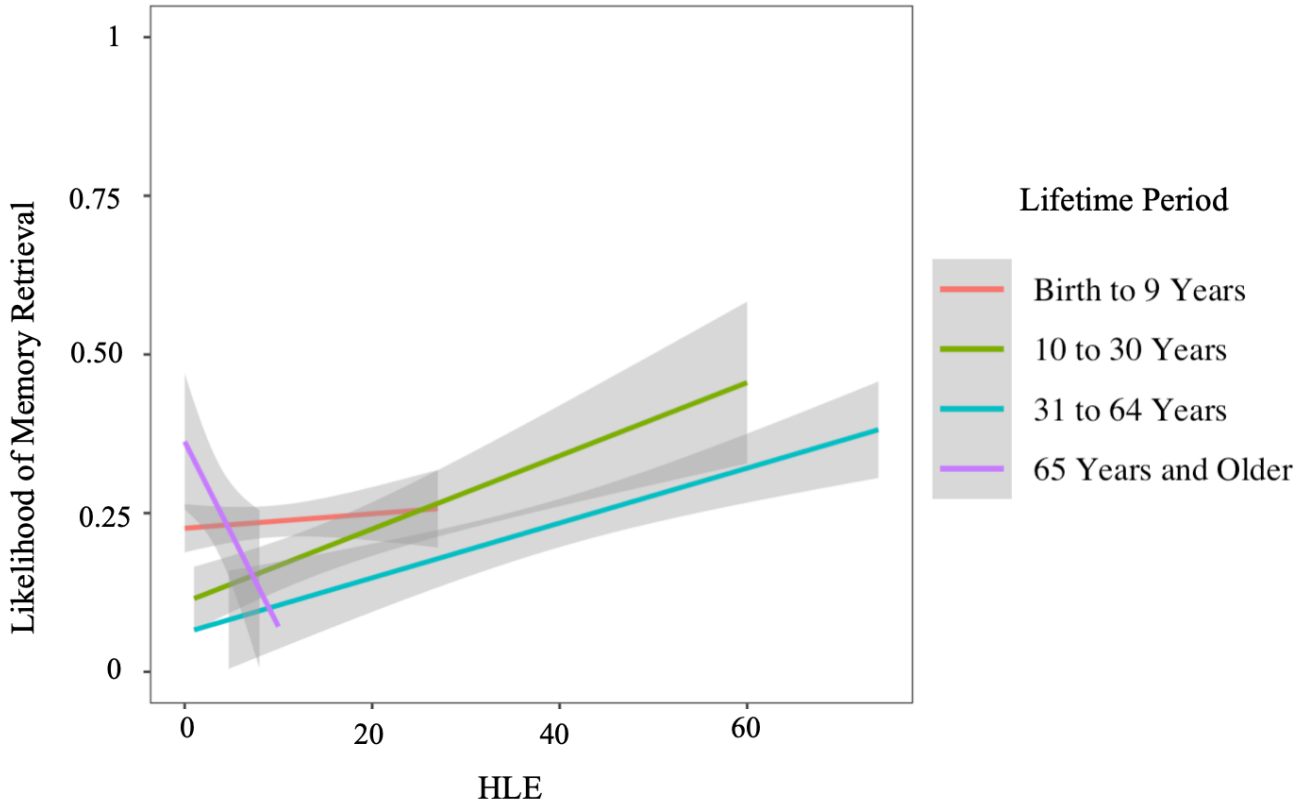
(M = 0.25, CI = [0.19, 0.31], $p < .05$), coinciding with the reminiscence bump. We also observed a main effect of HLE, $F(1, 267.87) = 4.22$, $p < .05$, indicating that longer potential exposure to stimuli in the real world was associated with a greater likelihood of retrieving a memory. There was not a significant difference in the likelihood of memory retrieval between modalities ($p > .05$ for all three comparisons).

An interaction of HLE and lifetime period also emerged, $F(3, 253.17) = 5.06$, $p < .001$ (Figure 3.10). Memories were more likely to be retrieved for advertisements that participants were exposed to for a longer amount of time and were aired when participants were 31 to 64 years of age or 65 and older. However, less exposure time was predicted greater likelihood of memory retrieval for advertisements from participants' childhood (birth to 9 years).

Autobiographical memory retrieval predicted by personal importance. We tested our hypothesis that participants would retrieve more memories for personally meaningful products using a one-way ANCOVA model that predicted likelihood of reminiscence using subjective ratings of personal importance for the advertised brands or products with five levels: not at all, very little, somewhat, fairly strongly, and very strongly. We observed an effect of the familiarity covariate, $F(1, 246.99) = 4.122$, $p < .05$, and personal importance of the advertised product or brand, $F(4, 235.76) = 47.11$, $p < .001$. Products rated as more personally important were more likely to evoke an autobiographical memory than less personally important products, and all possible contrasts were significant ($p < .05$) except for items rated as very personally important compared to fairly personally important (Figure 3.11).

Figure 3.10

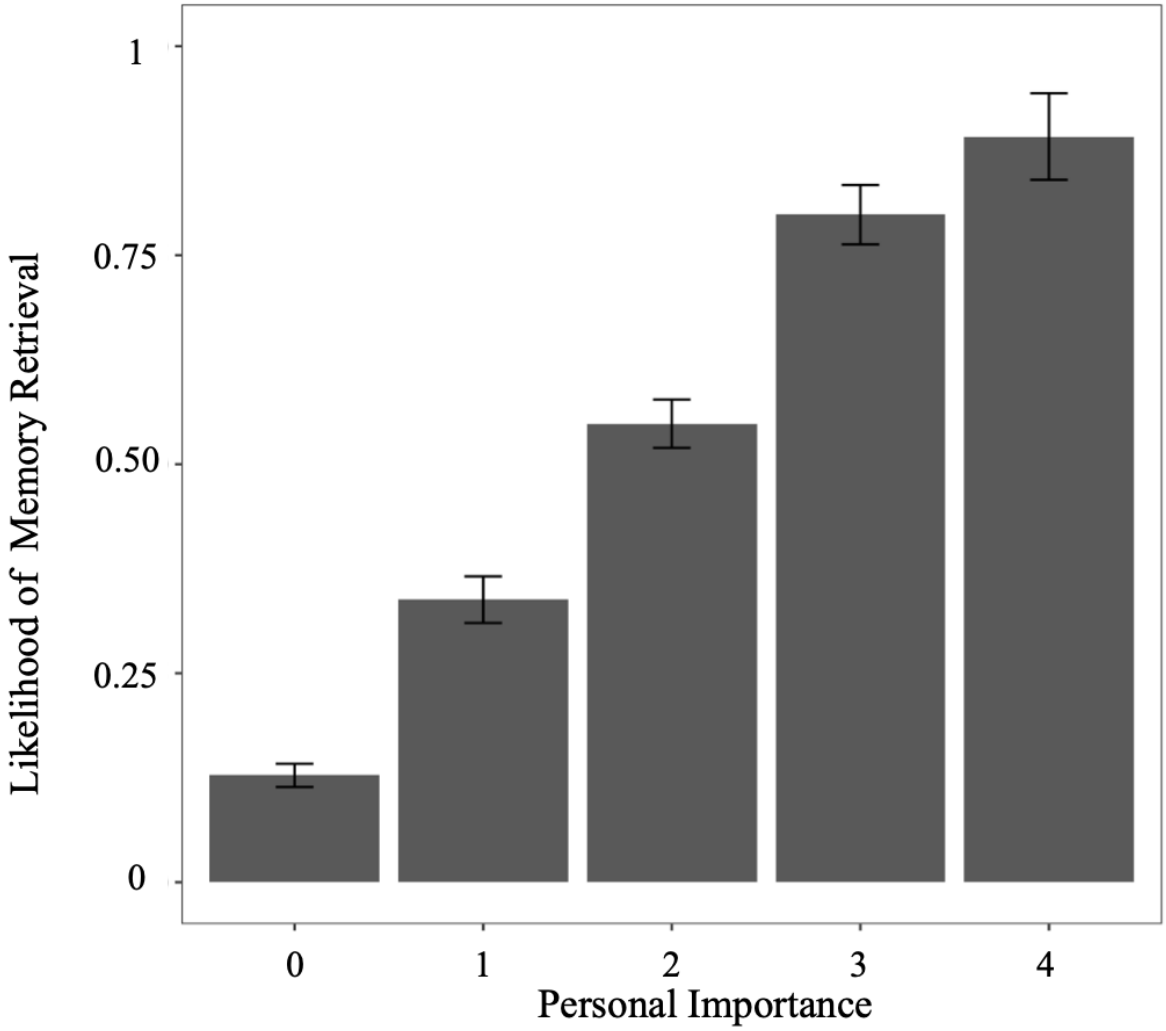
Autobiographical memory retrieval predicted by lifetime period and HLE



Note. Data points are fit with regression lines featuring 95% confidence intervals.

Figure 3.11

Autobiographical memory retrieval predicted by personal importance



Note. Error bars represent one standard error from the mean.

Autobiographical memory retrieval predicted by nostalgia-proneness and nostalgia ratings. A two-way ANCOVA model was used to test whether nostalgia ratings for the advertised products and brands predicted autobiographical memory retrieval. Nostalgia ratings consisted of five levels: Not at all, Very little, Somewhat, Fairly strongly, and Very strongly. Nostalgia-proneness was also included as a fixed effect in this model to account for the

contribution of trait-level nostalgia ratings in the study. As noted earlier, nostalgia-proneness was a continuous score based on participants' responses to the Southampton Nostalgia Scale (Routledge et al., 2008). We observed a main effect of nostalgia ratings after controlling for familiarity and duration, $F(1, 247.36) = 3.96$, $p < .01$, such that higher nostalgia ratings were associated with a greater likelihood of memory retrieval (Figure 3.12).

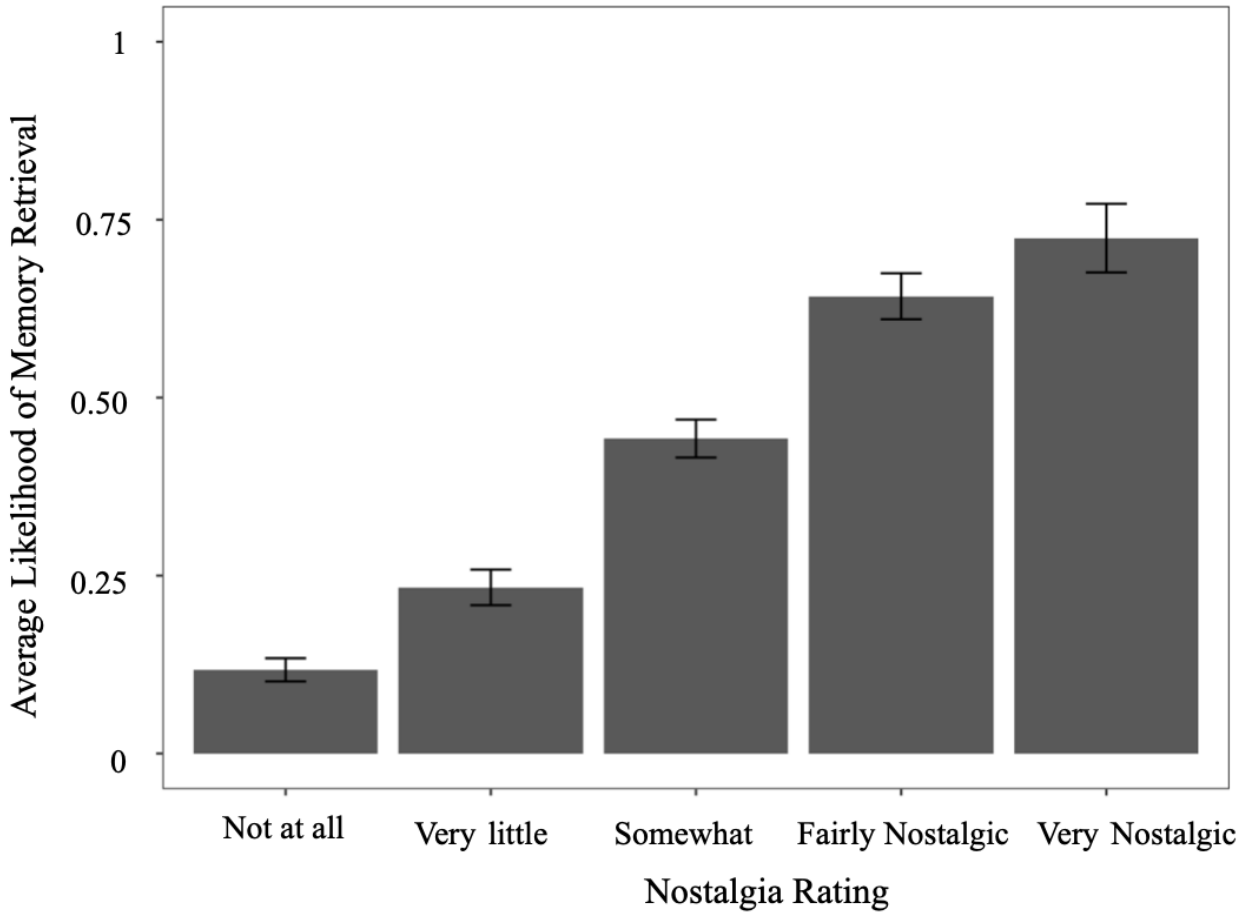
Ratio of internal memory details predicted by age and nostalgia. A two-way ANCOVA model was used to test our hypothesis that older adults would provide fewer episodic details, and more nostalgic stimuli would prompt the retrieval of more event-specific autobiographical details among older adults in particular. The dependent variable consisted of the ratio of internal-to-total details which served as an unbiased measure of vivid episodic memory retrieval (see Table 3.3 for descriptive statistics for each scoring category). The categorical predictors were age and nostalgia for the advertised product.

We observed a main effect of age on the ratio of internal-to-total details after controlling for familiarity, $F(1, 102.31) = 19.36$, $p < .001$. Namely, young adults ($M = 0.15$, $CI = [0.11, 0.18]$) provided memories that featured a higher proportion of internal-to-total details compared to older adults ($M = 0.03$, $CI = [0.01, 0.05]$, $p < .001$). Nostalgia ratings for the advertised products also predicted the ratio of internal-to-total details after controlling for familiarity, $F(4, 171.44) = 3.69$, $p < .01$. Higher nostalgia ratings were associated with the inclusion of more episodic memory details. There was also an interaction of age and nostalgia for the advertised products after controlling for familiarity, $F(4, 167.75) = 3.73$, $p < .01$. Older adults provided fewer internal details ($M = 0.01$, $CI = [-0.10, 0.11]$) than young adults ($M = 0.34$, $CI = [0.23, 0.46]$, $p < .001$) for products rated as not nostalgic and somewhat nostalgic ($M_{\text{Older adults}} = 0.06$, $CI_{\text{Older adults}} = [0.01, 0.12]$, $M_{\text{Young adults}} = 0.17$, $CI_{\text{Young adults}} = [0.11, 0.24]$, $p < .05$). However, there

was no difference in the ratio of internal details provided by both age groups for more nostalgic products ($p > .05$).

Figure 3.12

Autobiographical memory retrieval predicted by nostalgia ratings for advertised products and brands



Note. Data points are fit with regression lines featuring 95% confidence intervals. Lines of different colors reflect the different levels of endorsement provided in response to the statement: "The advertised product typically makes me feel nostalgic".

Table 3.3

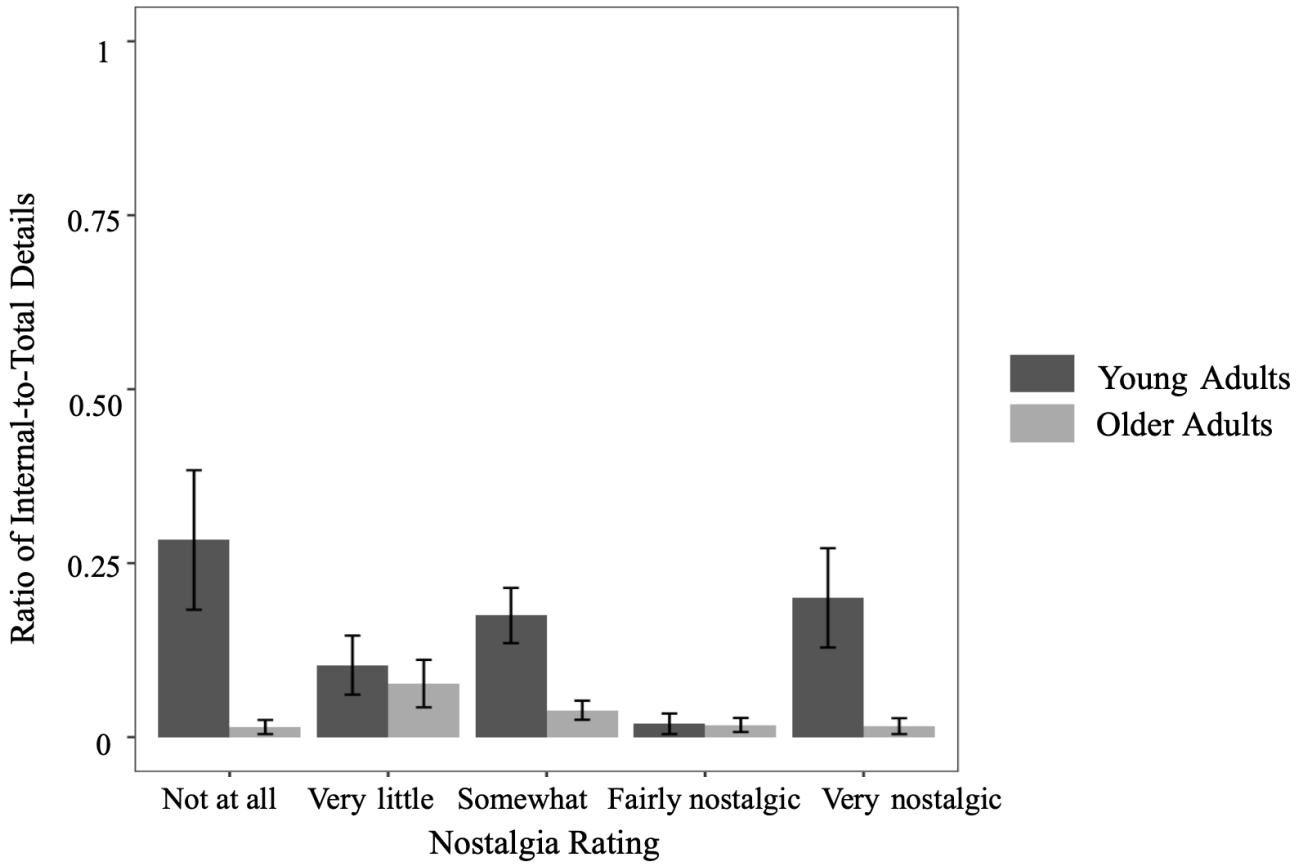
Average number of details and range of each memory scoring category

Scoring Category	Mean (SD)	range
Internal Details	0.32 (0.98)	0-7
External Details	1.63 (1.37)	0-9
LTP and GRE details	0.93 (1.06)	0-4

Although no differences emerged among older adults ($p > .05$), young adults provided a higher proportion of internal details for products that they rated as not at all nostalgic (M = 0.28, CI = [0.19, 0.36]) compared to items rated as very little (M = 0.10, CI = [0.02, 0.18], $p < .05$) or fairly nostalgic (M = 0.01, CI = [0.05, 0.06], $p < .001$). Fairly nostalgic products (M = 0.01, CI = [0.05, 0.06]) were also associated with a larger ratio of internal details compared to products that were rated as somewhat nostalgic (M = 0.17, CI = [0.11, 0.22], $p < .001$). However, items that young adults rated as very nostalgic (M = 0.19, CI = [0.11, 0.27]) were associated with a higher proportion of internal details than products rated as somewhat nostalgic (M = 0.17, CI = [0.11, 0.22], $p < .01$; Figure 3.13). Post hoc pairwise comparisons for age groups reflected that older adults (OA) provided a lower proportion of internal details than did young adults (YA) for stimuli that were rated as not at all nostalgic (OA: M = 0.00, CI = [-0.06, 0.07]; YA: M = 0.28, CI = [0.19, 0.36], $p < .001$), somewhat nostalgic (OA: M = 0.04, CI = [0.00, 0.07]; YA: M =0.17, CI = [0.11, 0.22], $p < .001$), and very strongly nostalgic (OA: M = 0.00, CI = [-0.05, 0.06]; YA: M = 0.19, CI = [0.11, 0.27], $p < .001$) (Figure 3.13).

Figure 3.13

Ratio of internal-to-total details predicted by age and nostalgia ratings for advertised products



Note. Error bars represent one standard error from the mean. The x-axis features endorsements for the statement "The advertised product or brand typically makes me feel nostalgic" (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4= Very strongly).

Ratio of external memory details predicted by age. A one-way ANCOVA model was used to test our hypothesis that older adults would provide fewer episodic details and more external details compared to young adults. The ratio of external-to-total details was used as an unbiased measure of the amount of semantic information or details provided that were external to the main episodic event. Age was used as the categorical predictor for this dependent variable.

We observed a main effect of age, $F(1, 93) = 26.28$, $p < .001$, such that autobiographical memories provided by older adults featured a larger ratio of external-to-total details (M = 0.65, CI = [0.58, 0.73]) than did autobiographical memories provided by young adults (M = 0.43, CI = [0.28, 0.34, 0.51], $p < .001$).

Frequent terms and memory length for each age group and modality. Older adults contributed a majority (70%) of the 481 total memories provided in this study and young adults provided the remaining 30% of memories. Following the removal of stop words (e.g., "the", "is", "are"), we found that older adults provided an average of 7.04 words per memory (range = 1 to 31, SD = 5.44) and young adults provided an average of 11.94 words per memory (range = 1 to 39, SD = 7.6). We then examined the most frequently provided words for each age group (counts are listed in brackets). Older adults used the words "remember" [70], "eat" [34], "drink" [30], "young" [30], "family" [29], "friends" [26], and "children" [25] most frequently. Young adults used the words "remember" [47], "school" [29], "eat" [29], "cereal" [25], "mom" [22], "time" [22], and "kid" [21] most frequently.

Modality was another primary variable of interest in this work so the word count and most frequently used terms for each modality are also provided in this section. However, since participants were told which product and company were advertised before they were asked to provide a memory, we acknowledge the potential confounds introduced by the study design with respect to memory retrieval and content. As noted in the *Discussion* section below, the findings reported here and throughout this chapter provide a preliminary look at the trends that may exist with respect to modality and memory. However, follow-up studies or an adapted version of this paradigm featuring memory retrieval prior to being told which items were advertised can shed

light on how robust these trends are and to what extent they are truly driven by the stimulus modality.

We found that 27% percent of autobiographical memories were provided following exposure to an auditory stimulus, 38% of memories were provided following the presentation of a visual stimulus, and 35% of memories were provided after participants were presented with a verbal stimulus. Following the removal of stop words (e.g., “the”, “is”, “are”), an average of 8.87 words per memory were provided following exposure to an auditory stimulus (range = 1 to 34, SD = 6.61), an average of 7.85 words per memory were provided following exposure to an visual stimulus (range = 1 to 39, SD = 6.35), and an average of 8.94 words per memory were provided following exposure to a verbal stimulus (range = 1 to 33, SD = 6.7).

We then examined the most frequently provided words for the memories provided following exposure to stimuli from each modality (counts are listed in brackets). Memories provided after the presentation of an auditory stimulus featured the words “remember” [40], “school” [16], “commercial” [14], “eat” [14], “jingle” [11], “time” [11], “family” [10], and “kid” [10] most frequently. Memories provided after the presentation of a visual stimulus featured the words “remember” [34], “eat” [24], “family” [20], “buy” [16], “time” [15], “young” [15], and “cereal” [14] most frequently. Memories provided after the presentation of a verbal stimulus featured the words “remember” [43], “eat” [23], “friends” [18], “drink” [16], “family” [16], “cereal” [15], “kool” [15] (either referring to Kool Aid or Kool cigarettes), and “time” [15] most frequently.

Average number of social references predicted by modality and age. Approximately 49% of the autobiographical memories featured at least one reference to another person. Moreover, the descriptive statistics provided for the memory reports at the beginning of the

"Analyses and Results" section reflected that social terms such as "kid", "mom" and "friend" were frequently used by participants from both age groups. Thus, we were motivated to examine whether the number of social details provided by participants could be predicted by age and modality. We constructed a two-way ANCOVA with modality and age as categorical predictors of the number of social references for this exploratory analysis. We observed a main effect of age, $F(1, 93) = 13.03$, $p < .001$, such that young adults provided more references to social entities ($M = 0.85$, $CI = [0.66, 1.03]$) than did older adults ($M = 0.43$, $CI = [0.26, 0.59]$, $p < .01$); there was no effect of modality or the interaction of age and modality ($ps > .05$).

Affective Ratings. Emotion ratings were collected and analyzed in this section in response to three sources. First, if participants indicated that the advertisement they were presented with was at least moderately familiar, they were asked to rate how happy, sad, and nostalgic the stimulus typically makes them feel as well as how personally meaningful or important it is to them (0 = Not at all, 1 = Very little, 2 = Somewhat, 3 = Fairly strongly, 4 = Very strongly). Participants were then told the correct product and company name for the presented advertisement. If they indicated that the advertised product or brand was at least moderately familiar, they were subsequently asked to rate how nostalgic, happy, and sad the *advertised product or brand* makes them feel as well as how personally meaningful or important it is to them using the aforementioned five-point Likert scale. Lastly, if participants provided an autobiographical memory in response to the advertised product or brand, they used the same scale to rate how happy, sad, and nostalgic the memory makes them feel.

Since certain ratings were collected when a minimum threshold was met (e.g., moderate familiarity or association with an autobiographical memory), the number of trials differed in the models for some dependent variables. Namely, statistical models predicting emotion ratings for

the advertisements were tested using a subset of 961 trials, statistical models predicting emotion ratings for the advertised product or company featured 1334 trials, and statistical models predicting emotion ratings for the memories featured 481 trials out of a total of 2146 trials.

Happiness ratings for memories predicted by age. In line with the positivity effect (Carstensen & Mikels, 2005), we used age as a categorical predictor in a one-way ANCOVA to test our hypothesis that older adults would provide more positive memories than young adults. However, none of the variables predicted subjective happiness ratings for autobiographical memories, (ps > .05).

Nostalgia for the advertised product predicted by personal importance and product category. We constructed a one-way ANOVA that predicted personal importance ratings with a fixed effect of product category consisting of five levels: Tobacco & Alcohol, Consumables, Nonconsumables & Services, Technology & Entertainment, Child & Toddler Products. The familiarity covariate for this model only consisted of two levels (Moderately familiar and Very familiar) since participants had to report that the advertised item was at least moderately familiar in order to rate it on other attributes related to the advertised brand or product (e.g., nostalgia or personal importance).

We observed an effect of the familiarity covariate, $F(1, 507.48) = 4.97$, $p < .05$, in addition to a main effect of personal importance after controlling for familiarity, $F(4, 472.47) = 57.90$, $p < .001$, such that higher ratings of personal importance were associated with greater subjective nostalgia for the advertised product. Tobacco & Alcohol products (M = 2.54, CI = [2.54, 3.03]) received lower nostalgia ratings than Child & Toddler Products (M = 3.37, CI = [3.09, 3.65], $p < .01$), Consumables (M = 3.20, CI = [3.06, 3.34], $p < .01$), and Nonconsumables & Services (M = 3.35, CI = [3.01, 3.68], $p < .05$).

Affective ratings for advertisements predicted by HLE. Three linear regression models were constructed to test our hypothesis that participants would provide stronger affective ratings for advertising campaigns that they were exposed to for longer periods of time. Each model featured HLE as a continuous predictor for happiness, sadness, or nostalgia ratings associated with the advertisement. We observed an effect of the familiarity covariate on happiness, $F(1, 106) = 5.81$, $p < .05$, and sadness ratings, $F(1, 106) = 29.15$, $p < .001$. How long participants were exposed to an advertisement did not predict affective ratings (ps > .05).

Discussion

Semantic Memory

As hypothesized, visual stimuli prompted the retrieval of more correct semantic knowledge for advertising stimuli across all participants, compared to auditory and verbal stimuli. The static yet distinct nature of logos may have made them easier to retain and remember across longer spans of time, compared to slogans which can often be vague (Example: Ford's "Drive one") and harder to distinguish from one another (Example: Chevrolet's slogan "Like a rock" and Prudential's slogan "Get a piece of the rock"). Our visual stimuli might also have been the most consistently used unimodal advertisement *across* various campaigns for the same company, which would make them more familiar and easier to retain compared to auditory and verbal stimuli. For instance, prior work has shown that although music is frequently used in advertisements and commercials, consistent musical motifs are not often used across campaigns (Sutherland & Sylvester, 2000). Future research should take this factor into account when examining differences between modalities.

We also examined how age affects semantic recall in order to determine whether older adults provided as many correct semantic details as young adults based on existing findings regarding the preservation of semantic memory for individuals later in the lifespan (e.g., Levine et al., 2002; Piolino et al., 2002), with older adults performing within the young adult range on semantic memory tasks (Craik & Jennings, 1992; Park, 2000). Indeed, we did not observe a significant difference between older and younger adults in the retrieval of semantic information, which supports previous work on aging and semantic memory.

Based on prior findings of enhanced short-term and delayed semantic memory recall for more emotionally arousing television commercials (Friestad & Thorston, 1985; Friestad & Thorston, 1986), we expected more emotional advertisements to prompt better long-term semantic memory compared to less emotional advertisements. However, emotional ratings did not predict semantic recall in this study. This particular result may have been a by-product of the study design. Participants were prompted to provide subjective affective ratings in response to the stimuli in this study by being asked to rate how happy, sad, or nostalgic each advertisement typically makes them feel. A caveat of this approach is that these ratings were based on personal experiences with the stimuli, as opposed to an objective appraisal of how each advertisement might be generally perceived with respect to various emotional dimensions. As a result, we could not disentangle the extent to which the emotional outcomes in this study were due to their personal associations as opposed to the more general emotional appraisals typically employed in studies on memory recall for emotional advertisements (e.g., Friestad & Thorston, 1985; Friestad & Thorston, 1986). Future studies should seek to explore the differences in memory for subjective and objective emotion ratings for advertisements or other tightly matched unimodal comparisons. Additional research should also be conducted to determine whether memory

retrieval and content are differentially affected by the emotions resulting from personal experiences, compared to second-hand or vicariously formed associations, in order to better understand the relationship between memory and emotion.

Another factor that was associated with better semantic memory performance across all participants was mental imagery. Notably, whereas Study 1 solely examined auditory imagery (imagining the jingle associated with an advertisement) and how effortful this process was, Study 2 expanded imagery to the visual and verbal modalities and focused on the *vividness* of this experience. Involuntarily imagining the advertisements for the other two modalities associated with an advertising campaign was associated with the retrieval of more semantic details. This was particularly true for advertisements that prompted more vivid imagery during the experiment. These results build on our findings from Study 1 to demonstrate that auditory imagery is not unique in its ability to help retrieve semantic knowledge. Having multiple perceptual anchors, regardless of the imagined modalities, provides more opportunities to bind the associated semantic information and reinforce these connections over time, thereby aiding long-term semantic memory retrieval (Nadel & Moscovitch, 1997; Nadel et al., 2000). This work also supports previous findings from consumer psychology studies based on the dual-coding hypothesis (Paivio, 1969; Paivio, 1971) which reported better recall and recognition for concrete brand names that evoke visual imagery, compared to more abstract words (Robertson, 1987).

We also explored how active engagement with the advertised products affects semantic recall by using how frequently the advertised product was used or purchased by participants as a predictor. Indeed, we found that semantic memory was better for products that participants purchased or used more frequently. These results support previous findings in the memory literature demonstrating that frequent exposure to a stimulus increases familiarity and subsequent

recall of that item (Krishnan & Shapiro, 1996; Mandler, 1979; Obermiller, 1985; Hintzman, 1970; Underwood, 1969) and increases the likelihood that associations with the item will be stored in long-term memory (e.g., Craik & Lockhart, 1972).

Autobiographical Memory Retrieval

Although we did not observe a main effect of modality for memory retrieval, we found that visual stimuli were more likely to evoke an autobiographical memory compared to auditory stimuli among older adults. Moreover, older adults were more likely to provide an autobiographical memory in response to visual stimuli, compared to young adults. This visual advantage among older adults contributes to existing work on autobiographical memory retrieval for meaningful nostalgic experiences evoked by visual advertising cues, such as product packaging (Ryynänen, Joutsela, & Heinonen, 2016). It is also a promising result for identifying additional visual stimuli, aside from product advertisements, for use in therapeutic interventions to uniquely facilitate autobiographical memory retrieval across the lifespan and mitigate the effects of aging.

Nostalgia ratings for the advertised products and brands were also used to predict autobiographical memory retrieval. Indeed, higher nostalgia ratings were associated with a greater likelihood of memory retrieval. This finding supports prior research which has reported that nostalgia accompanies autobiographical memories (e.g., Batcho, 2007; Leboe & Ansons, 2006; Sedikides et al., 2008; Wildschut et al., 2006). Future work should further investigate this relationship between nostalgia and reminiscence to examine how the induction of this past-oriented emotion may enhance autobiographical memory encoding and increase memory retrieval for clinical purposes, as well as consumer and marketing applications. We also sought to extend the results on nostalgia-proneness and familiarity from Studies 1 and 2 to see if this

trait affects autobiographical memory retrieval. As hypothesized, we found that individuals who are more prone to nostalgia were more likely to retrieve a memory. This supports prior findings that nostalgia-proneness increases the tendency to recall nostalgic experiences (Havlena & Holak, 1991) and suggests that more nostalgic individuals retain and retrieve autobiographical details better than less nostalgic individuals.

We also found that more active interaction with the product, represented by regularly using or purchasing the advertised brands and products, was associated with a greater likelihood of providing an autobiographical memory in the study. This result may have been driven by increased opportunities to form personal connections with the advertised brands and products by regularly purchasing them, akin to the role of *involvement* or the perceived personal importance and interest in a stimulus (Antil, 1984; Andrews, Durvasula, & Akhter, 1990). Greater consumer involvement is thought to yield more motivation for individuals to attend to advertisements about those products and spend more cognitive effort processing the information (Petty & Cacioppo, 1984). This could, in turn, make those advertisements and advertised products more memorable over time, and render the associated memories more readily available.

The subjective importance of the advertised product or brand also predicted autobiographical memory retrieval, such that advertisements for products that were rated as more personally meaningful were more likely to evoke an autobiographical memory than less personally important products. This finding supports previous research on the role of personal importance in the retrieval of nostalgic memories (Barrett et al., 2010). It also reflects the formative role that identification with the brand or product plays in the retention and retrieval of associated autobiographical memories.

The lifetime period during which each stimulus aired interacted with the potential length of exposure to each stimulus to predict autobiographical memory retrieval. Namely, memories were more likely to be retrieved for advertisements that participants were exposed to for a longer amount of time and that were aired when participants were 31 to 64 years of age or 65 and older. As noted for the nostalgia ratings in Study 1, this effect was likely driven by a bias among participants who fit the age groups that would have received stimuli for these two lifetime periods (middle-aged adults and older adults). As noted earlier, this analysis was performed using modified lifetime periods which better matched the typical division of lifetime periods with respect to the reminiscence bump. Given the resulting mismatch between the lifetime periods used for stimulus presentation (6 to 16 years, 17 to 30 years, 31 to 64 years, and 65 years and older) and stimulus analysis (birth to 9 years, 10 to 30 years, 31 to 64 years, and 65 years and older), we recommend approaching these findings as preliminary results which would ideally be confirmed with a modification of our procedure to account for this discrepancy.

An examination of how product category affects autobiographical memory retrieval would clarify whether certain types of products serve as more robust memory cues or perhaps memories for different products are more resilient to the cognitive effects of aging and more readily retrieved over time. Indeed, the appearance of keywords related to food in our memory reports provides evidence that advertisements related to consumable products, especially ones that are targeted toward youth, such as candy and cereal, may serve as particularly strong autobiographical memory cues. Given the limited amount of data available for the autobiographical memories in this study, it did not seem reasonable for us to break the data up further into a comparison of product categories. However, future research should explore this further using an even distribution of advertisements across various product categories.

Autobiographical Memory Content

Following our examination of memory retrieval, we analyzed the content of the autobiographical memories to better understand how they are affected by modality, age, nostalgia, and other exploratory factors. This descriptive linguistic analysis demonstrated that approximately 23% of trials featured a memory, and most of these memories were provided by older adults. The most frequently provided terms were examined for the memories provided by each age group and following exposure to each modality. Unsurprisingly, the most frequently used word in each experimental condition was "remember". Indeed, this act of reminiscence often prompted participants from both age groups to reminisce about their childhood or their children's youth, reflected by the frequent use of "time", "children", and "kid" among both age groups. Modality-specific words also emerged following exposure to auditory, visual, and verbal stimuli. For instance, the word "jingle" was featured in the top 10 most frequent terms for memories provided after exposure to auditory stimuli. In comparison, memories provided following exposure to visual and verbal stimuli were related to specific products (e.g., "cereal" for the visual modality and "kool" for the verbal modality, referring to Kool Aid or Kool cigarettes).

Nearly half of all the autobiographical memories featured at least one reference to another person. Moreover, social terms such as "kid", "mom" and "friend" were frequently used by participants from both age groups. Follow-up analyses showed that young adults provided more references to social entities than did older adults. This result demonstrated the power of advertisements and products to activate representations of ourselves in relation to others and reminisce about the past. Social references in the memories ranged from treasured rituals, like

separating the marshmallows in Lucky Charms with parents, to vivid memories of adolescent awkwardness while interacting with members of the other sex during a game of Twister.

We expected to see more social references in memories evoked by jingles since we often experience music with others and it is known to play an important role in our social interactions across the lifespan (Juslin & Sloboda, 2011) as well as the associations we form for significant people, places, and self-defining periods of our lives (Janata et al., 2007; Schulkind et al., 1999; Cady et al., 2008). However, none of the modalities evoked more social details than the others. Again, this may have been a byproduct of the study design and asking participants to reminisce after being told which product and company were advertised. Future work should further examine the specific individuals who were mentioned in memories evoked by different modalities, such as the proportion of romantic partners mentioned versus family and friends or acquaintances. Examining which social and relational figures are mentioned by participants in each condition and how frequently they are mentioned can serve as a window into the personal connections we make and retain with brands. Namely, this form of analysis could provide greater insight into how we come to define ourselves through social interactions and personal rituals featuring these products.

We also used the unbiased measures of internal-to-total ratio, external-to-total ratio, and LTP/GRE-to-total ratio in order to examine the types of memories provided by each age group and following exposure to each modality. As predicted, autobiographical memories provided by older adults featured a larger ratio of external-to-total details, indicating more semantic and external memory content. Young adults also provided memories that featured a larger ratio of internal-to-total details compared to older adults, reflecting more episodic reminiscence. In tandem, these results support existing findings of older adults providing fewer episodic details

and more external details than young adults (St. Jacques & Levine, 2007; Singer, Rexhaj, & Baddeley, 2007; Levine et al., 2002; Craik & Jennings, 1992; Park, 2000). However, it is worth noting that unlike other prominent memory retrieval paradigms which prompt reminiscence using guided interviews with progressively specific memory probes to encourage participants to provide as much detail as possible (e.g., Autobiographical Interview; Levine et al., 2002), we used a more naturalistic approach to preserve the involuntary nature of reminiscence. A caveat of this approach is that participants provided a relatively small amount of details per memory ($M_{\text{Details per memory}}$ = 3.51, SD = 2.25, range = 0 to 15), which may have driven the effects we observed. A comparison of modality and age group would be more fruitful for longer memories featuring more details.

Modality did not predict the ratio of internal-to-total details provided, but this finding supports previous results from Belfi and colleagues (2016) who also found no difference in the number of internal details provided in memories evoked by auditory (Billboard Top Pop Charts) and visual (famous faces) stimuli. Moreover, our inclusion of tightly matched verbal advertisements allowed us to examine this phenomenon through a comparison of three different modalities, rather than solely comparing visual and auditory musical stimuli. However, this null result may also have been an outcome of our study design. Participants were provided with the correct company and product for each advertisement prior to retrieving an autobiographical memory, and this could have been sufficient for prompting autobiographical reminiscence. We recommend collecting autobiographical narratives prior to providing the correct answer in future related studies in order to avoid this confound and more clearly parse the effect of modality. If we were to replicate this study in the future, we would randomly assign participants to either receive the semantic memory questions before the episodic questions or vice versa. This

counterbalancing would help us disentangle whether the semantic questions and subsequent responses affected participants' autobiographical memory recall. We would also collect data from more subjects to have a more robust data set for analysis and to help ensure that we sampled from a sufficiently diverse subject pool with respect to memory recall in both age groups.

Although older adults have been shown to retrieve fewer episodic memory details (St. Jacques & Levine, 2007; Singer, Rexhaj, & Baddeley, 2007; Levine et al., 2002; Craik & Jennings, 1992; Park, 2000) and more overly general memories (Piolino, Desgranges, & Eustache, 2009; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Ford, Rubin, & Giovanello, 2014) compared to young adults, they have also been found to respond more strongly to emotional stimuli (Mather & Carstensen, 2005; Carstensen & Mikels, 2005; Kennedy, Mather, & Carstensen, 2004; Levine & Bluck, 1997; Comblain et al., 2005; Berntsen & Rubin, 2002; Schulkind, Hennis, & Rubin, 1999; Zator & Katz, 2017; Banaji & Hardin, 1994; Bower, 1981; Christianson & Safer, 1996; Conway, 1990; Pillemer et al., 1996; Revelle & Loftus, 1990; Thompson et al., 1996; Wagenaar, 1986). Thus, we examined whether nostalgia for the advertised product or brand prompted greater episodic details in older adults.

An interaction of age and nostalgia for the advertised products demonstrated that although young adults provided a higher ratio of internal details than older adults for products with low nostalgia ratings, the ratio of internal details did not differ between these two age groups for more nostalgic products. In other words, nostalgia for the advertised product was associated with the retrieval of more internal details among older adults which mitigated the observed age difference in the retrieval of episodic details. Future research can build on these

findings by manipulating nostalgia for products to examine whether it causes the retrieval of more episodic internal details among older adults.

Affective Ratings

Based on the well-documented positivity effect (Carstensen & Mikels, 2005; Field, 1981; Kennedy, Mather, & Carstensen, 2004; Reed & Carstensen, 2012; Levine & Bluck, 1997; Schlagman, Schulz, & Kvavilashvili, 2006), we examined how age affected emotion ratings for the autobiographical memories provided by participants. However, contrary to previous studies which reported that older adults provide more positive memories than young adults, we did not find an effect of age in this study. This surprising result may have been a result of data collection during the ongoing pandemic, which was particularly disruptive and depression-inducing for older adults due to factors such as long-term social isolation (Li & Huynh, 2020; Armitage & Nellums, 2020). A depressed state could have primed older adults in our study to retrieve fewer happy memories as a form of mood congruent memory (Lewis et al., 2005; Barry et al., 2004) and subsequently flatten previously documented age effects. Providing a mood survey (e.g., PANAS; Watson, Clark, & Tellegen, 1988) to gauge participants' emotional and mental state prior to participation would have provided more insight into this effect and help assess whether the inferred emotional state changes during this period (e.g., increased nostalgia and sadness) affected the observed results. We recommend adding this step for future iterations of this work.

We also examined how potential length of exposure to advertisements (HLE) affected emotion ratings for our stimuli across all participants. However, the three affective ratings we examined were not predicted by potential exposure time. We expected that longer exposure to advertisements would increase the likelihood of forming personally meaningful connections and positive experiences with them, thereby rendering them as more valuable and nostalgic over

time, in line with prior results featuring advertised products and brands (Keller, 1993; Merchant & Ford, 2008). This null result could have been an outcome of the stimuli in this study receiving lower affective ratings in general ($M_{affective\ rating} = 1.74$, SD = 1.22, range = 0-4). Perhaps we would have observed an effect if more emotionally evocative advertisements were used as stimuli in this study.

As expected, ratings of personal importance were positively associated with subjective nostalgia for the advertised product. Advertisements for certain product categories also received higher nostalgia ratings. Namely, advertisements for Child & Toddler products, Nonconsumables, and Consumables & Services received higher subjective nostalgia ratings than Tobacco & Alcohol products. These results indicate that participants may associate more personal memories and treasured experiences with these products, and they can be used to successfully trigger nostalgia in future work.

Lastly, we examined the effects of modality and lifetime period on nostalgia ratings based on findings that stronger emotional ratings are provided for popular music from listeners' youth (Schulkind, Hennis, & Rubin, 1999). Although we predicted that auditory advertisements which aired during the period coinciding with the reminiscence bump (10 to 30 years of age; Rubin & Schulkind, 1997) would evoke higher subjective ratings of nostalgia for the advertised brand or product, no significant predictors emerged. This demonstrates that although much of the literature on nostalgia draws from events encountered during childhood or youth, this complex emotional experience is not exclusive to that time period and future research should seek to better understand the temporal trajectory of nostalgia across the lifespan.

Summary

Study 2 provided insight into semantic and episodic memory for naturalistic stimuli (product advertisements) repeatedly presented across the lifespan and examined the effects of modality and age on memory in a nuanced manner that expanded upon previous research on semantic memory for television advertisements. For instance, whereas Friestad and Thorston (1985, 1986) used cross-modal advertisements to study undergraduate students' retrieval memory, we implemented unimodal (auditory, verbal, & visual) stimuli in order to differentiate and compare the role of various modalities for this purpose. Moreover, we collected responses from older adults (65 to 76 years of age), as well as younger adults, to study how age affects the retention and retrieval of personal and semantic memories associated with advertisements across the lifespan. Lastly, we examined long-term memory extending far beyond eight weeks following exposure (Friestad & Thorston, 1986) to reflect our experiences with advertising stimuli in a more realistic manner by including items that were repeatedly encountered from one year ago up until 68 years ago.

Contrary to our expectations, auditory musical stimuli did not serve as superior memory retrieval cues. Although jingles represent auditory and musical stimuli in this work, they might not have affected listeners in the same exact manner as songs and, therefore, would not prompt the same patterns of memory recall as previously observed for music-evoked memories (e.g., Bartlett & Snelus, 1980; Cady, Harris, & Knappenberger, 2008; Schulkind, Hennis, & Rubin, 1999; Janata, et al., 2007; Belfi, Karlan, and Tranel, 2016). For instance, consumers and listeners do not play the Kit Kat jingle when they want to amp themselves up and change their mood or reminisce about the past in the same way that they might play music by Drake or Nina Simone. Additional research that directly compares jingles to pop songs could provide additional insight

into the similarities and differences between these two forms of musical stimuli, how they affect reminiscence and nostalgia across the lifespan, and how they might become integrated into one's identity. Study 2 also contributes to existing findings regarding aging and memory retrieval. Consistent with previous findings, we reported that young adults provided more internal details and fewer external details than older adults, and the number of semantic details retrieved by older adults did not significantly differ from young adults.

CHAPTER IV

CONCLUSION

The present work aimed to identify whether music uniquely facilitates memory retrieval and subjective nostalgia across the lifespan compared to other modalities. Contrary to our original hypotheses, musical stimuli were not rated as more familiar than verbal and visual stimuli, and music did not have a significantly greater effect on autobiographical memory retrieval than the other modalities in this work. However, our initial hypothesis was partially supported by the result that young adults rated auditory stimuli as more familiar than verbal stimuli, indicating a potential auditory advantage among this age group. We also found that, consistent with existing research on nostalgia for music (e.g., Barrett et al., 2010; Routledge et al., 2011), musical advertising stimuli were rated as more nostalgic than visual and verbal stimuli. This finding supports the use of jingles over logos and slogans to create meaningful and memorable bonds between consumers and products--especially in light of a recent decline in the use of jingles in advertisements (Taylor, 2012).

Overall, we found that advertisements for visual stimuli were rated as more familiar than verbal and auditory stimuli across all age groups as well as within each age group in Study 1. In tandem with the semantic memory advantage observed for visual stimuli in Study 2, these results suggest that visual stimuli could serve as a promising candidate for enhancing long-term semantic memory and the accuracy of recognition memory across the lifespan. Moreover, these findings suggest that therapeutic interventions and memory aids geared toward healthy older adults could benefit from integrating more visual cues and providing important reminders through this modality.

In Study 2, we found that, consistent with previous results from studies on aging and memory, the number of semantic details retrieved by older adults did not significantly differ from young adults and young adults provided more internal details and fewer external details than older adults. However, this age difference with respect to internal details did not emerge for highly nostalgic stimuli. The interaction of age and nostalgia confirms our original hypothesis that more nostalgic stimuli would be associated with more internal details among older adults because this age group responds more strongly to emotional stimuli than younger adults. Future work should further examine this with an experimental manipulation of nostalgia to study the causal impact of this past-oriented emotion on memory specificity and episodic memory content for individuals across the lifespan.

In all, the findings of this dissertation have applications in a wide variety of settings. We build on existing research on aging, modality, nostalgia, and memory while extending these findings to realistic applications, such as marketing and advertising. By examining the associated semantic and episodic memories that have persisted for advertising campaigns over time, this research contributes to our understanding of how products fit into our lives and derive new meaning through remembered moments in our personal narratives. We also provide promising insights to help identify modalities that can be used in therapeutic interventions to uniquely facilitate autobiographical memory retrieval across the lifespan and mitigate the effects of aging on cognition in healthy populations.

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