THE REMINISCENCE BUMP ON THE LIFELINE: A GRAPHICAL DEPICTION OF PERSONAL IDENTITY IN AUTOBIOGRAPHICAL MEMORY

By

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Abstract

Studies of autobiographical memory have observed the *reminiscence bump* phenomenon in which older adults recall a relatively large number of important personal memories from their 10s and 20s (Rubin, Rahhal, & Poon, 1998). The current study investigated how individuals depicted the reminiscence bump period (ages 11 – 30) within the Lifeline Interview Method (Assink & Schroots, 2010), a graphical measure of autobiographical memory. A sample of 25 older adults (M = 79.68 years) drew a continuous line, the *lifeline*, to depict the subjective course of their life from birth to current age, drawing the line up and down to indicate positive and negative affect, respectively. Subjects recalled and marked important life events along the lifeline and labelled them with their age at the time of the event. The study detected a significant spatial expansion of the reminiscence bump period, which consumed 177% of its proportional share of horizontal space on the lifeline. An underlying pattern was observed in which the dense cluster of life events in the reminiscence bump period was more evenly spaced across the distance of the lifeline. The reminiscence bump period specifically consumed lifeline space which would otherwise have been allocated to middle-age. The reminiscence bump expansion was still detected in an additional lifeline drawn in reverse direction, from current age back to birth, supporting that the effect was not an artifact of drawing direction. The depiction and composition of the reminiscence bump was also investigated in three additional lifelines designated for the life domains of Family/Home, Work/Education, and Social/Friends. The paper discusses how the graphical representation of the reminiscence bump period on the lifeline may reflect its magnified importance in autobiographical memory as the period of identity formation.

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Dedication

Dedicated to all the seniors who have ever shared their life stories with me.

Whether I was conducting an interview, working in an assisted living community or nursing home, or you just caught me and wouldn't let me leave, I always enjoyed listening.

As explored in this study, our stories are who we are.

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Chapter 1: Introduction

Through the act of reminiscence, "the recall of personally experienced episodes from one's past" (Webster, Bohlmeijer, & Westerhof, 2010, p. 528), individuals' past autobiographical memories influence and inform who they are in the present. Departing from the stereotype of reminiscence as a dysfunctional feature of old age, Butler (1963) conceived of reminiscence as a universal, natural occurrence in older adults as they draw nearer to the end of life, serving to help integrate past experiences. A wealth of research over the following decades has pointed to the larger role of reminiscence across the lifespan, finding that reminiscence "is not the exclusive province of elderly adults" (Webster & McCall, 1999, p. 75), and that reminiscence contributes to the shaping of personal identity throughout life. Memory and identity are interwoven, and it may be considered that "autobiographical memory is a part of the self" (Conway & Pleydell-Pearce, 2000, p. 264). Reminiscence, specifically, functions as the vital process by which past autobiographical memories may be integrated into a cohesive narrative identity. Indeed, it has been argued that memories must be highly relevant to one's sense of self to be considered truly *autobiographical*, and that such memories can only be understood in the context of individuals' full life story (Bluck, 2000). In McAdams' (2001) life story model of identity, individuals rely on the subjective process of reminiscence to construct their life story into something more than a collection of objective biographical facts. In doing so, they attempt to better understand themselves, integrate their experiences, and derive meaning and purpose. Individuals' *narrative identity* has been conceptualized as their "internalized, evolving, and integrative story of the self" (McAdams, 2008, p. 242). The subjective nature of reminiscence may also be reflected in the bi-directional relation between memory and identity,

i.e., not only do past memories influence one's present sense of identity, but identity also influences how and why individuals engage in reminiscence (Wilson & Ross, 2003).

In addition to the link between reminiscence and identity, research has identified a broad array of functions of reminiscence – "By remembering salient information, we connect with others, feel good about ourselves, overcome negative emotions, render current problems manageable, and consolidate a developing autobiographical narrative and sense of identity" (Webster et al., 2010, p. 543). Notably, the Reminiscence Functions Scale (RFS; Webster, 1993) asks subjects to indicate the degree to which they reminisce for a specific purpose. Using the RFS, eight primary functions have been identified: bitterness revival, boredom reduction, conversation, death preparation, identity, intimacy maintenance, problem solving, and teach/inform (Webster & McCall, 1999). These functions have been conceptualized as occurring along two dimensions; (1) self versus social-oriented functions, and (2) reactive/loss versus proactive/growth-oriented functions (Webster, 2003). For example, the identity function has been categorized as self-oriented and proactive/growth-oriented, as reminiscing for purposes of identity serves to facilitate enhanced functioning based on a clarified sense of self and role.

Reminiscence functions have been understood within the larger context of Webster, Bohlmeijer, and Westerhof's (2010) conceptual model of reminiscence, which ties together a variety of research and perspectives under universal constructs and terminology. In this model, reminiscence may be primed by environmental cues known as *triggers*, it may occur in a public or private setting (*mode*), and social *contexts* may influence how memories are processed. Individual differences such as age, gender, and personality may act as *moderators* with regard to how individuals reminisce. As mentioned above, reminiscence serves various *functions*, whereby the act of reminiscence itself may lead to certain positive or negative *outcomes*. Within this

framework, different reminiscence functions have been associated with different personal characteristics and aspects of autobiographical memory, such as the emotional valence of memories and their frequency of occurrence across the lifespan (Webster et al., 2010).

The range of reminiscence functions stipulated by the RFS converges with the narrative view of autobiographical memory, most prominently by way of the identity function, which shows "how we use our past in an existential manner to discover, clarify, and crystalize important dimensions of our sense of who we are" (Webster & McCall, 1999, p. 76). Interestingly, studies have found that younger adults score higher on the identity function than older adults, pointing to age as a moderator of this particular function (Webster & McCall, 1999). Indeed, younger adults scored higher on all four self-oriented functions (Identity, Problem Solving, Boredom, and Bitterness Revival), while older adults scored higher on all four social-oriented functions (Webster & Gould, 2007). Such findings have led to the idea that while older adults use reminiscence to reinforce their identity, younger adults additionally use reminiscence as a means of identity *formation* (Webster & McCall, 1999), consolidating their experiences into a coherent self schema (Webster & Gould, 2007).

The Reminiscence Bump

The young adult period and identity formation have also been linked through investigation into the *reminiscence bump*, a phenomenon of autobiographical memory in which, for older adults, "the most autobiographical memories, the most vivid memories, and the most important memories" (Rubin, Rahhal, & Poon, 1998, p. 3) are drawn from experiences from ages 10 – 30. Indeed, the pool of memories from this period is characterized by the presence of vivid, highly-available memories (Fitzgerald, 1988). Additionally, the reminiscence bump in adolescence and young adulthood has been identified as the source for many of an individual's

lifelong cultural preferences, such as favorite books and music (Rubin, 1998). This finding may be unsurprising in that it supports the common knowledge that people often feel highly nostalgic about things from their youth. Furthermore, the reminiscence bump in young adulthood has been understood as the period of formation of generational identity, together with one's age cohorts, which may leave a lasting impression of the cultural zeitgeist of that era (Conway & Pleydell-Pearce, 2000).

Theories based on identity formation have been proposed to explain the overrepresentation of the reminiscence bump in autobiographical memory. Individuals in adolescence and young adulthood work to form their identity and find their place in society in a number of ways – "socially, vocationally, [and] ideologically" (Rubin et al., 1998, p. 16). Upon forming a coherent adult identity in young adulthood, individuals may rely on this easily-accessible schema throughout the lifespan to reinforce their sense of self. Part of identity formation may involve the setting of long-term goals and reminiscence bump events may "remain highly accessible in memory because of their enduring association with the current goals of the working self" (Conway & Pleydell-Pearce, 2000, p. 280). Indeed, narrative identity may become less malleable after young adulthood, reflecting a state of foreclosure, as it may no longer be necessary to add new elements to the existing, cohesive narrative (Fitzgerald, 1988).

In addition to identity-based accounts, cognitive explanations of the reminiscence bump have also been proposed, based on enhanced processing of experiences in adolescence and young adulthood, due to both the novelty of such experiences and the workings of peak cognitive abilities in this period (Rubin et al., 1998). The cognitive account of the reminiscence bump may be theoretically compatible with the identity account, as enhanced processing could facilitate development of narrative identity through integration of memories. For example,

autobiographical reasoning, involving integration of memories into cohesive identity, may not be possible until the underlying cognitive capabilities develop (Habermas & Bluck, 2000). More mature cognitive faculties may be necessary in order to imbue the personal narrative with the types of coherence necessary for its emergence (Habermas & Bluck, 2000). For example, a narrative must be bound by *causal coherence*, in that it attributes each event to causes internal or external to the individual. At a broader level, *thematic coherence* must work for interpretation of a series of events in the context of an overall narrative, e.g., "My life has been a series of ups and downs," or, "My life has been all uphill" (Habermas & Bluck, 2000, p. 751).

The Reminiscence Bump and the Lifeline Measure of Autobiographical Memory

The Lifeline Interview Method. By adopting the metaphor of life as a journey on a footpath, Schroots' Lifeline Interview Method (LIM) has been used to investigate autobiographical memory in graphical form (Assink & Schroots, 2010). To draw a *lifeline* using the LIM, a participant draws a continuous line from left to right, depicting the course of their life from birth to anticipated death, by drawing peaks and troughs for positive and negative experience, respectively. As well, the participant marks points along the lifeline to indicate when important life events occurred, labels each point with their chronological age at the time of the event, and describes the event to the interviewer. Once the paritcipant has drawn the lifeline up to their current age, they draw an additional segment depicting their anticipated future life course. The lifeline, rather literally, embodies the metaphor of life as a footpath, with the horizontal dimension representing chronological time and the vertical dimension representing positive and negative affect. Consistent with Habermas and Bluck's (2000) concept of thematic coherence, the LIM lifeline "symbolizes the course of human life with its ups and downs of important life events" (Assink & Schroots, 2010, p. 7).

On the basis of the common footpath metaphor, the LIM provides a familiar and accessible measure for investigating autobiographical memory in a simple, straightforward manner (Assink & Schroots, 2010). Although easy to use, the lifeline provides a sophisticated portrait of an individual's life story, from which insights into narrative identity can be gleaned. Particularly, the affective, non-directive, self-pacing, and self-structuring aspects of the LIM allow subjects the freedom to depict a subjective appraisal of their life course from their unique perspective. By embracing the subjective features of autobiographical memory the LIM not only inquires of subjects' raw memory for past events, but their "reflective and integrative capacity for these events" (Schroots, 2003, p. 193). Indeed, by focusing on the subjective meaning of life events in context, rather than merely their objective presence in autobiographical memory, lifeline research reflects the "integration of an event-based perspective with the personal life course narrative" (de Vries, 2013, p. 32).

Findings from lifeline research converge with those of the autobiographical memory field at-large in demonstrating the reminiscence bump in adolescence and young adulthood, within which older adults indicate a relatively high number of events on the lifeline (Assink & Schroots, 2010; Schroots, van Dijkum, & Assink, 2004). The goal of the current study was to further investigate the depiction and composition of the reminiscence bump on the lifelines of older adults. The current study investigated the role of the reminiscence bump in individuals' narrative identity, which was facilitated by the subjective, lifespan perspective afforded by the lifeline measure. As reviewed above, the reminiscence bump in adolescence and young adulthood may reflect the principal era of identity formation, supporting the notion that reminiscence works to maintain narrative identity throughout the lifespan. The current study was designed to deepen understanding of the reminiscence bump's influence on identity by examining how subjects

portrayed adolescence and young adulthood on the lifeline. The current study also investigated of how different areas of life and types of events contribute to the content and overall influence of the reminiscence bump.

The retrospective lifeline. The current study employed a modified version of the LIM, referred to here as the *retrospective lifeline*. In this version, the lifeline ends at a subject's current age, rather than their age of anticipated death. Prior LIM research included additional space for subjects to draw the course of their future life and mark anticipated future events in order to examine *prospective memory*, which is "concerned with the retrieval of expectations, anticipations, or future events," (Schroots et al., 2004, p. 70) in addition to retrospective memory. Inclusion of future events in the LIM has allowed for direct comparison between the lifelines of younger, middle-aged, and older adults, which all cover the entire lifespan (Assink & Schroots, 2010). In contrast, the current study focused exclusively on autobiographical memory in older adults. By defining the range of the lifeline from birth to current age, it was possible to examine retrospective autobiographical memory in isolation from prospective memory. The use of this method limited the potential influence of subjects' anticipated future on their depiction of past events. In addition, due to the division of the standard LIM lifeline into past and future, subjects in prior research were limited to a square box in which to draw the past segment of their lifeline. By utilizing the entire page for depiction of the past, the retrospective lifeline provides subjects with a large, rectangular box in which to draw. This shape may potentially allow for more expressive drawing and may better fit with people's normal conceptions of the shape for a timeline. Additionally, the vertical line dividing past from future in the standard LIM was no longer necessary. The presentation of the completely blank lifeline potentially communicates a greater degree of freedom to subjects, in how they are to draw the lifeline. The potential

advantages of the retrospective lifeline were especially relevant for the current study's investigation of how subjects allocate space to adolescence and young adulthood on the lifeline.

Proportional scaling of the reminiscence bump on the lifeline. Because the lifeline does not include an objective chronological scale showing years of age on the horizontal axis, the subject is free to make use of the provided space however they see fit in drawing the course of their life from birth to their current age. The current study examined the amount of horizontal length of the lifeline that subjects used to depict the period of ages 11 – 30, corresponding to the reminiscence bump. Pierce and Schroots (2009) found that the period from ages 15 – 29 took up more than its proportional share of horizontal space (202%) on the retrospective portion of standard LIM lifelines of older adults. Based on this result, it was hypothesized that ages 11 – 30 would take up more space on the lifeline than would be proportional to its share of subjects' chronological age. This hypothesis was based on the idea that overrepresentation of the reminiscence bump on the lifeline may reflect the elevated influence of adolescence and young adulthood, relative to other periods of life, in autobiographical memory. Furthermore, it has been found that the pattern underlying the expansion of the reminiscence bump may be the high number of events in this period combined with relatively even spacing of events across the lifeline (Pierce & Schroots, 2012). On this basis, it was hypothesized in the current study that there would be an *uneven* distribution of events across chronological age and a relatively *even* distribution of events across the lifeline, accompanying the expansion of the reminiscence bump period.

Ruling out effects of drawing direction. The current study additionally investigated the validity concern that the spatial expansion of the reminiscence bump could partly be an artifact of drawing the lifeline specifically from birth to the current age. Hypothetically, subjects' use of

lifeline space could potentially be affected by a chronic underestimation of the remaining space available to draw the lifeline to their current age. As anyone who has attempted to make a sign with big, block letters can attest, people very often run out of room due to underestimating, or ignoring, how much space they need. In the context of drawing the lifeline from birth to current age, i.e., from left to right, a chronic tendency to underestimate remaining space could factor into the spatial expansion of earlier decades, including the reminiscence bump. In order to rule out this concern, the study included an additional lifeline drawn from current age back to birth, i.e., from right to left. It was hypothesized that in this reverse-drawn lifeline, the reminiscence bump period (ages 11 – 30) would still take up more than its fair share of horizontal space. In that case, the influence of drawing direction would be ruled out and the forward-drawn lifeline could be considered methodologically valid in this respect. Such a result would strengthen the interpretation that the reminiscence bump expansion was attributable to aspects of autobiographical memory.

Contribution of domains of life to the reminiscence bump. The current study also examined how events from different areas of life, or *life domains*, may contribute to the content and importance of the reminiscence bump in overall life narrative. Domains of life were operationalized as basic, intuitive divisions of life's experiences, as common to everyday experience. Three domains of life were specified: Family/Home, Work/Education, and Social/Friends, in an attempt to capture as much of life's content as possible. In developing these domains, consideration was made of categories for LIM lifeline events employed by Schroots and Assink (2005): Relations, School, Work, Health, Growth, Home, Birth, Death, and Other. The domains of the current study were loosely derived by collapsing these categories into

broader constructs and by excluding relatively narrow categories in order to ensure there would be a large number of events for each domain.

The current study included three domain-specific lifelines, in which subjects drew the course of their Family/Home, Work/Education, and Social/Friends lives, respectively, and included only events from the specified domain. This novel innovation in lifeline research allowed for investigation of the source of the reminiscence bump's content and importance in different domains of life. First, it was investigated whether the spatial expansion of the reminiscence bump, as described above, was present in each of the domain lifelines. As with the overall lifeline, the degree of expansion in each domain lifeline was interpreted as directly corresponding to the importance of the reminiscence bump within that domain. Furthermore, the relative expansion/importance of the reminiscence bump in each domain was interpreted as an indication of the extent to which family, work, and social life contribute to the expansion/importance of this period in the overall lifeline and life narrative.

Additionally, the composition of events in the reminiscence bump was investigated in terms of the contribution of the domains of Family/Home, Work/Education, and Social/Friends. The proportion of reminiscence bump events in a subject's overall lifeline which were drawn from each domain was calculated in order to investigate how different domains of life may serve as the source for events in the reminiscence bump. Prior research using Assink and Schroot's (2010) event LIM event categories identified the most common types of events for the decades of the 10's and 20's. For the 10's, the categories of School and Other contained the most events for men, while for women, Other and Relations were most represented. For the 20's, Relations was most represented for men, while, for women, Birth and Relations were most represented. Using the broader domains of Family/Home, Work/Education, and Social/Friends, and by

drawing out events through use of the domain-specific lifelines, the current study aims to explore, in-depth, the types of events which compose the reminiscence bump.

Correlations with the Reminiscence Functions Scale. Additionally, the Reminiscence Functions Scale (Webster 1993), as described above, was administered to link features of the lifeline with reminiscence functions, specifically the Identity function. It was hypothesized that total RFS scores, indicating how often subjects reminisce for all the primary functions, and Identity subscale scores, would be positively correlated with the total number of lifeline events. It was hypothesized that Identity sub-scores would be positively correlated with number of negative-affect lifeline events, as it has been theorized that reminiscing for purposes of identity may involve reflecting on both positive and negative experiences in order to improve oneself (Webster, 2003; Webster & McCall, 1999). It was also hypothesized that Identity subscale scores would be positively correlated with both the number of events in the reminiscence bump (ages 11 – 30) and the degree of spatial expansion of the reminiscence bump which, as described above, may be the primary period of identity formation.

Chapter 2: Method

Participants

Community-dwelling participants age 60 and above were recruited from retirement communities and the general public. The study was advertised through flyers, newsletters, employee contacts at the retirement communities, and word-of-mouth. Participants volunteered by contacting the researcher. The overall sample was composed of 25 participants (11 men, 14 women) with an average age of 79.68 years (*SD* = 7.84), and an age range of 64 – 93 years. Twenty-four participants identified as White, and one participant identified as White and an unspecified ethnicity. The sample was very highly educated, with an average of 18.13 (*SD* = 3.17) years of primary, secondary, and post-secondary education, e.g., 16 years of education was defined as that of a bachelor's degree.

Measures

Demographics questionnaire. A brief demographics questionnaire was administered in order to collect information on participants' age, sex, ethnicity, and other variables (See Appendix A).

Lifeline Interview Method. As described above, a modified form of the Lifeline Interview Method (Assink & Schroots, 2010) was used in the current study, in which participant's drew a continuous line, the *lifeline*, to depict the ups and downs of their life from birth to their current age. In the standard LIM, the lifeline is drawn past current age, ending at age of anticipated death. However, the current study employed a *retrospective lifeline* only, which ended at current age. Participants were presented with a piece of legal-sized (8.5" x 14") paper in a landscape orientation. On the page, the space for drawing the lifeline was a rectangular box, with the top and bottom sides measuring 300 mm in length and the left and right sides

measuring 185 mm in height (See Appendix C). The horizontal axis represented chronological age, with the left boundary marking birth and the right boundary marking current age. The vertical axis represented valenced affect, with the top labelled *Most positive*, and the bottom labelled *Most negative*. A dashed horizontal line representing neutral affect was placed at the midpoint of the vertical axis and spanned the length of the box. To draw the lifeline, participants began at the origin (birth, neutral affect) and drew the course of their life to the right boundary, with peaks showing positive experiences and troughs showing negative experiences. The participant also marked important life events with a small, vertical dash through the lifeline at the age at which the event occurred. They then labeled the mark with the age at which the event occurred and briefly described the event to the interviewer.

Each participant completed a series of five different types of lifelines, all using identical blank templates. For the first lifeline, participants depicted their overall life experience. For the next three lifelines participants depicted only experiences from each of three specific domains of life: Family/Home, Work/Education, and Social/Friends. Additionally, a three-item questionnaire asked participants how important they considered each respective domain of life to be (See Appendix D). For the fifth lifeline, as with the first, participants were asked to depict their overall life experience. However, in this instance they were to draw the lifeline in reverse direction, from right to left (i.e., current age back to birth).

Reminiscence Functions Scale. In order to strengthen understanding of why people engage in reminiscence and to better interpret the lifelines, the Reminiscence Functions Scale (RFS) ($\alpha = .84$) was administered to each participant. The RFS is a comprehensive measure of an individual's purposes for reminiscence and includes 43 numerically-scaled questionnaire items, for which participants indicate the degree to which they reminiscence for a specific

function (RFS; Webster, 1993). For each item, participants rated how often they reminiscence for a specific purpose on a scale from 1 – 6 (*Never* to *Very Frequently*). Scores were obtained for functions of Boredom Reduction, Death Preparation, Identity, Problem-Solving, Conversation, Intimacy Maintenance, Bitterness Revival, and Teach/Inform by summing the responses for all the items that fall under each factor (Webster & McCall, 1999).

Procedure

Each participant completed the study in a scheduled interview conducted by the researcher in the participant's home. The participant and the researcher sat across from each other at a table, which provided a flat writing surface for drawing the lifeline. First, the researcher briefly explained the purpose of the study, informed participants that they would be paid $10 for participating, and informed them that they were free to opt-out at any time and still receive the full payment. After prompting the participant for any questions and answering any questions they may have had, the researcher obtained the participant's signature giving their consent to participate.

The procedure followed the basic guidelines stipulated by the Lifeline Interview Method (Assink & Schroots, 2010), while accommodating the modifications to the LIM implemented in the current study. Participants first completed the demographics questionnaire. Following that, the researcher described the lifeline measure, explained how to complete it, and presented three sample completed lifelines, which ranged from simple to more complex wave patterns (See Appendix B). The participant then completed the series of five lifelines, starting with the lifeline for overall life experience, then the three domain lifelines (Family, Career, and Social), and finally, the reverse-drawn lifeline for overall life experiences. The order in which the domain lifelines were presented was counter-balanced across all participants who began the interview

(not all completed the entire study), using the six different possible orders of presentation. If each lifeline type was to be assigned a letter (Family = A, Career = B, Social = C) then the six different orders were ABC, ACB, BAC, BCA, CAB, and CBA. These six orders were used in the order listed for the first six numbered participants, respectively, and the order was repeated for each additional set of six numbered participants. The reverse-drawn lifeline was administered last, in order to separate it from the forward-drawn lifeline, so that participants would potentially be less inclined to merely re-create their original lifeline from memory.

The procedure for each of the lifeline types was identical, except for the content (i.e., different domains), and drawing direction (i.e., the reverse-drawn lifeline). The participant was instructed that they were to portray their overall life experiences from birth to their current age, drawing the line up and down to represent positive and negative affect. They were told that once they had drawn the lifeline they would be asked to mark their most important life events. After receiving the instructions, the participant was asked to write their current age directly below the right boundary line. The participant was then given as much time as they needed to draw the lifeline, beginning at the origin point (birth, neutral affect).

Once the participant had finished drawing all the way to the right boundary, for their current age, the researcher began the process of collecting information about life events. For each indicated life event, participants were asked to (1) mark a small vertical dash through the lifeline at the point when the event occurred, (2) label the mark with their age at the time of the event, and (3) provide a brief verbal description of the event. Using this information, the researcher recorded a list of events for the particular lifeline, listing a brief, descriptive label for each event (e.g., marriage, retirement) alongside the age at which it occurred. To begin collecting event information, the researcher prompted the participant to indicate the earliest important life event

they could recall. Once information on that event was collected, the participant was prompted to indicate the next important life event in chronological order, and so on. In this way, the participant worked from birth to their current age to indicate important life events, although participants were allowed to jump around to different ages, if necessary (e.g., forgetting to mark an event from childhood). Once the participant had indicated their most recent life event, the researcher pointed out any remaining peaks or troughs on the lifeline that were not already marked with an event and asked if there was a life event associated with that point that the participant wanted to include. Once information on these events and any others the participant wanted to include was collected, the lifeline was complete, and the researcher presented the next lifeline until all five were completed.

The Domain Importance Questionnaire was administered directly after the participant completed their third domain lifeline but before beginning the reverse-drawn lifeline. After the reverse-drawn lifeline was completed the researcher presented the participant with the Reminiscence Functions Scale. The participant read the instructions for the RFS and the researcher answered any questions about how to complete it. Once the participant had completed the RFS, the study was concluded. Participants were thanked for their participation and were given the $10 reimbursement for participating.

Data Reduction and Plot Digitization

For investigating how life events were distributed across the lifeline, it was necessary to record the position of each event along the horizontal axis, in millimeters from the left boundary (0 – 300 mm). A set of coordinates for each life event was generated by measuring the event's position on both the horizontal (chronological) and vertical (affective) axes. In order to efficiently measure the position of life events from over 100 lifelines, the process was facilitated

by the using a type of computer program known as a *plot digitizer*. Each lifeline was converted to an image file through scanning and was then uploaded into the program. In order to measure the position, in millimeters, of each life event on a lifeline, the researcher (1) clicked on the origin and endpoint for both the horizontal and vertical axes, (2) scaled the image by inputting the length of the horizontal axis (300 mm) and the height of the vertical axis (185 mm), and (3) clicked on the marks for each of the life events on the lifeline. The program then automatically generated the horizontal and vertical coordinates for each life event. The particular program used in the study was WebPlotDigitizer (Rohagi, 2015).This novel method represents an improvement in time required to measure event position, over existing procedures of hand-measurement with a ruler. Three lifelines were measured by hand, whereby it was confirmed that the program was able to match the accuracy of hand-measurement to the millimeter.

Chapter 3: Results

Life Events Throughout the Lifespan

Number of life events. To investigate the basic features of the sample's lifelines the mean number of life events per subject for overall ($N = 25$) and domain ($N = 21$) lifelines was calculated, along with the mean percentages of positive and negative life events for each lifeline type, as shown in Table 1.

Table 1: Number of life events for lifeline types

	Life events		Positive life events			Negative life events		
Lifeline	*M*	*SD*	*M*	*SD*	%	*M*	*SD*	%
Overall	10.92	4.47	8.32	4.07	75.45	2.60	2.29	24.55
Family/Home	7.90	4.30	6.00	3.92	74.05	1.86	1.46	25.42
Work/Education	7.24	2.74	6.48	2.64	90.33	0.76	1.14	9.67
Social/Friends	5.43	2.52	4.67	2.54	86.29	0.67	1.02	12.52

Distribution of life events over decades of life. A frequency distribution was generated showing the distribution of life events over decades of life, using the sample-wide ($N = 25$) pool of life events from the overall lifeline, as shown in Figure 1. The reminiscence bump was evident in the 10s and 20s, which contained the most events per decade.

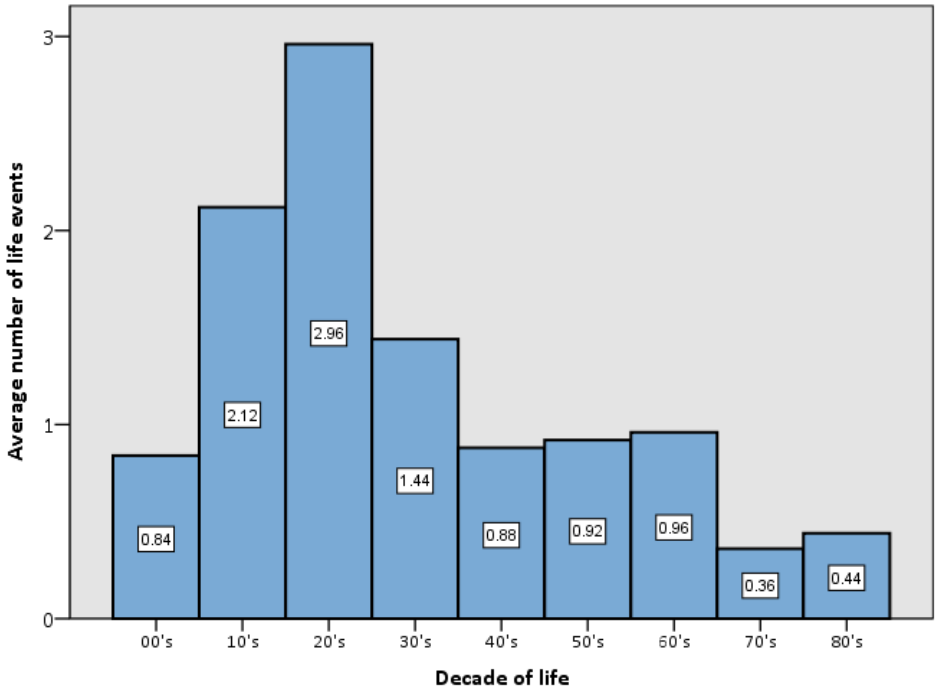


Figure 1. Distribution of lifeline life events over decades of life.

Frequency distributions were also generated for each of the domain lifelines (Family/Home, Work/Education, and Social/Friends), showing the distributions of the sample's (N = 21) pooled life events over decades of life, as shown in Figures 2, 3, and 4. Consistent with the reminiscence bump pattern seen in the overall lifeline, in the Work and Social lifelines, the 10s and 20s contained the most life events per decade. In the Family lifeline, the 20s contained the most life events, reflecting the reminiscence bump, while the 50s contained the second-most life events.

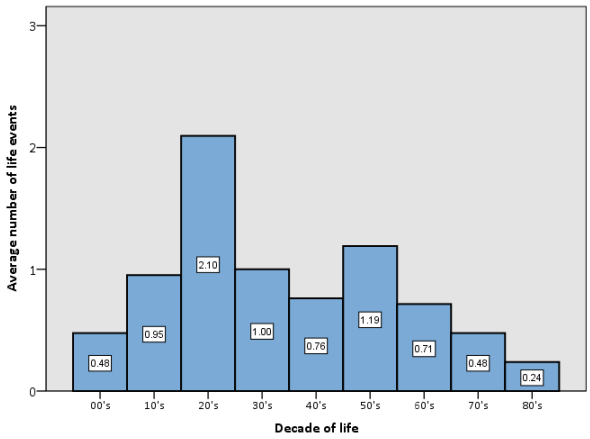


Figure 2. Distribution of family life events over decades of life

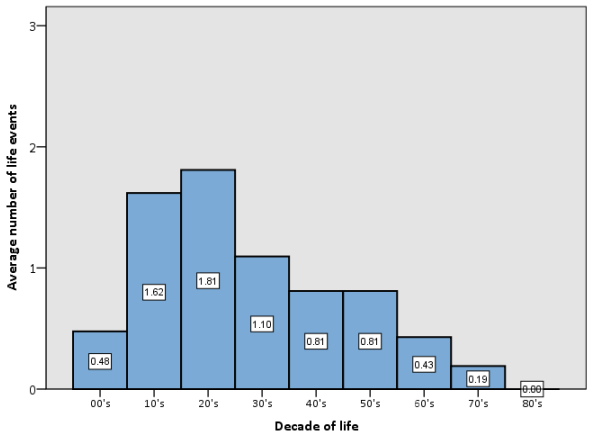


Figure 3. Distribution of career life events over decades of life

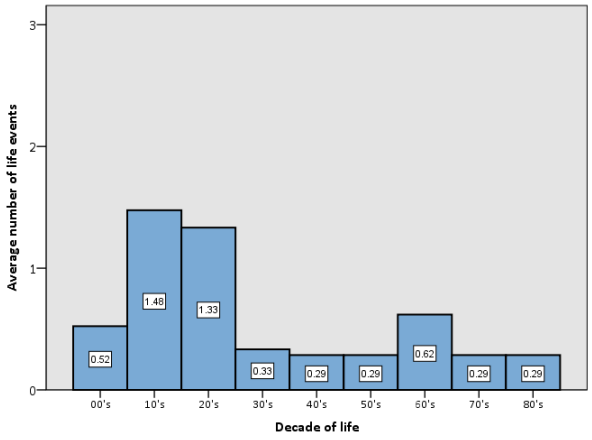


Figure 4. Distribution of social life events over decades of life

Life events drawn from domains of life. The influence of the different life domains of Family/Home, Work/Education, and Social/Friends life on subjects' overall lives was investigated by analyzing the number of events on each subject's ($N = 21$) overall lifeline which were also present in any of their domain lifelines, as shown in Table 2. On average, 60.04% of a subject's overall lifeline life events were also present in one or more of the subject's domain lifelines, with the Family lifeline containing the most shared events, followed by the Career and Social lifelines.

Table 2: Overall lifeline life events shared with each domain lifeline

	Life events		% of overall lifeline events	
Lifeline	*M*	*SD*	*M*	*SD*
One or more domain	6.19	2.86	60.04	22.16
Family	3.48	2.56	35.81	22.68
Work	2.33	1.62	22.78	17.04
Social	2.19	1.86	19.68	16.12
None (non-shared)	4.33	3.32	39.96	22.16

Correlations with Importance Ratings of Domains. The hypothesis that the percentage of overall lifeline events shared with a given domain would be positively correlated with importance ratings for the respective domain was not supported for any of the three domains. There was no significant correlation between percentage of shared Family events and importance ratings for family life, $r(19) = -.33$, $p = .075$, between percentage of shared Work events and importance ratings for work life, $r(19) = -.24$, $p = .149$, or between percentage of shared Social events and importance ratings for social life, $r(19) = -.08$, $p = .361$. Restriction of range may have been an issue in subjects' responses to each item on the Domain Importance Questionnaire, as ratings of importance were negatively skewed for each domain of Family ($M = 4.76$, $SD = 0.63$), Work ($M = 4.10$, $SD = 0.70$), and Social ($M = 3.76$, $SD = 1.18$), and standard deviations were small.

Influence of the Reminiscence Bump on the Lifeline

Chronological and spatial density of life events. To investigate how the reminiscence bump period (ages 11 – 30) was depicted on the lifeline, the distribution of overall lifeline life events, across percentiles of age, and percentiles of horizontal distance on the lifeline, was analyzed. Life events were sorted into 10 equal intervals (deciles) of percentage age, based on

the current age of the particular subject to whom the event belonged. A frequency distribution was then generated for the sample's ($N = 25$) pooled life events over deciles of percentage age (Figure 5). A second frequency distribution was generated for life events across 10 equal deciles of percentage of horizontal lifeline distance (Figure 6).

In the distribution of events over percentage age, a sharp peak occurs in the third and fourth deciles, which each contained nearly 20% of total events. The peak may be related to the reminiscence bump and the similar peak of events observed in the 10s and 20s decades. In contrast, events were distributed much more evenly across the horizontal axis of the lifeline. The frequency distributions for life events over deciles of percentage chronological age and percentage horizontal lifeline space, respectively, were significantly different from each other, $\chi^2 (9, N = 546) = 32.76, p < .0005$. The density of events within the reminiscence bump period, combined with the even spacing of events on the lifeline, may underlie the expansion of the reminiscence bump over an inordinately large amount of lifeline space. Thus, the relatively large number of important life events in the reminiscence bump may be related to its expansion over the lifeline.

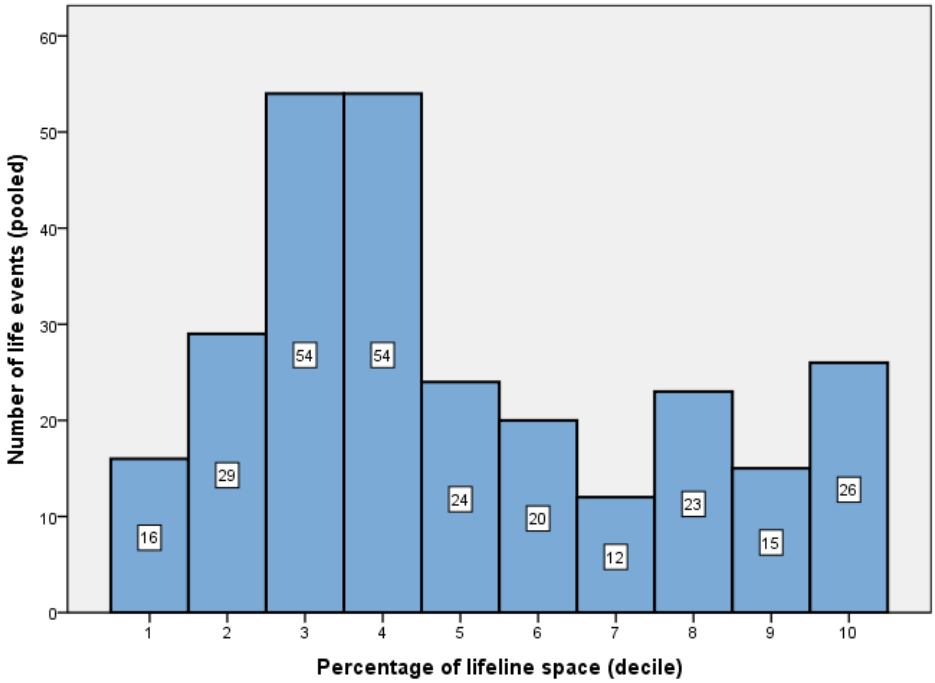


Figure 5. Distribution of lifeline life events over percentiles of lifeline space

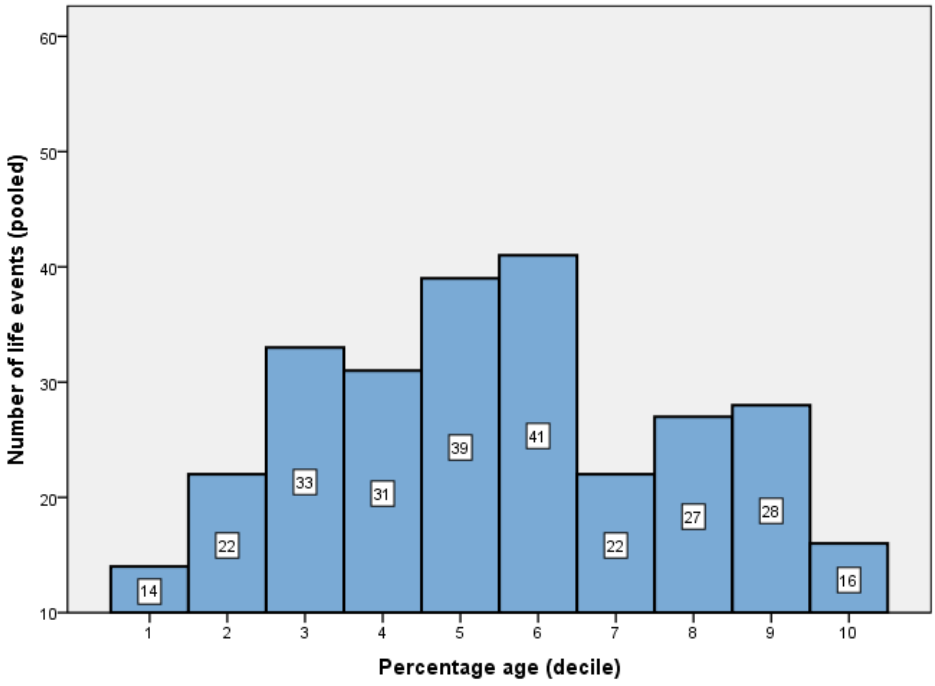


Figure 6. Distribution of lifeline life events over percentiles of age

The distribution of events, specifically in the reminiscence bump period, was then examined to see how it fit with this overall pattern. From the same set of pooled overall lifeline life events, only events from ages 11 – 30 were selected. Figures 7 and 8 show this set of events

on the same frequency distributions as above, over deciles of percentage age and lifeline distance. Comparison of the two distributions reveals that the reminiscence bump may expand into space which would otherwise be allocated to middle-age. This rightward shift is evidenced by the fact that virtually all of reminiscence bump events (98.4%) occurred within or before the fourth decile of percentage age, while fully 40.9% of events fell into the fifth decile and above for percentage distance. The effect can also be seen in the difference between the means for percentage age (M = 27.12, SD = 7.09) and percentage distance (M = 37.24 SD = 14.92) for the set of reminiscence bump events.

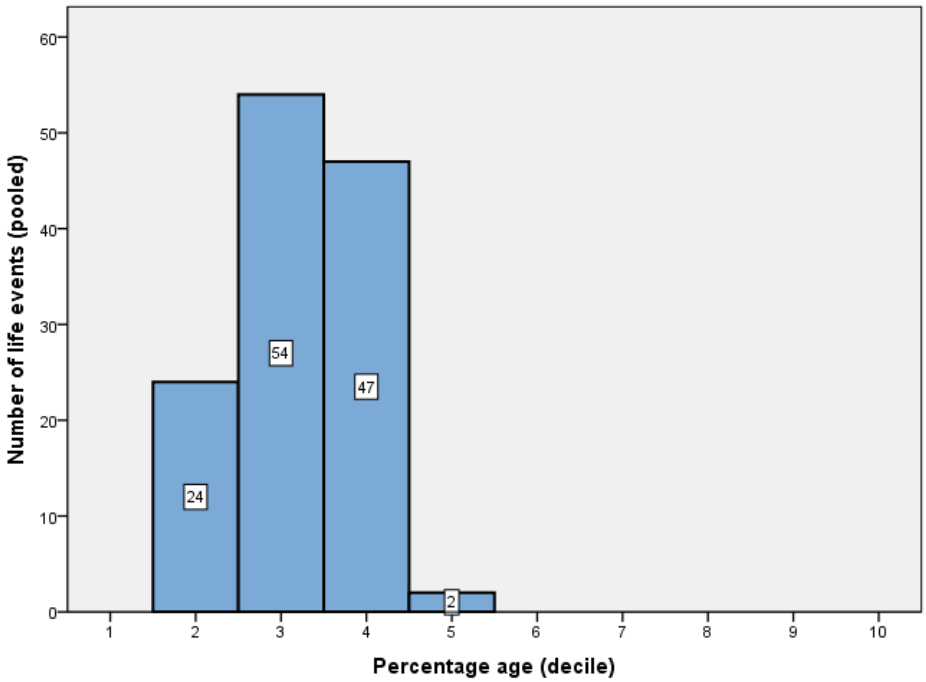


Figure 7. Distribution of lifeline life events (ages 11-30) over percentiles of age

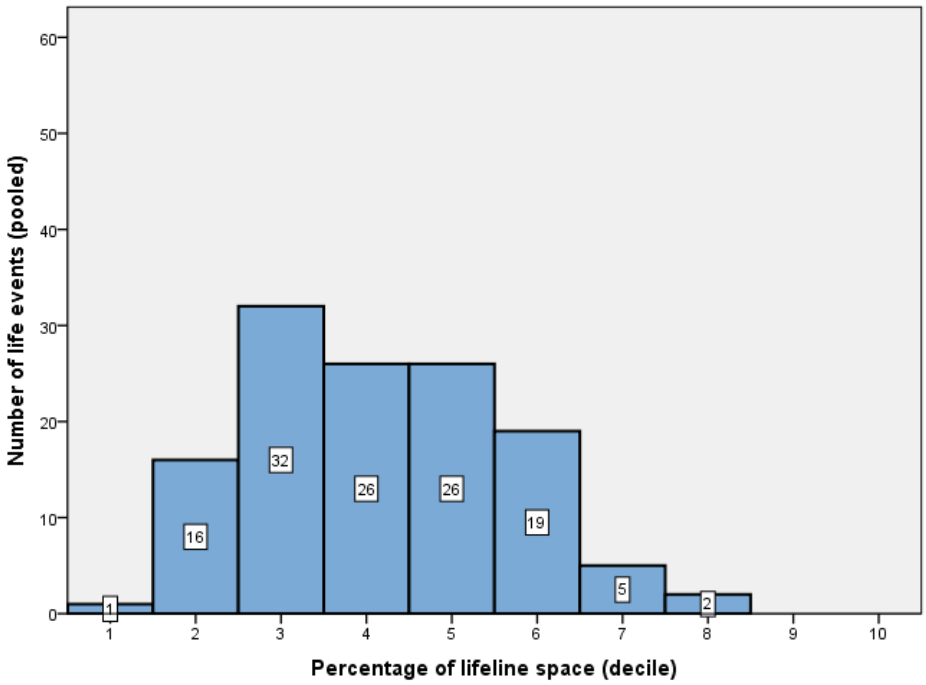


Figure 8. Distribution of lifeline life events (ages 11-30) over percentiles of lifeline space

Quantifying the ratio of expansion using regression analyses. To quantify the spatial expansion of the reminiscence bump over the horizontal space of the lifeline a ratio was calculated providing the percentage of lifeline space taken up for each percentage of a subject's

age within the period of ages 11 – 30. This ratio indicates the degree of expansion, i.e., the extent to which the reminiscence bump took up more than its fair share of lifeline space relative to other periods. To calculate the ratio, life events were plotted based on (1) the percentage of chronological age at which the event occurred and (2) the percentage distance across the horizontal length of the lifeline. Figure 9 shows the plot of overall lifeline events pooled from the sample ($N = 25$) for illustration. However, it was necessary to use a separate plot for each subject, rather than a plot of pooled events, in order to control for the varying age of subjects, as well as varying numbers of events. Individual-subject analyses were particularly necessary considering that the reminiscence bump occurs at different percentages of age, based on the subject's current age (e.g., age 20 occurred at about 33% of chronological age for a 60-year-old subject, but at 25% of chronological age for an 80-year-old subject).

For each subject's scatterplot of reminiscence bump events, shown in Figure 10 the regression equation predicting percentage distance from percentage age was obtained. The slope of the regression line provides the ratio of expansion for this set of events, i.e., the percentage of lifeline distance taken up by each percentile of chronological age. A hypothetical slope of 1.0 would indicate that lifeline space was allocated evenly based on percentage age, while a slope greater than 1.0 would indicate that the set of events took up an inordinately large amount of space. The results showed that the mean slope of the regression equation (the unstandardized regression coefficient) among subjects ($N = 25$) for reminiscence bump events (ages 11 – 30) was 1.77 ($SD = 0.97$). The computed slope of 1.77 was significantly greater than the hypothetical slope of 1.0, $t(24) = 3.97$, $p = .001$, $d = 0.79$. Thus, the reminiscence bump period took up more than its share of space on the lifeline. Specifically, each percentile of age within the reminiscence bump period took up about 1.77 percent of lifeline space or 177% of its fair share.

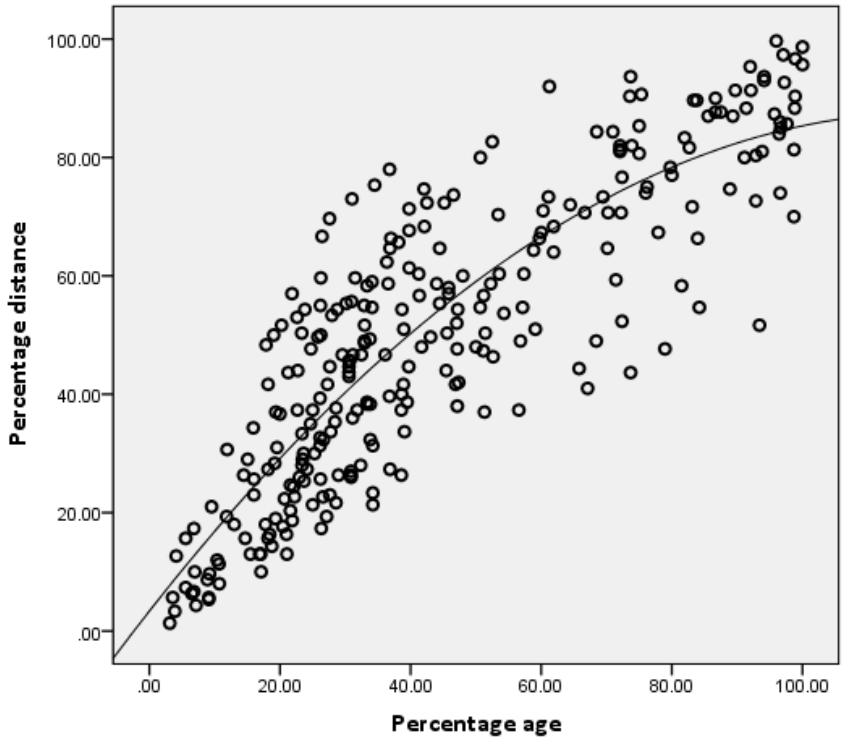
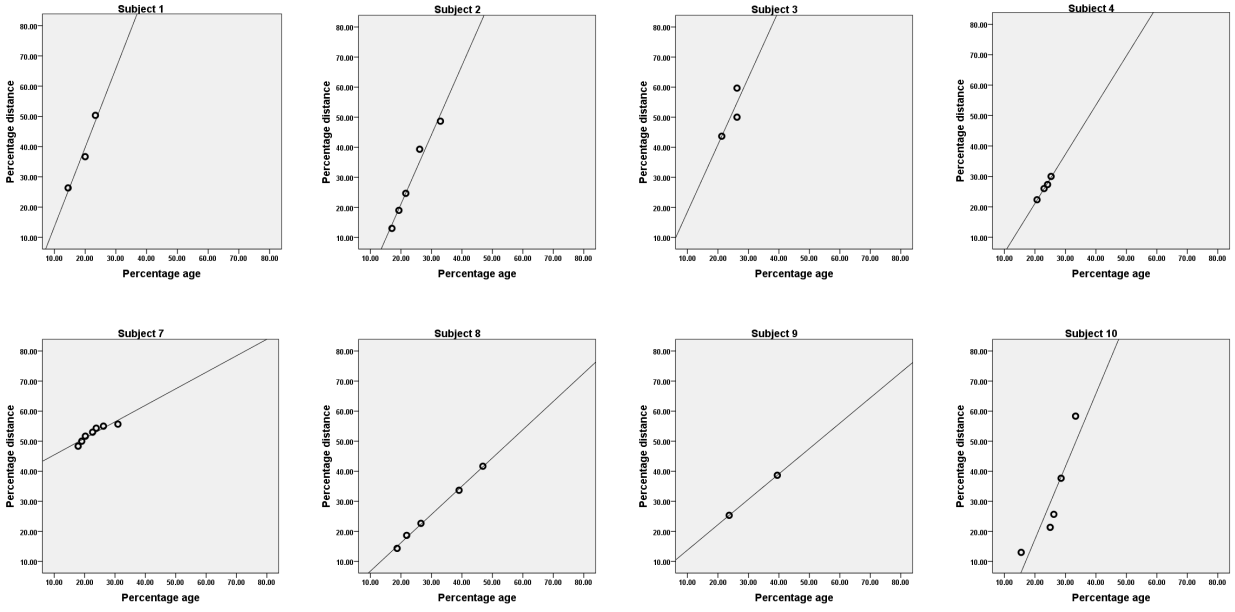


Figure 9. Pooled life events from the sample



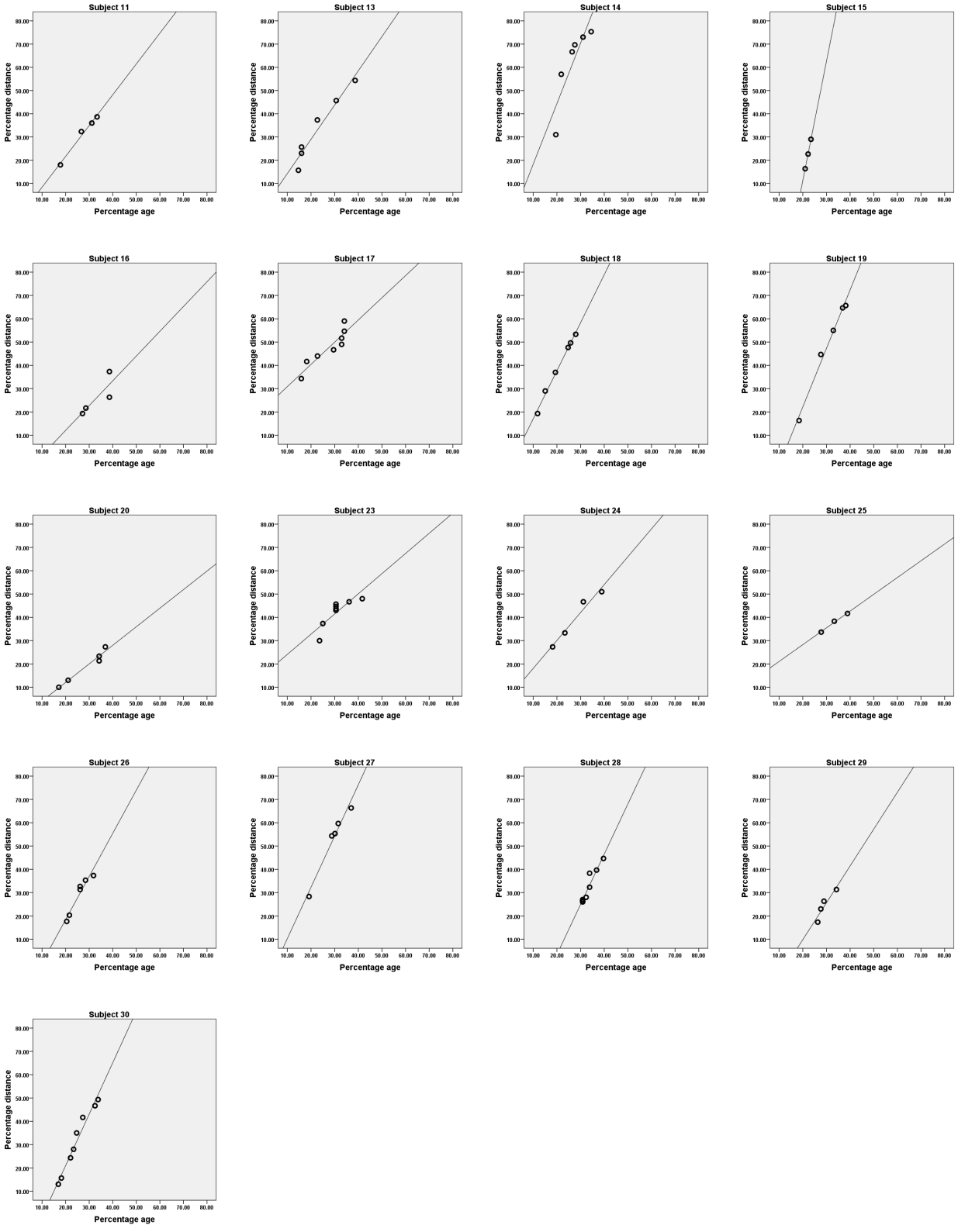


Figure 10. Lifeline events (ages 11-30) as percentage of subject age vs percentage of lifeline distance

Positional shift of the reminiscence bump. The expansion of the reminiscence bump period and spread of the associated events into space which would otherwise be allocated for middle age was further investigated in the context of how events from each decade of life were shifted from their *expected position* on the lifeline. For each event, the expected percentage distance across the lifeline was assigned to match that event's actual percentage of the subject's chronological age. Thus, expected position was based on the hypothetical assumption of a perfect linear relationship between an event's percentage of chronological age and its percentage of distance across the lifeline. For each event, the deviation from the expected position was calculated in units of percentages of lifeline space as the difference between actual position and expected position. Events that were shifted to the right on the lifeline had a positive deviation score, or *positional shift*, and vice versa. Then, for each of ages 1 – 90, the average shift of the pooled events for a respective age was calculated and, finally, a mean shift was calculated for each decade of life (e.g., 10s, 20s, etc.) by averaging across the values for each age within the decade. This method produced a statistic showing the extent to which events from each decade of life were shifted from their expected position, while controlling for subjects' varying ages, and for the frequency at which events occurred across different ages. Figure 11 shows this statistic, the average positional shift for each decade, based on subjects' ($N = 25$) life events from the overall lifeline.

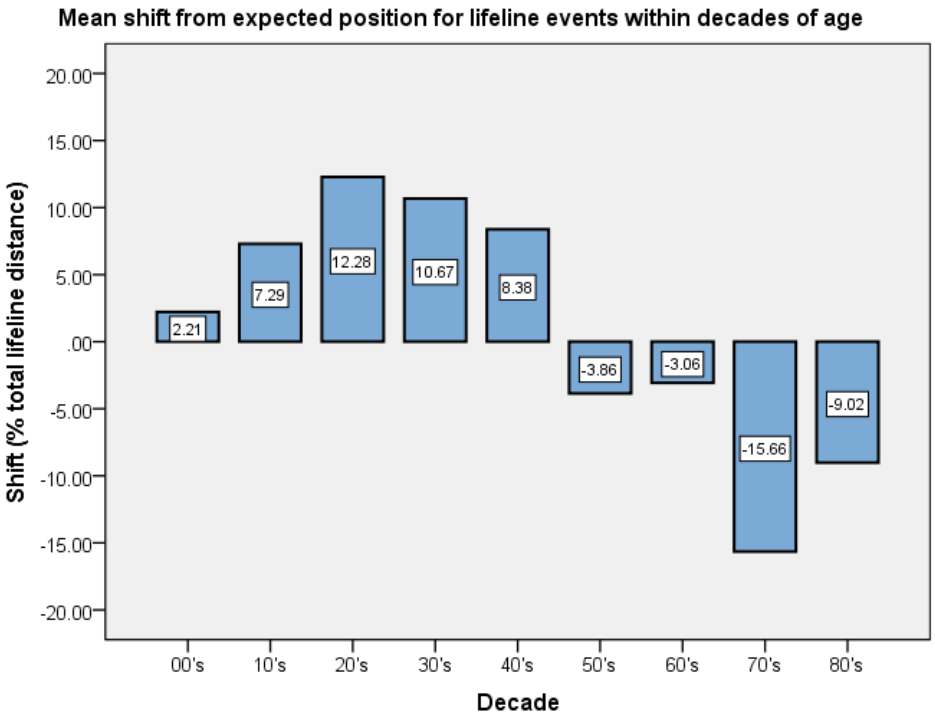


Figure 11. Mean shift from expected position for lifeline events within decades of age

Table 3 provides the mean shift for each decade and an accompanying value referred to as the *independent positional shift*. A given decade's shift may be influenced by the additive effects of the shifts for the decades that were drawn prior to it. Starting with the mean shift for a given decade, the sum of the preceding decades' shifts may be subtracted to yield the independent shift. By cancelling out the additive effect of preceding decades the independent shift shows the degree to which a decade's events were shifted once the subject reached that decade in the process of drawing the lifeline. Judging from the mean shift for events in the 10s and 20s, it is seen that reminiscence bump events were substantially shifted to the right from their expected position. The effect remains when looking at the isolated shifts for the 10s and 20s, confirming that events from these decades were shifted to the right, independently of events from younger childhood (the 00's), which were drawn in preceding order. The finding that events from the 00's were shifted only slightly to the right, compared to the subsequent decades,

shows that the rightward expansion may be specific to the reminiscence bump period and not merely a tendency to expand the first decades a subject draws. This analysis provided further evidence that events from the reminiscence bump period expanded rightward into space which would otherwise be allocated for middle age.

Table 3: Mean shift from expected position for lifeline events within decades

Decade	Shift (% total lifeline distance)	Independent shift (% total lifeline distance)
00's	2.21	2.21
10s	7.29	5.08
20s	12.28	4.99
30s	10.67	-1.61
40s	8.38	-2.29
50s	-3.86	-12.24
60s	-3.06	0.80
70s	-15.66	-12.60
80s	-9.02	6.64

Note. The mean shift for each year of age within a decade was weighted equally to produce the mean shift for the decade. Isolated shift was calculated by subtracting the sum of preceding decades' shifts.

The Reminiscence Bump in Domains of Life

Reminiscence bump events drawn from domains. To investigate how events within the reminiscence bump period were drawn from different domains of life, the number of events ages 11 – 30 on each subject's ($N = 21$) overall lifeline which were also present in any of their domain lifelines was analyzed, as shown in Table 4. The highest percentage of events were drawn from the domain lifeline for Family/Home, followed by that for Social/Friends, and Work/Education.

Table 4: Overall lifeline life events (ages 11 – 30) shared with each domain lifeline

	Life events		% of overall lifeline events (ages 11 – 30)	
Lifeline	*M*	*SD*	*M*	*SD*
Family/Home	1.76	1.18	39.05	24.89
Work/Education	1.19	1.12	25.48	23.27
Social/Friends	1.33	1.20	28.17	26.01
None (Nonshared)	1.81	1.57	34.72	25.85

Influence of the reminiscence bump drawn from domains. To investigate the spatial expansion of the reminiscence bump in each of the domain lifelines, the same ratio as for the overall lifeline was calculated, providing the percentage of lifeline space taken up by each percentage of a subject's age, within the period of ages 11 – 30. Again, this ratio indicates the degree of expansion, i.e., the extent to which the reminiscence bump took up more than its fair share of lifeline space. For each domain (Family/Home, Work/Education, Social/Friends), the same method as for the overall lifeline was followed to produce the ratio of expansion. For each subject, the regression line was calculated predicting percentage distance from percentage age. Participants that had less than two events between ages 11 – 30 on a particular domain lifeline were excluded from the regression analysis of that domain, as a regression line could not be calculated. The slope of the regression line provided the ratio of expansion for this set of events, i.e., the percentage of lifeline distance taken up by each percentile of chronological age. A hypothetical slope of 1.0 would indicate that lifeline space was allocated evenly based on percentage age, while a slope greater than 1.0 would indicate that the set of events took up an inordinately large amount of space.

For the Family/Home lifeline, the results showed that the mean slope of the regression equation (the unstandardized regression coefficient) among subjects ($N = 17$) for reminiscence bump events (ages 11 – 30), was 1.96 ($SD = 1.41$). Compared to the hypothetical slope of 1.0,

representing even allocation of space, the computed slope of 1.96 was significantly greater than 1.0, $t(16) = 2.83$, $p = .012$, $d = 0.69$. Thus, the reminiscence bump period took up more than its share of space on the Family/Home lifeline. Specifically, each percentile of age within the reminiscence bump took up about 1.96 percent of lifeline space, or 196% of its fair share.

For the Work/Education lifeline, the results showed that the mean slope of the regression equation among subjects ($N = 19$) for reminiscence bump events (ages 11 – 30), was 1.85 ($SD = 1.25$). Compared to the hypothetical slope of 1.0, representing even allocation of space, the computed slope of 1.85 was significantly greater than 1.0, $t(18) = 2.96$, $p = .008$, $d = 0.68$. Thus, the reminiscence bump period took up more than its share of space on the Work/Education lifeline. Specifically, each percentile of age within the reminiscence bump took up about 1.85 percent of lifeline space, or 185% of its fair share.

For the Social/Friends lifeline, the results showed that the mean slope of the regression equation among subjects ($N = 17$) for reminiscence bump events (ages 11 – 30), was 2.37 ($SD = 1.94$). Compared to the hypothetical slope of 1.0, representing even allocation of space, the computed slope of 2.37 was significantly greater than 1.0, $t(16) = 2.92$, $p = .010$, $d = 0.71$. Thus, the reminiscence bump period took up more than its share of space on the Social/Friends lifeline. Specifically, each percentile of age within the reminiscence bump took up about 2.37 percent of lifeline space, or 237% of its fair share.

Effects of Drawing Direction

One purpose of the study was to investigate whether the reminiscence bump expansion may be an artifact of drawing the lifeline from left to right, due to people underestimating how much space they need to draw the entire lifeline, causing them to expand earlier decades and compress later ones. To examine this possibility, subjects in the study also completed a lifeline

drawn from right to left, i.e., from current age back to birth. The reverse-drawn lifeline was analyzed with regards to the reminiscence bump expansion, using the same techniques as for the forward lifeline.

Chronological and spatial density of life events. Frequency distributions were generated for reminiscence bump events (ages 11 – 30) over ten equal divisions of percentage age and percentage of lifeline space using the pooled set of events from the reverse lifeline (N = 21), shown in Figures 12 and 13. In contrast to the forward lifeline, a rightward shift of reminiscence bump events is not clearly evident from these distributions. Indeed, for reminiscence bump events on the reverse lifeline, the mean of percentage age (M = 28.51, SD = 7.38) and the mean of percentage distance (M = 29.70, SD = 11.02) were comparable. However, the distribution for percentage distance did appear to be relatively more spread out, equally in each direction, rather than shifted solely to the right. It was found that 82.5% of reminiscence bump events occurred in the 3rd and 4th deciles of percentage age, but only 70.0% of these events occurred within the 3rd and 4th deciles for percentage distance, indicating that a portion of events was distributed to the surrounding deciles. The frequency distributions for reverse lifeline events from all ages over percentage age and percentage of lifeline space are also shown in Figures 14 and 15 for reference.

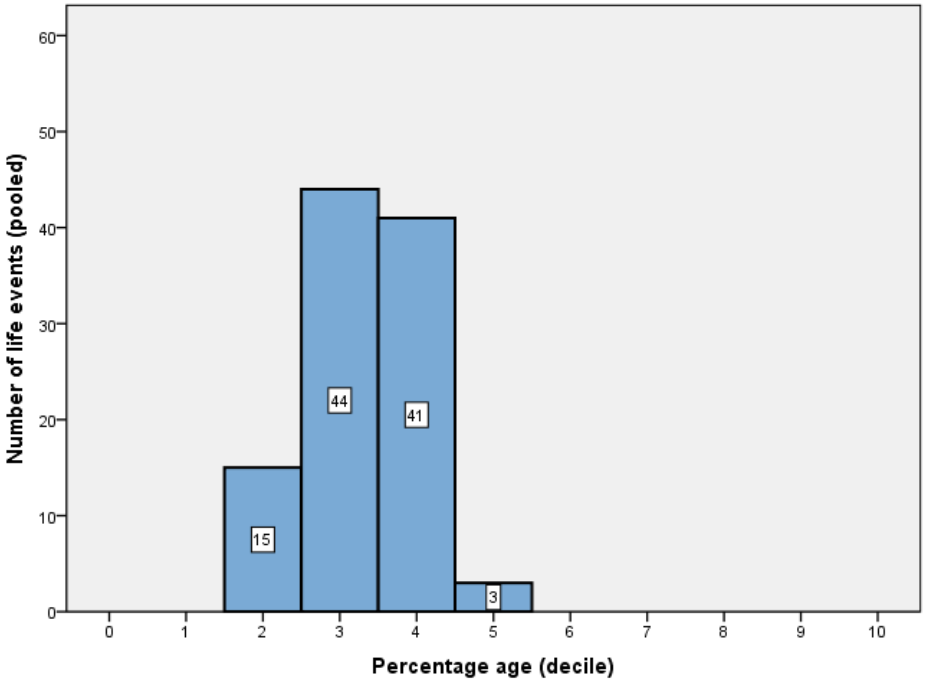


Figure 12. Distribution of reverse lifeline life events (ages 11-30) over percentiles of age

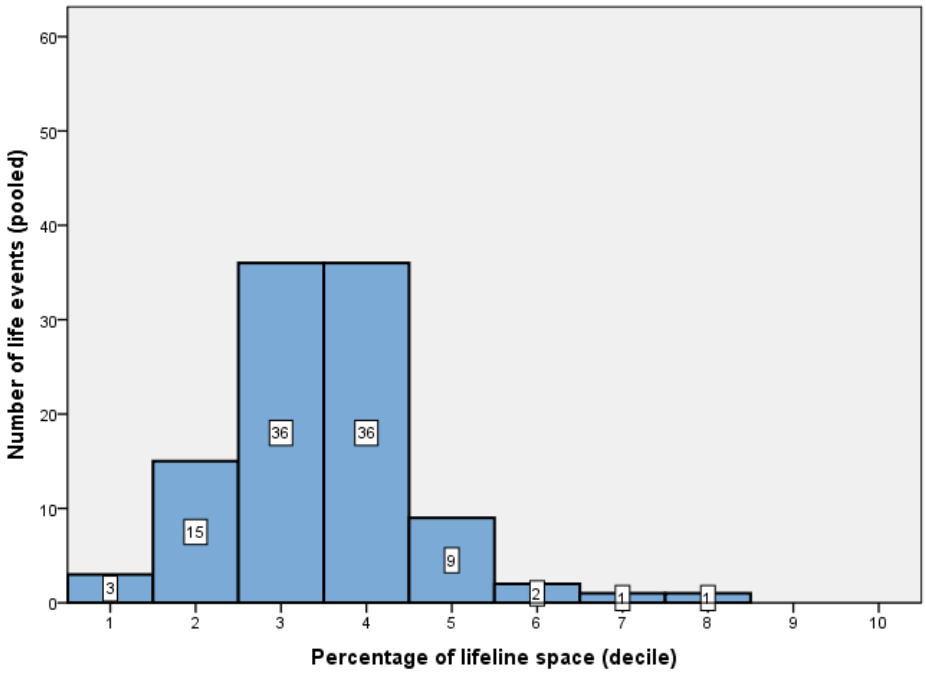


Figure 13. Distribution of reverse lifeline life events (ages 11-30) over percentiles of lifeline space

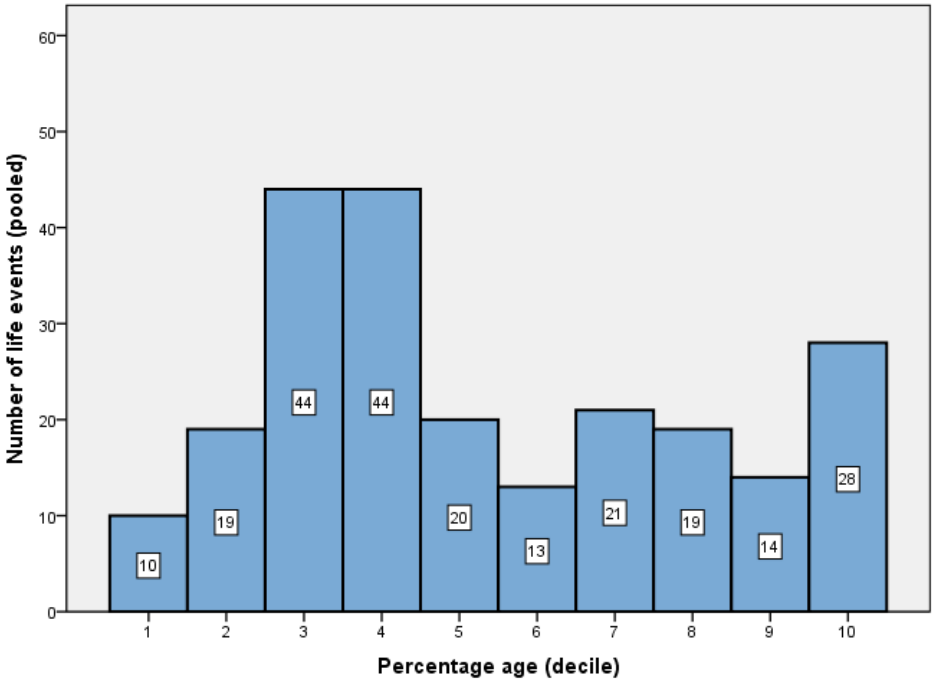


Figure 14. Distribution of reverse lifeline life events over percentiles of age

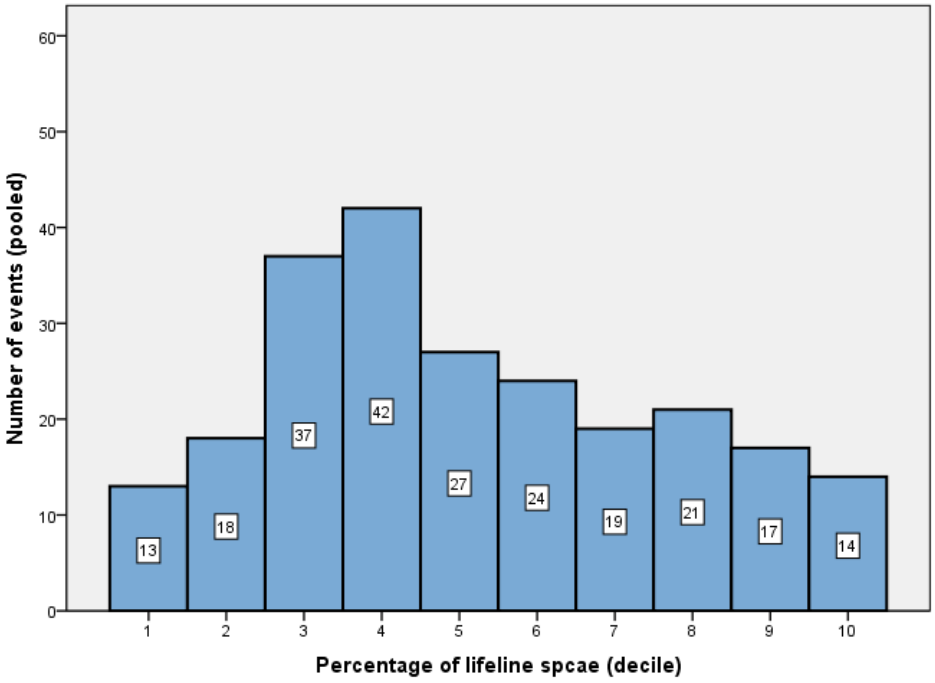


Figure 15. Distribution of reverse lifeline life events over percentiles of lifeline space

Quantifying the ratio of expansion in regression analyses. To further investigate whether the reminiscence bump expansion was an artifact of the forward drawing direction, the degree of expansion present within the reverse lifeline was quantified using the same ratio as for

the forward lifeline. Again, this ratio indicated the degree of expansion based on the percentage of lifeline space taken up for each percentile of a subject's age, within the period of ages 11 – 30. For each subject's life events, the regression line predicting percentage distance from percentage age was obtained. Participants that had fewer than two events between ages 11 – 30 on a particular domain lifeline were excluded from the regression analysis of that domain, because a regression line could not be calculated. The slope of the regression line provided the ratio of expansion for this set of events, i.e., the percentage of lifeline distance taken up by each percentile of chronological age. A hypothetical slope of 1.0 would indicate that lifeline space was allocated evenly based on percentage age, while a slope greater than 1.0 would indicate that the set of events took up an inordinately large amount of space.

The results showed that the mean slope of the regression equation (the unstandardized regression coefficient) among subjects ($N = 20$) for reminiscence bump events (ages 11 – 30), was 2.00 ($SD = 2.51$). However, the computed slope of 2.00 was not significantly different from the hypothetical slope of 1.0, representing even allocation of space, $t(19) = 1.43$, $p = .168$, $d = 0.32$. Thus, it could not be statistically confirmed that the ratio's difference from 1.0 was not due to chance. Despite a ratio of expansion of 2.00 for the reverse lifeline, compared to 1.77 for the forward lifeline, only the latter was confirmed to be significantly higher than 1.0. This was due to the fact that the standard deviation of the ratio of expansion among subjects ($SD = 2.51$) for the reverse lifeline was more than twice that of the forward lifeline ($SD = 0.97$). The higher standard deviation indicates that subjects scaled the reminiscence bump period very differently from each other in drawing the reverse lifeline. The smaller sample size for the reverse lifeline may have also contributed to the nonsignificant result, as not all subjects were able to complete

that final lifeline. So, the regression analysis used to calculate the ratio of expansion was not able to quantify the expansion as significantly different from that of an even allocation of space.

Positional shift of the reminiscence bump. As an additional method to determine whether the reminiscence bump expansion was an artifact of the forward drawing direction, the study investigated how events from each decade of life in the reverse lifeline were shifted from their expected position on the lifeline. The same method employed for the forward, overall lifeline was employed to analyze the reverse lifeline. For each event, the expected percentage distance across the lifeline was assigned to match that event's actual percentage of the subject's chronological age. Thus, expected position was based on the hypothetical assumption of a perfect linear relationship between an event's percentage of chronological age and its percentage of distance across the lifeline. For each event, the deviation from the expected position was calculated as the difference between actual position and expected position (i.e., percentage of lifeline distance minus percentage of age) in units of percentages of lifeline space. As described in detail in the above analysis of the forward lifeline, a statistic representing the mean shift for each decade of life (e.g., 10s, 20s, etc.) was calculated, with a rightward shift receiving a positive value and a leftward shift receiving a negative value. Figure 16 shows the average position shift for each decade, based on subjects' ($N = 21$) life events from the reverse-drawn lifeline.

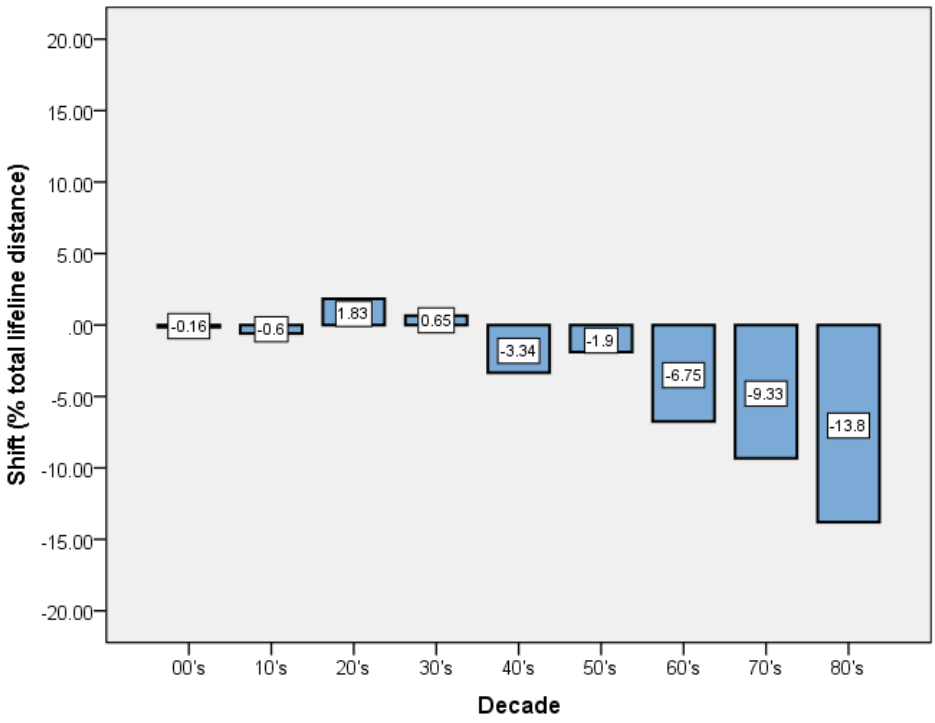


Figure 16. Mean shift from expected position for reverse lifeline events within decades of age

Table 5 provides the mean shift for each decade, and, as with analysis of the forward lifeline, an accompanying value referred to as the independent positional shift. By cancelling out the additive effect of shifts accumulated from decades drawn in preceding order, the independent shift shows the degree to which a decade's events were shifted once the subject reached that decade in the process of drawing the lifeline. So, for the reverse-drawn lifeline, which was drawn right-to-left, i.e., current age back to birth, the independent shift controls for the additive effect of shifts accumulated from *older* decades. Looking at the independent shift is especially pertinent for the 10s and 20s because, unlike with the forward lifeline, multiple decades of events were drawn *before* the subject reached young adulthood in the drawing process. Looking at the mean shift for reminiscence bump events, it is observed that events in the 20s were first independently shifted slightly to the right (M = 1.18), and, following that, events from the 10s were then independently shifted slightly to the left (M = -2.43). This effect matches the pattern observed in the frequency distributions for reverse lifeline reminiscence bump events, namely, that events

were spread out both left, into younger childhood's space, and right, into space for full adulthood. These two slight shifts in opposite directions combined to form the expansion of the 10s and 20s. It is also observed that events from the 30s were independently pulled back to the right ($M = 3.99$), against the drawing direction, making room for this expansion. Overall, it was seen that drawing the lifeline in reverse led subjects to expand the reminiscence bump period into space for both earlier and later years, in contrast to the distinct expansion rightward into middle age seen in the forward-drawn lifeline. So, the reminiscence bump expansion was found not to be an artifact of drawing the lifeline from left-to-right, but there was an interaction between drawing direction and specifically *how* the 10s and 20s were expanded.

Table 5: Mean shift from expected position for reverse lifeline events within decades

Decade	Shift (% total lifeline distance)	Independent shift (% total lifeline distance)
00's	-0.16	0.44
10s	-0.60	-2.43
20s	1.83	1.18
30s	0.65	3.99
40s	-3.34	-1.44
50s	-1.90	4.85
60s	-6.75	2.58
70s	-9.33	4.47
80s	-13.80	-13.80

Note. The mean shift for each year of age within a decade was weighted equally to produce the mean shift for the decade. Isolated shift was calculated by subtracting the sum of preceding decades' shifts.

Correlations with Reminiscence Functions Scale Identity Factor

The hypothesis that subjects' total RFS score and their total number of events on the overall lifeline would be positively correlated was not supported, as there was not a significant correlation, $r(16) = .44$, $p = .066$, but the relationship was in the hypothesized direction. Neither was the hypothesis supported that subject's scores on the Identity factor would be positively correlated with total number of events on the overall lifeline, as there was not a significant correlation, $r(19) = .19$, $p = .423$. However, as hypothesized, there was a moderate positive correlation between subject's Identity factor scores and the total number of negative events in the overall lifeline, $r(19) = .44$, $p = .046$. This finding supports the previous finding that the Identity factor was negatively correlated with happiness, indicating that reminiscing for purposes of identity may involve reflecting on both positive and negative experiences in order to improve oneself (Webster, 2003; Webster & McCall, 1999). Finally, the hypotheses was not supported that subjects' Identity factor scores would be positively correlated with their total number of events in the reminiscence bump period (ages 11 – 30), $r(19) = .03$, $p = .915$ or with the ratio of spatial expansion of the reminiscence bump, $r(19) = .02$, $p = .934$. Additionally, in an exploratory analyses, there were no significant correlations between Identity scores and the percentage of overall lifeline reminiscence bump events shared with the Family lifeline, $r(19) = .10$, $p = .667$, Work lifeline, $r(19) = -.24$, $p = .291$, or Social lifeline, $r(19) = -.04$, $p = .872$.

Chapter 4: Discussion

The purpose of the study was to investigate how the reminiscence bump period of adolescence and young adulthood was depicted on the LIM lifeline (Assink & Schroots, 2010) and to draw conclusions on how the graphical representation of this period may reflect its importance in autobiographical memory. The study sought to quantify how individuals scaled their depiction of the reminiscence bump period in the context of subjective allocation of lifeline space. The study also sought to investigate the pattern of how life events were distributed across both chronological age and lifeline space. The reverse-drawn lifeline, drawn from current age back to birth, was used to determine whether the spatial expansion of the reminiscence bump was an artifact of drawing direction. Additionally, domain-specific lifelines for family, work, and social life were used to examine the degree to which different domains of life contribute to the influence and event content of the reminiscence bump in autobiographical memory. Conclusions are drawn based on how adolescence and young adulthood, comprising the reminiscence bump period, may serve as the principal period of identity formation, and how reminiscence may work to maintain narrative identity throughout the lifespan.

The Reminiscence Bump on the Lifeline

Detection of the reminiscence bump. Replicating previous research, a reminiscence bump was detected in the overall lifelines of a sample of older adults, with the 10s and 20s containing the most events per decade. The same finding was observed in the domain-specific lifelines for Work/Education and Social/Friends. A slightly different pattern was observed on the Family/Home lifeline, with the 20s containing the most life events per decade, reflecting the reminiscence bump, and the 50s containing the second-most life events. On the Family lifeline, events associated with one's children becoming adults predominated in the 50s, such as a child's

college graduation, their marriage, or the birth of their children (i.e., the subject's grandchildren). Overall, the findings align with past autobiographical memory research, which has established the existence of a reminiscence bump for the number of events (Rubin, Rahhal, & Poon, 1998), including prior lifeline research (Assink & Schroots, 2010; Schroots, van Dijkum, & Assink, 2004). This congruence with prior research in detecting the reminiscence bump supports the validity of the current study's use of the retrospective lifeline and domain-specific lifelines.

Spatial expansion of the reminiscence bump. As hypothesized, the reminiscence bump took up more than its proportional share of horizontal space on the overall lifeline. The calculated *ratio of expansion* for the overall lifeline showed that each percentage of chronological age within the reminiscence bump (ages 11 – 30) took up 1.77 percent of lifeline distance, indicating that the reminiscence bump took 177% of its proportional share of space. The ratio of 1.77 was significantly greater than the hypothetical ratio of 1.0, representing an even allocation of space. The findings support those of Pierce and Schroots (2009), who initially showed the spatial expansion of the reminiscence bump on the lifeline, by reporting a ratio of expansion of 2.02 (i.e., 202% of proportional representation) for ages 15 – 29 on the retrospective portion of LIM lifelines. The spatial expansion of the reminiscence bump, i.e., its overrepresentation on the lifeline may serve as a measure of this period's elevated importance in autobiographical memory and, relatedly, personal identity. The importance of the reminiscence bump in personal identity may be explained by theories of identity formation in adolescence and young adulthood. Individuals may first integrate their experiences into a coherent adult identity in adolescence and young adulthood and may rely on this identity throughout their lifespan (Rubin et al., 1998). This formative period may remain highly accessible in autobiographical memory throughout the lifespan, particularly as individuals continuously refer back to lifelong

goals initially formed in adolescence and young adulthood (Conway & Pleydell-Pearce, 2000). Indeed, after the distinct period of identity formation in adolescence and young adulthood, narrative identity may solidify and become more resistant to change (Fitzgerald, 1988).

Mechanics of the expansion effect. As hypothesized, statistical comparison of the chronological and spatial distributions of life events on the overall lifeline revealed that, despite the density of events in early life, events were relatively evenly spaced across lifeline distance. The frequency distribution of life events over percentage age showed a sharp peak in the third and fourth deciles, reflecting the reminiscence bump. In contrast, the frequency distribution of life events over percentage of lifeline distance showed that events were more evenly distributed across the horizontal space of the lifeline. Thus, a major underlying factor of the spatial expansion of the reminiscence bump may be subjects' tendency to space events more evenly across the lifeline, regardless of how closely together events occurred chronologically. Specifically, given the density of events within the 10s and 20s, this period may necessarily consume more than its fair share of space, as subjects tend to spread out events more equally across the lifeline.

Based on this effect, the large number of important life events within the reminiscence bump may be a major factor underlying its overrepresentation on the lifeline and influence in autobiographical memory. The findings match those of Pierce and Schroots (2012), who also found that lifeline events were more evenly distributed across lifeline space than over chronological age. The current study was able to confirm this pattern by comparing distributions of percentage age and percentage distance, partially controlling for subjects' varying current age. That subjects may be less concerned with objectively-accurate scaling and more concerned with distinguishing important life events from each other underscores the subjective nature of the

lifeline measure and how conclusions regarding personal identity may be drawn based on subject' responses in drawing the lifeline.

The reminiscence bump consumes space from middle age. In order to further investigate the spatial expansion of the reminiscence bump, the chronological and spatial distributions of reminiscence bump events (ages 11 – 30) were compared. Consistent with the pattern described above, the peak of events in this period was relatively spread out across the space of the lifeline. Specifically, it was found that events from ages 11 – 30 spread into space which would otherwise be allocated to middle-age, but did not spread into space for childhood. Indeed, for reminiscence bump events, the mean percentage of lifeline distance was approximately 10% greater than the mean percentage of chronological age.

In order to investigate the positional shift of the reminiscence bump on the overall lifeline in the context of the entire lifespan, the mean positional shift for life events from each decade was calculated. *Positional shift* was calculated as the difference between actual position along the length of the lifeline and expected position, i.e., where the event would be positioned if the lifeline were accurately scaled by chronological years. It was found that events from the 10s and 20s were shifted to the right of their expected position by 7.29% and 12.28% of total lifeline distance, respectively. It was further observed that shifts were primarily independent of the very slight rightward shift in childhood (the 00s), which is important because childhood events were drawn before adolescence and young adulthood and could potentially affect how they were positioned. Thus, the analysis of positional shift from expected position by decade provided further evidence that events from the reminiscence bump period consume space from middle age. In the context of the entire lifespan, it was observed that events from the 30s, 40s, and 50s were independently pulled back to the left, compressing middle age against young adulthood. The

finding that the reminiscence bump in adolescence and young adulthood effectively steals space from middle age on the lifeline may indicate that the magnified importance of this period in autobiographical memory and personal identity may come at the expense of the perceived importance of middle age. The fact that lifelong personal identity may solidify in young adulthood may explain the potentially limited role of experiences from middle age in autobiographical memory (Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, Rubin et al., 1998).

The Effect of Drawing Direction on the Reminiscence Bump Expansion Effect

In order to determine that the spatial expansion of the reminiscence bump was not an artifact of drawing the lifeline from birth to present, the effect was analyzed in the reverse-drawn lifeline, which was drawn from current age back to birth (right to left). The concern was that individuals may exhibit a tendency to underestimate the amount of remaining space necessary to complete the lifeline to scale, contributing to the spatial expansion of earlier decades, including the reminiscence bump. To detect the reminiscence bump in the reverse lifeline and evaluate the potential effects of drawing direction the reverse lifeline was analyzed using the same techniques as for the forward lifeline.

The calculated ratio of expansion for the reverse lifeline showed that each percentage of chronological age within the reminiscence bump (ages 11 – 30) took up 2.00 percent of lifeline distance, indicating that the reminiscence bump took 200% of its proportional share of space – However, this ratio was not found to be significantly greater than a ratio of 1.0, representing even allocation of space. Thus, despite a quantitatively greater ratio of expansion in the reverse lifeline than in the forward lifeline (200% vs. 177%), the regression analysis was not powerful enough to quantify the spatial expansion of the reminiscence bump as significantly greater than

an even allocation of space. The fact that the standard deviation of the ratio of expansion for the reverse lifeline (SD = 2.51) was more than twice that of the forward lifeline (SD = 0.91) detracted from the power of the regression analysis. This higher standard deviation indicated that subjects scaled the reminiscence bump period very differently from each other in drawing the reverse lifeline. The high variation among subjects indicates that drawing the lifeline in reverse may be a difficult or odd task, which affects subjects' responses in different ways. It should be noted that the reverse-drawn lifeline was only used in the current study in order to control for the possible confound of drawing direction, and that the forward-drawn lifeline, as a well-established measure, was used to evaluate the study's hypotheses.

While the regression analysis was too underpowered to meet the statistical criterion necessary to quantify the ratio of expansion in the reverse lifeline, examination of the frequency analysis of reverse lifeline life events demonstrated the spatial expansion of the reminiscence bump. Comparison of the chronological and spatial distributions of reverse lifeline reminiscence bump events (ages 11 – 30) showed how the distribution of events in this period was relatively spread out across the space of the lifeline space. Interestingly, in the reverse lifeline, events were spread out relatively equally in both directions, consuming space from both childhood (the 00s) and middle age, in contrast to how events in the forward lifeline were spread exclusively into middle age. Indeed, among reverse lifeline reminiscence bump events, the mean of percentage of chronological age (M = 28.51, SD = 7.38) and the mean percentage of lifeline distance (M = 29.70, SD = 11.02) were within 1.25 percent of each other.

Additionally, in order to investigate the positional shift of the reminiscence bump on the reverse lifeline in the context of the entire lifespan, the mean positional shift for life events from each decade was calculated, as was done for the forward lifeline. Again, positional shift was

calculated as the difference between actual position along the length of the lifeline and expected position, i.e., where the event would be positioned if the lifeline were accurately scaled by chronological years. Looking at the *independent shift*, which controlled for the additive shift accumulated from decades drawn previously on the lifeline, was especially pertinent for the 10s and 20s in the reverse-drawn lifeline, because, unlike the forward lifeline, multiple decades of events (i.e., old age and middle age) were drawn *before* the subject reached young adulthood. It was found that events from the 20s were first independently shifted slightly to the right of expected position by an average of 1.18% of total lifeline distance. Following that, events from the 10s were independently shifted slightly to the left of expected position by an average of 2.43% of total lifeline distance. Overall, these two slight shifts in opposite directions combined to form the spatial expansion of the reminiscence bump, comprised of the 10s and 20s, matching the pattern observed in the frequency analysis and demonstrating that reverse lifeline reminiscence bump events consumed space from both childhood (the 00s) and middle age. This pattern contrasted with the distinct rightward expansion of the reminiscence bump into middle age observed in the forward-drawn lifeline.

Beyond the particular pattern of expansion, the most important finding from the frequency analysis and analysis of positional shift was that the spatial expansion of the reminiscence bump was still present in the reverse-drawn lifeline, confirming that the effect was not merely an artifact of drawing the lifeline from birth to current age. Because the pattern of results did not implicate drawing direction as a confound in the expansion effect, the study's conclusions based on the forward lifeline remain intact. The finding that childhood (the 00s) was not substantially shifted to the right on the forward lifeline supports the notion that rightward expansion was specific to the reminiscence bump and not part of a general tendency for subjects

to expand the first few decades they draw. While the regression analysis was too underpowered to meet the statistical criterion necessary to specifically quantify the ratio of expansion in the reverse lifeline, this should not diminish confidence in the primary findings from the frequency analysis, particularly in light of the quantitatively greater, though non-significant, ratio of expansion for the reverse lifeline, compared to the forward lifeline (2.00 vs. 1.77).

Interestingly, the particular pattern by which the reminiscence bump period consumed space from adjacent periods differed between the forward and reverse-drawn lifelines. However, upon closer inspection, the pattern in the reverse lifeline actually solidifies the primary finding that the reminiscence bump period effectively steals space from middle age. In the context of both the forward and reverse-drawn lifelines, and considering the order in which decades were drawn, space was stolen from middle age regardless of drawing direction, even when, in the reverse lifeline, this apparently required forethought that extra space may be desired for the reminiscence bump period. In contrast, space was only stolen from childhood (the 00s) in the reverse-drawn lifeline, when subjects were effectively left with no other option if they were to use extra space for the reminiscence bump period. Thus, data from both lifeline types support the primary finding that the reminiscence bump in adolescence and young adulthood specifically consumes lifeline space which would otherwise be allocated to middle age.

The Reminiscence Bump in Domains of Life

Through the use of domain-specific lifelines for Family/Home, Work/Education, and Social/Friends, the current study was able to explore how both reminiscence bump events and the expansion effect of the reminiscence bump may be drawn from different areas of life. This allowed for investigation into how different domains contribute to the content and magnified influence of the reminiscence bump. First, the event content of the reminiscence bump was

investigated by calculating the percentage of each subject's overall lifeline life events in ages 11 – 30 which were also present in each of the subject's domain lifelines. Comparison of these percentages provided an indication of how reminiscence bump events may be drawn from the basic domains of family, work, and social life. The highest percentage of overall lifeline reminiscence bump events was drawn from the Family/Home domain (39.05%), followed by that of the Social/Friends (28.17%) and Work/Education (25.48) domains. The findings indicate that the event content of the reminiscence bump may be largely drawn from major and important areas of life, such as family, social, and work life. The particularly large proportion of reminiscence bump events drawn from family life were predominately related to the formation of one's family (i.e, marriage and the birth of a child), supporting the idea that one's family becomes part of one's personal identity. The finding aligns with those of Assink and Schroots (2010), who found that the most common categories for lifeline events in the 20s were Relations for males participants and Birth and Relations for female participants. Interestingly, the percentage of events drawn from the Social domain was noticeably higher within the reminiscence bump than over the lifespan as whole (28.17% vs. 19.68%), indicating that one's social life may be especially important to personal identity in adolescence and young adulthood.

Additionally, the study investigated how the influence of the reminiscence bump, as shown by its overrepresentation on the lifeline, may be drawn from different areas of life. Specifically, the potential domain source of the spatial expansion of the reminiscence bump was investigated by determining the presence of the expansion in each of the domain lifelines of Family, Work, and Social life. The ratio of expansion was calculated providing the percentage of lifeline space taken up by each percentage of chronological age within the reminiscence bump period of ages 11 – 30. Based on the ratio of expansion it was found that the reminiscence bump

took up 196% of its proportional share of space on the Family lifeline, 185% on the Work lifeline, and 237% on the Social lifeline. Each domain's ratio of expansion was higher than that of the overall lifeline (177%), indicating that these domains may, collectively, contribute to the spatial expansion of the reminiscence bump. The finding that the reminiscence bump was especially overrepresented on the Social lifeline indicates that the influence of adolescence and young adulthood in autobiographical memory may be particularly drawn from important social experiences in that period.

One potential limitation of the study involved how overall lifeline events were automatically categorized as belonging to the domains of Family/Home, Work/Education, and Social/Friends, based solely upon their presence in the respective domain lifeline. In this way, rather than following a set of rules for categorizing events, the study allowed subjects themselves to nominate events as belonging to a certain domain. A more consistent method of individually categorizing lifeline events, such as that employed by Schroots and Assink (2005), may have enabled improved accuracy. In the current study, domains were only broadly defined for the subject so that it would not be too difficult for them to recall events for that domain's lifeline. As a result of the broad definition of domains, some life events were present in multiple of a subject's domain lifelines and were categorized as belonging to both domains. As well, a small number of events were present in certain domain lifelines which did not appear to be strictly related to that domain but were nonetheless categorized as belonging to it on the basis of the subject's choice to include them. While the use of the broad domains of family, work, and social life allowed the study to draw conclusions about the influence of major areas of life, a more exact categorization system may have potentially delineated more clearly among domains and excluded unrelated events from a given domain. Future research using domain-specific lifelines

could still make use of a small number of broad domains, while also incorporating more exact rules for inclusion and categorization of events. Schroots and Assink's (2005) categorization system could potentially be adapted for use with domain-specific lifelines by combining numerous of their categories and narrow subcategories into larger domains, while maintaining the respective rules of categorization.

General Conclusion

Overall, the study presents a number of contributions with regards to both the theory and practice of lifeline research. The digitization of lifeline data represents a step forward in efficiency and accuracy of data reduction, reducing measurement of event position to a fraction of the time required to measure by hand. The implementation of a solely retrospective lifeline, which defined the range of the lifeline as from birth to current age, allowed for exclusive focus on autobiographical memory for the past and limited the potential influence of subjects' anticipated future on their responses. Primarily, the current study quantified the spatial expansion of the reminiscence bump period, across the space of the lifeline, by determining that the 10s and 20s took up 177% of their proportional share of lifeline distance. This supports results from prior research (Pierce & Schroots, 2009) and also qualified how different domains of life contribute to the reminiscence bump and its expansion. Investigation into the underlying mechanics of the reminiscence bump expansion revealed that, despite the density of events in the 10s and 20s, events were relatively evenly spaced across lifeline distance, supporting results from past research (Pierce & Schroots, 2012) and indicating that the large number of important life events within this period contributes to its expansion on the lifeline. The spatial expansion of the reminiscence bump was further qualified by the finding that events from the reminiscence bump period spread into space which would otherwise be allocated to middle age but did not spread

into space for childhood, indicating that the magnified importance of this period in autobiographical memory and personal identity may come at the expense of middle age. This finding supports the theory that lifelong personal identity may solidify in young adulthood, leading to a more limited role for middle age in autobiographical memory (Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, Rubin et al., 1998). Future research may evaluate the external validity or generalizability of the findings beyond the relatively homogenous White, highly-educated sample in the current study.

Analysis of the reverse-drawn lifeline, which was drawn from current age back to birth (right-to-left), supported the position that the spatial expansion of the reminiscence bump was not an artifact of drawing the lifeline from birth to present. The expansion effect was specific to the reminiscence bump and was not part of a potential general tendency for subjects to expand the first decades that they drew. Additionally, through the novel use of domain-specific lifelines, it was demonstrated how the event content and influence of the reminiscence bump may be drawn from family, work, and social life domains. The finding that a large proportion of reminiscence bump events were drawn from family life supports the idea that one's family becomes part of one's personal identity. That the reminiscence bump was most overrepresented on the Social lifeline and that a relatively large percentage of events were drawn from social life within the reminiscence bump, compared to the lifespan as a whole, indicates that the influence of adolescence and young adulthood in autobiographical memory may be particularly drawn from important social experiences.

Overall, the study supports and clarifies the important role of adolescence and young adulthood, comprising the reminiscence bump period, as the integral period of identity formation. Future research should examine the depiction of each phase of life on the lifeline in

order to more fully develop a model of how different periods are scaled based on their importance in autobiographical memory and personal identity. The study's analysis of the positional shift from expected position of events from each decade represents a step in this direction. Future research may potentially employ different types of lifelines, such as those for specific domains, and this larger scale of research may be aided by improvements in data reduction. By taking a number of innovative steps, the study highlights the abundance of opportunity available in lifeline research. While a simple and intuitive measure, the subjective nature and lifespan perspective offered by the lifeline allows for deeper insight into both autobiographical memory and personal identity.

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Appendix A: Demographics Questionnaire

Demographics questionnaire

1. What is your ethnicity? (Check all that apply)

- ☐ White
- ☐ Black
- ☐ Hispanic/Latino
- ☐ Asian
- ☐ Native American
- ☐ Other

2. What is your gender?

- ☐ Male
- ☐ Female

3. What is your age?

_____

4. Are you right or left-handed?

- ☐ Right-handed
- ☐ Left-handed
- ☐ Ambidextrous

5. How many years of education do you have?

_____

6. What was/is your primary career?

_____

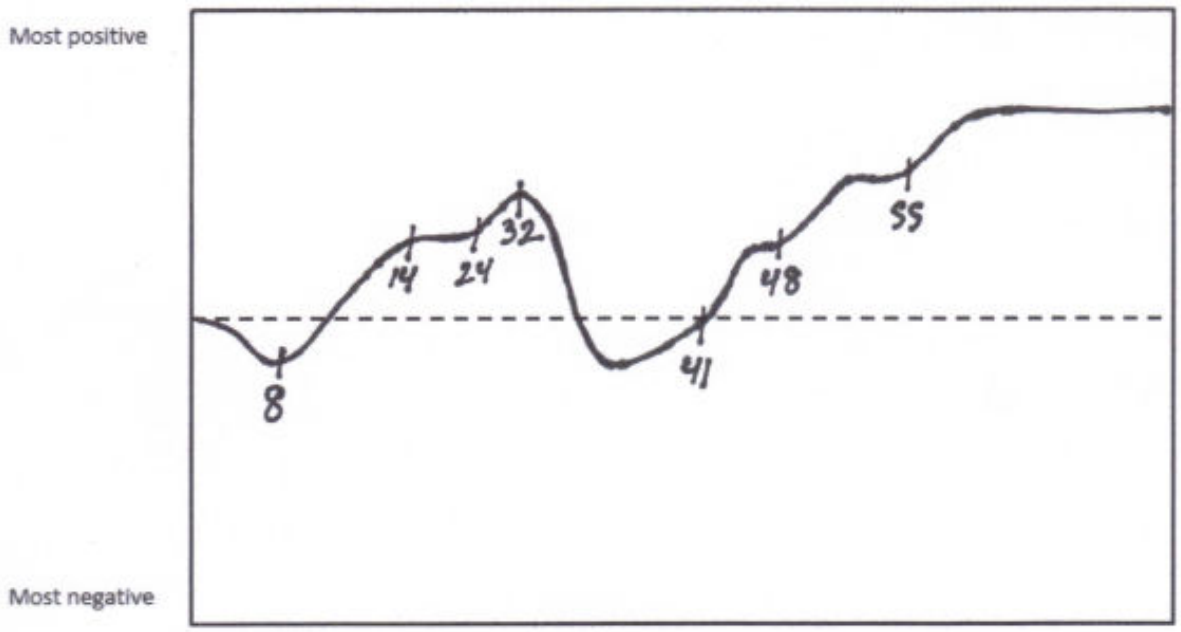
7. How many hours of sleep do you normally get?

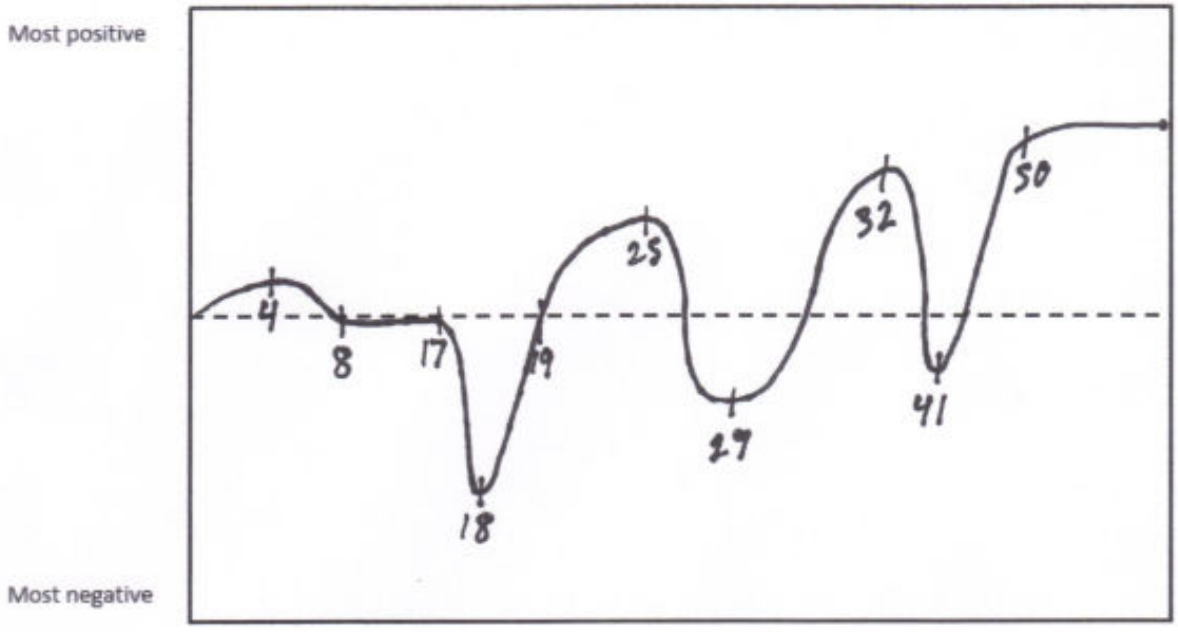
_____

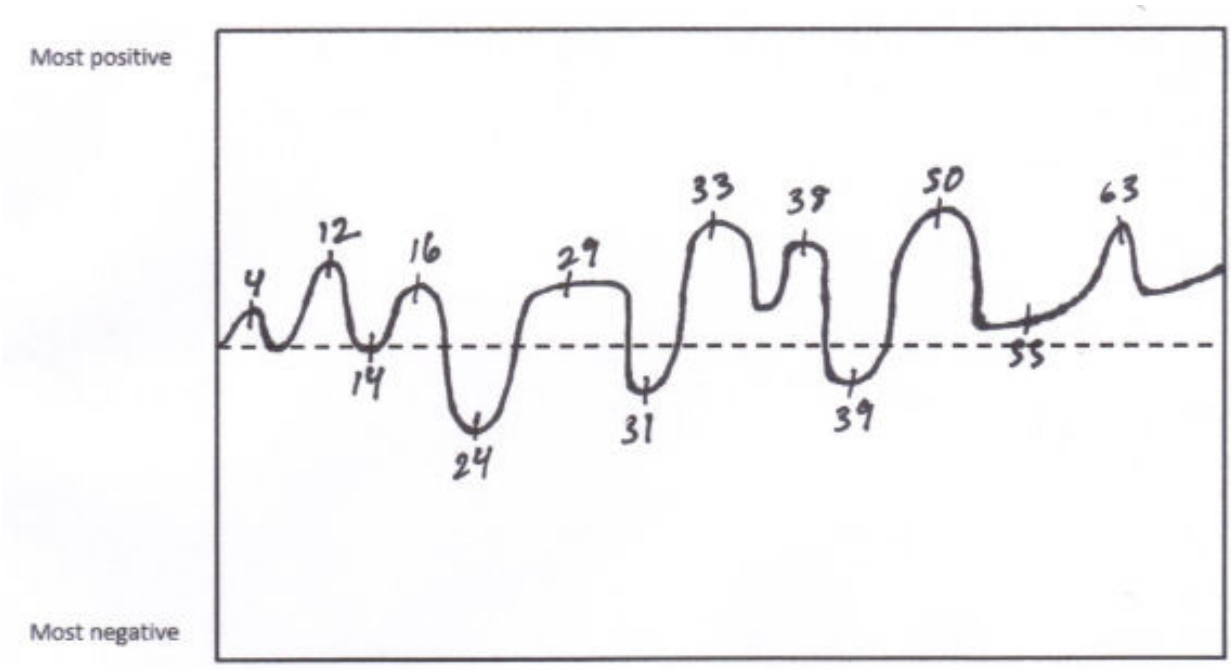
8. How many hours of sleep did you get last night?

_____

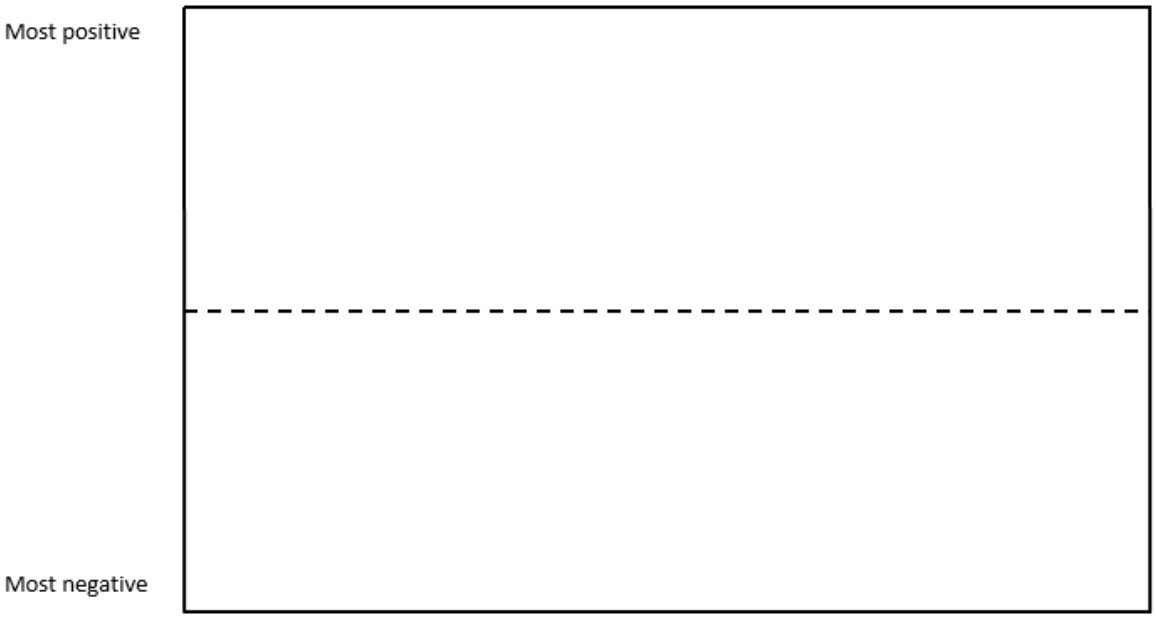
Appendix B: Sample Lifelines






Most positive
4
12
14
16
24
29
31
33
39
39
50
55
63
Most negative

Appendix C: Blank Lifeline



Appendix D: Domain Importance Questionnaire

Domain importance questionnaire

1. How important is your family and home life to your life overall?

1	2	3	4	5
Less important				More important

2. How important is your work and school life to your life overall?

1	2	3	4	5
Less important				More important

3. How important is your social life with friends to your life overall?

1	2	3	4	5
Less important				More important