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Immigration, Language Proficiency, and Autobiographical Memories: Lifespan Distribution and Second-Language Access

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Abstract

This investigation examined two controversies in the autobiographical literature: how cross-language immigration affects the distribution of autobiographical memories across the lifespan and under what circumstances language-dependent recall is observed. Both Spanish/English bilingual immigrants and English monolingual non-immigrants participated in a cue word study, with the bilingual sample taking part in a within-subject language manipulation. The expected bump in the number of memories from early life was observed for non-immigrants but not immigrants, who reported more memories for events surrounding immigration. Aspects of the methodology addressed possible reasons for past discrepant findings. Language-dependent recall was influenced by second-language proficiency. Results were interpreted as evidence that bilinguals with high second-language proficiency, in contrast to those with lower second-language proficiency, access a single conceptual store through either language. The final multi-level model predicting language-dependent recall, including second-language proficiency, age of immigration, internal language, and cue word language, explained $\frac{3}{4}$ of the between-person variance and $\frac{1}{5}$ of the within-person variance. We arrive at two conclusions. First, major life transitions influence the distribution of memories. Second, concept representation across multiple languages follows a developmental model. In addition, the results underscore the importance of considering language experience in research involving memory reports.

Many individuals have the experience of moving to a new home over the course of their lives, but for cross-language immigrants the new home is accompanied by a new culture, new laws, and a new language. We took advantage of the natural experiment provided by cross-language immigration to answer unresolved questions regarding the influence of the socio-linguistic context on aspects of autobiographical memory, specifically, the reminiscence bump and language-dependent recall.

Memories from early life are over-represented in a lifetime distribution, a phenomenon referred to as the reminiscence bump (Rubin, 2000). The effect is considered to be robust despite variations across culture in the specific age period it emerges and differences across

investigations in the techniques used to elicit memories (Conway, Wang, Hanyu, & Hague, 2005; Janssen, Chessa, & Murre, 2005; Rubin, Berntsen, & Hutson, 2009; Rubin & Schulkind, 1997; Steiner et al., 2013). The mechanisms underlying the reminiscence bump are not completely understood, but are thought to include both enhanced encoding and preferential retrieval (e. g., Bernstein & Rubin, 2004; Rubin, Rahhal, & Poon, 1998).

The majority of the theoretical explanations for the reminiscence bump support the prediction that cross-language immigration would result in overrepresentation of memories for the period surrounding immigration. This major life transition could guide retrieval, affect identity, and/or become a temporal landmark (e. g., Gluck & Bluck, 2007). At present, however, the few extant investigations report conflicting results. Is there a notable increase or a paucity of memories for the period of like surrounding immigration? We examined the lifetime memory distribution and the positions of the reminiscence bump among immigrants and non-immigrants to reconcile these findings.

Our cross-language participants also allowed us to examine the relation between language and memory access. Previous research with cross-language immigrant participants robustly finds that memories are often recalled through the language of their encoding (Schrauf & Rubin, 1998, 2000). However, there is a discrepancy in the literature regarding whether there is a relationship between the language spoken to elicit the memory and the language of their encoding (Schrauf & Rubin, 1998; Marian & Neisser, 2000). We examined whether a developmental model of acquired second-language proficiency could explain discrepancies in the previous literature.

Lifespan Memory Distribution and Immigration

Despite the universality of the reminiscence bump, the mechanisms that underlie the phenomenon remain unknown. Explanations include enhanced encoding of early life events because of identity formation, accommodating the new information associated with physical and psychological transitions, or optimal cognitive functioning (Brown, Hansen, Lee, Vanderveen, & Conrad, 2012; Conway & Haque, 1999; Janssen & Murre, 2008; Steiner, Pillemer, Thomsen, & Minigan, 2013). Explanations also rely on processes at retrieval that guide remembering such as culturally scripted experiences or temporal landmarks (Berntsen & Rubin, 2004; Brown et. al, 2012). Many theories would predict a “bump” during time points outside of young adulthood for a significant life event, such as involvement in war (Conway & Haque, 1999; Zebian & Brown, 2014). With the possible exception of the attribution of the bump to optimal cognitive functioning in young adulthood, the theoretical accounts listed above would thus predict a bump at immigration because it is a life-altering event that affects identity, provides a temporal landmark, and represents a major life transition. However, as discussed below, the few investigations of the lifetime distribution of memories in cross-language immigrants have differing results, with one group of studies supporting a bump during the period surrounding immigration and another providing evidence for a paucity of memories around the time of this event. This study was designed to test this discrepancy and offer an explanation for the diverging results of previous investigations.

Two studies examined the impact of cross-language immigration on the distribution of memories in a sample of older adults who immigrated to the U. S. from Spanish-speaking countries approximately 30 years earlier (Schrauf & Rubin, 1998; 2001). All participants reported high functional fluency in English. In the first study, each of the 12 participants provided a memory in response to 50 cue words from each language, and a bump emerged that corresponded to early (age 20–24), middle (26–30), or late (34–35) age of immigration, with these age groupings based on the immigration age distribution of the participants (Schrauf & Rubin; 1998). The results were replicated in a second study using a life story method with 10 of the original participants (Schrauf & Rubin, 2001).

In contrast, 44 college students who relocated to the US from Russia during adolescence exhibited a dip in the number of memories reported from the time period surrounding immigration after responding to 8 English and 8 Russian cue words (Marian & Neisser, 2000). The results were attributed to the participants' poorer encoding of events surrounding immigration compared to other events across the lifespan, resulting from their lack of a schema for the novel experiences associated with the cultural relocation. Alternatively, the dip could be an artifact of the method, which constrained participants' response to the language in which the cue word was presented (Marian & Neisser, 2000).

In addition to procedural distinctions, the different investigations varied with regard to participant age, age of immigration, and second-language fluency. The participants in Schrauf and Rubin's studies (1998, 2001) were older adults who had immigrated at least 30 years prior to the investigations and had high levels of self-rated English fluency (92.9 on a 100 point scale). In contrast, the participants in Marian and Neisser's (2000) investigation were college students who had only been in the US for 6 years on average. We addressed this controversy through both the methodology we used and the characteristics of the sample we recruited. Specifically, we used the cue word method to examine the distribution of autobiographical memories without constraining participants' language used, and we included individuals who varied in age, age of immigration, and language proficiency.

Language-Dependent Recall

Consistent with the encoding specificity principle, the mother-tongue hypothesis asserts that memories are more easily recalled through the language of their encoding (Schrauf, 2000; Tulving & Thomson, 1973). An additional component of Marian and Neisser's (2000) study supports this hypothesis. Among US college students originally from Russia, Russian cues were more likely to elicit Russian memories from before the age of immigration, whereas English cues elicited English memories from after immigration. The language of the cue also significantly predicted the participant's age at the time of the remembered event (i.e., the age at encoding) in a study with Japanese/English bilingual college students who immigrated in adolescence (Matsumoto & Stanny, 2006).

In contrast, Schrauf and Rubin's (1998, 2000) cue word studies found that the language of the cue word was not related to the age at encoding; that is, Spanish cue words did not elicit earlier memories. These studies used the same small and highly fluent Spanish/English bilingual samples described previously. Twenty older and highly fluent Danish/Polish

bilingual participants who immigrated decades prior exhibited similar results (Larson, Schrauf, Fromholt, & Rubin, 2002). We explored the possibility that the inconsistencies between studies with regard to the importance of external language might be explained by differences in the participants' second-language proficiency.

This possible explanation is based on recent findings regarding the cognitive representation of multiple languages. There is converging evidence from behavioral and neuroscience studies pointing to a single conceptual store representing bilinguals' languages (see van Heuven & Dijkstra, 2010, for review). If so, there should not be a relationship between the language of the cue word and that of encoding because the cue words would activate concepts that are not language dependent (van Heuven & Dijkstra, 2010). However, a developmental model of language acquisition predicts that individuals with low proficiency may not yet be at a point where knowledge transcends language (e.g., Kroll & Hermans, 2011). From this perspective, the second language is not initially linked to the conceptual store and may require translation through the first language until sufficient proficiency is established. To address this possibility, we examined proficiency as a moderator of language-dependent recall through a cue word study with a diverse group of cross-language immigrants.

This Study

We utilized the cue word method without constraining the language in which the participants responded. Consequently, we could explore the role of immigration and language proficiency in the distribution of memories across the lifespan and the contexts that support language-dependent recall. We expected that our sample of monolingual, non-immigrant participants' memory distributions would show a bump in reported memories that took place from middle childhood through early adulthood, replicating the results of previous studies using the cue word method (e.g., Janssen, Rubin, & St. Jacques, 2011; Janssen & Murre, 2008; Rubin & Schulkind, 1997). In contrast, we predicted that among cross-language immigrants, the bump would correspond to the age of immigration, reflecting added attention to this life-altering transition. Further, we expected to find more memory reports from the period surrounding immigration, in contrast to memories from other points in the lifespan, to be reported through two languages or a language different from that spoken by the interviewer. If so, such code-switching suggests an explanation for the reported paucity of memories surrounding immigration in the study that restricted language use (Marian & Neisser, 2000).

We further predicted that language-dependent recall would be moderated by participants' level of second-language proficiency, offering support for a developmental model of bilingual concept representation. We expected speakers to exhibit language-dependent recall if they lacked the proficiency necessary for a single conceptual store. This prediction reflects an assumption that individuals with higher proficiency would have developed a single conceptual store for a greater proportion of their vocabulary and would hence have access to autobiographical memories through either language.

Method

Participants

Thirty-six potential participants, including both Spanish/English bilingual U.S. immigrants (BI; $n = 23$) and English-speaking monolingual non-immigrants (MNI; $n = 13$), were recruited through schools offering both traditional and Spanish immersion education. All participants were teachers in the same schools within 2 school systems in Eastern North Carolina. Recruitment through the schools ensured that the two groups would have generally equivalent levels of education and similar demographic characteristics. Prior to recruitment, principals confirmed that the teachers who were native Spanish speakers had functional fluency in English, as demonstrated by their participation in professional interactions conducted in English, including parent conferences and staff development. Monolingual English speakers taught within the same schools, but in traditional English classrooms. Group assignments were established at the conclusion of the interview by participants' responses to the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, Blumefeld, & Kaushanskaya, 2007). As verified by this measure, the MNI group members had no more second language exposure than a U.S. high-school education requires, whereas the BI participants had functional use of both languages. A total of 11 additional participants were interviewed but eliminated from analyses because their language histories as elicited by the LEAP-Q did not meet the criteria for inclusion (e. g., absence of immigration; bilingual fluency at the time of immigration). The language history characteristics of the BI group are described in Table 1; Tables 2 and 3 provide information about the backgrounds of the participants in each group. As described below, not all 36 participants contributed data to all analyses. The interpretation of the Reminiscence Bump included MNI and BI participants, but only those who had not immigrated within the most recent two years ($n = 34$; see Table 2). The examination of language-dependent recall included only BI who completed the within-subject language manipulation ($n = 17$; see Table 3).

An additional 40 volunteers, 10 Spanish/English bilingual speakers and 30 English monolingual speakers, recruited through personal contacts participated only in the pilot testing of materials. The investigation was approved by the North Carolina State University IRB.

Materials

Autobiographical memory measure—A cue word recall task was chosen because it allowed for a within-subjects manipulation of two different languages for bilingual participants. Words were chosen from a list of 100 cue words, determined to be comparable in frequency and imageability prior to their use in a previous study of Spanish/English bilingual autobiographical memory (Schrauf & Rubin, 1998). Thirty of these words were selected for the present study on the basis of the research team's subjective assessments of high frequency, equivalency of frequency across languages, concreteness, imageability, connotation across language contexts, and cognate status. Each selected word was then evaluated for frequency, concreteness, and imageability using the MRC Psycholinguistic Database (Wilson, 1988). Two lists of 15 words each, 5 of which were cognates, were then created and the comparability of the three variables was established across lists using the

MRC Psycholinguistic Database (Wilson, 1988). Ratings were then obtained from an independent sample of 10 Spanish/English bilingual volunteers and 30 English monolingual volunteers which confirmed that the frequency, concreteness, and imageability were equivalent across lists and languages.

Words and list order were kept consistent for all participants, but the language of the lists was counterbalanced for BIs who were willing to participate in the language manipulation. As described below, BI participants were asked if they were willing to complete a list in English and a list in Spanish. Language was counterbalanced across BI participants so that half received list 1 in English and list 2 in Spanish and half received list 1 in Spanish and list 2 in English. The dependent variable resulting from the cue word task was the participant's estimate of the age when each reported remembered experience originally took place, labeled the Age at Encoding (AaE).

Fluency measure—The Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, Blumenfeld, & Kaushanskaya, 2007) was utilized to assess the bilingual language status of all participants who had a history of immigration or whose second language instruction exceeded requirements for a general high school degree in the state (2 years of introductory courses). The questionnaire has consistently shown both internal and criterion-based validity using factor analysis, multiple regression, and correlation analysis with a battery of standard behavioral linguistic measures (Marian et al., 2007). It contains questions regarding personal history (including immigration history), past and present language exposure, and language competence across all languages spoken.

The proficiency measure utilized in this study was the percentage of the time that the individual would choose to speak in English to a person who knew Spanish and English equally well. This preference was operationalized through the use of the following question: “When conversing with another individual who knows both Spanish and English equally well, what percentage of the time would you choose to speak in English?”. This measure was chosen because it incorporated both frequency and fluency and avoided self-evaluation of formal language abilities that might erroneously lead to low fluency self-reports for individuals whose language was socially acquired (Grosjean, 2010). The measure also implied a degree of comfort with the language that cannot be captured in a vocabulary task. Other fluency measures, listed in Table 1, were used as exclusion criteria as described above.

Code-switching Measure—Code-switching is defined as responding to a speaker in a different language (i.e. responding to a Spanish cue in English) or using more than one language within one phrase (i.e. “alguien llevo a preguntarme ‘*What’s up?*’”) (Grosjean, 2010). The language or languages used by the participant for each memory title (see below) reported in the autobiographical memory task were recorded. Titles that contained more than one language or that were provided in a language other than that of the interviewer were coded as code-switches.

Procedure

Individual interviews took place in a quiet work area in the participants' schools. They were conducted by one of three female college students of differing ethnic backgrounds, but who

all had native or native-level Spanish and English fluency. All research assistants interviewed participants from both BI and MNI groups. The interviews were based upon a scripted protocol that started with an introduction and inquiry regarding whether the participant would prefer a consent form in English or Spanish. Using the preferred language, the interviewer then told the participants that they were going to be given 30 word cues across two blocks of trials with a break for an alternative task. For each word, they were asked to think of the first memory of a specific event that came to mind from anytime throughout their life. They were asked to report a “title” for the memory for the interviewer to write down (e. g., “My sister’s wedding”) so they would be able to identify which memory they were recalling if they came back to it later. The interviewer asked if the participant was comfortable if one list was provided in English and one in Spanish. If so, the interviewer proceeded with the randomly assigned language order with all instructions and interactions on the interviewers’ part provided in the language of the cue words. If not, both lists as well as all instructions were provided through the participant-selected language. All MNI and 6 BI completed the study in one language only (English and Spanish respectively).

In responding to the cue word, participants were encouraged to report the first memory that came to mind without evaluating their reports. To further encourage such unfiltered memory reporting, the interviewer activated a timer as soon as she said the cue word and stopped it when the participant completed the “title” of the memory. No restrictions were placed on language use. If participants asked which language to use they were told “you may respond however you choose.” Interviewers recorded the time, the title of the memory, and the language(s) the participant spoke in without participant discussion.

There was a break after the presentation of the first 15 cue words, during which participants were asked to complete three computerized cognitive tasks (which were unrelated to the measures of interest in this investigation and hence are not considered in this report). The second block of 15 words followed, with the interviewer speaking in the alternate language and using the alternate language cue word list for those participants taking part in the language manipulation. Participants were then read back the titles they had provided in the same order in which they had been reported and were asked to date each memory with age in years and months at the time of the event to the best of their ability. Interviewers helped participants narrow down the time frame of the event by presenting such questions as “Were family members present?”, “Was it near a holiday?” and “Do you remember the location?”.

In addition, all BI were asked to identify the language of thought. Participants were told “the language in which you first thought about the event may not have been the same as the language you used to tell me about the event. We are going to go through the memories you reported and I would like you to tell me which language the memory first came to you in. It could be Spanish, English, neither - such as a visual memory -, or both.” These instructions made sense to all bilingual participants and they were able to provide one of the four labels to each memory. All participants then answered demographic questions and BI participants completed the LEAP-Q.

Results

All analyses were two-tailed. Analyses of covariance and t-tests were conducted using SPSS software. Multi-Level Modeling was conducted using SAS.

Lifespan Memory Distribution

Prior to analysis of the Reminiscence Bump, data from individuals who had immigrated within the most recent two years were eliminated, leaving a final sample for this portion of the analyses of 34 participants (13 MNI, 306 reported memories included; and 21 BI, 348 reported memories included). Memories from the most recent 2 years were eliminated for the remaining participants. Both of these measures were taken to avoid the intrusion of the recency effect on results. There were no differences between language groups in gender, $F(1, 34) = 2.64, p = .11$, education, $F(1, 34) = .08, p = .78$, or participant age, $F(1, 34) = 2.37, p = .13$. The BI group was predominantly Latino/a compared to a predominantly Caucasian MNI group, $F(1, 34) = 61.54, p < .001, \eta^2 = .66$. Preliminary multi-level modeling (MLM) analysis revealed no effect of the order of language presentation, participant age, sex, or years of education on the dependent measure, age at encoding (AaE), $F(1, 30) < 3.63, p > .07$. Data were collapsed across these variables for further analysis with the exception of participant age. Participant age was kept as a covariate because the age at encoding that could be reported was restricted by participant age and there was variability in participant age by design. Because participants cannot provide a memory for an event that has yet to happen, the memory distributions of young and older participants were assumed to differ. Because race was strongly associated with language group, it could not be used as a covariate.

Following the method reported in Janssen, Rubin, and St. Jacques (2011), the number of memories reported per 5-year bin was tallied to create the lifespan distribution. First, we tested for group differences in the distribution of memories. Based on previous research, we expected the bump to appear for MNI between the reported memory ages of 5 and 20, and hence we combined the number of memories reported during that period into one bin and compared it to number reported for the 15 years immediately following, controlling for participant age. We ran a 2×2 mixed model ANCOVA with between (MNI vs. BI) and within (ages 5–20 vs. 20–35) subject factors, using participant age as a covariate and Bonferroni adjustments in the follow-up analysis. The results revealed a significant interaction, $F(1,30) = 5.52, p = .03, \eta^2 = .16$, in that the BI reported significantly fewer memories between the ages of 5–20 compared to the MNI, $F(1,30) = 4.40, p = .04, \eta^2 = .13$, but the groups did not differ with regard to the number of memories reported between the ages of 20–35, $F(1,30) = 1.24, p = .27$. In addition, the MNI group had significantly more memories between the ages of 5–20 than 20–35, $F(1, 30) = 15.31, p < .001, \eta^2 = .34$, whereas the immigration group did not show a significant difference in the number of memories reported during these time periods, $F(1,31) = 1.33, p = .26$ (see Figure 1).

These analyses confirmed the expected bump for MNI and indicated that immigration affected memory distribution; however, they could not confirm a bump for the period of immigration. To do so, we centered each BI participant's memories around the individual's age of immigration, following the method of Schrauf and Rubin (2001). The 10-year period

surrounding immigration was then compared in a Repeated Measures analysis of variance to two 10-year age bins before immigration, which represented 25–15 (labeled 20 years prior) and 15–5 (labeled 10 years prior) years prior to the relocation, and a bin representing the 5–15 (labeled 10 years after) year period after the period of immigration (encompassed 5 years prior to 5 years after immigration year). Mauchly's test indicated that the assumption of sphericity had not been violated $\chi^2(5) = .384, p = .58$. There was a significant main effect of age bin on the number of memories reported, $F(3, 24) = 6.62, p < .002, \eta^2 = .45$. Pairwise comparisons revealed that the periods of 20 years prior to immigration, 10 years prior to immigration, and 10 years after immigration all contained significantly fewer memories than the 10-year period surrounding immigration (see Figure 2).

To test whether there were more code-switches surrounding immigration than other periods, we compared the 10-year period surrounding the year of immigration to all the other time bins combined in a paired sample t-test. Only those BI participants ($n = 14$) who contributed data to all 4 time bins (20 years prior, 10 years prior, immigration period, and ten years after) could be included in this analysis. The results revealed that there were significantly more code-switches during the 10-year period surrounding immigration than during all other time periods combined, $t(13) = -2.41, p = .03$, Cohen's $d = 1.34$ (see Figure 3).

Language-Dependent Recall

Language-dependent recall was examined by qualifying the relationship between age at encoding (AaE) and cue word language (CWL). Language-dependent recall was considered evident when the language of the cue word predicted the time period from which the memory was recalled. This portion of the data included only the BI participants who agreed to participate in the within-subject language manipulation ($n = 17$). Across participants, 66% of the memories were reported to have been thought in Spanish, 23% in English, 9% were considered non-linguistic, and 2% were described as thought in both languages. The hypotheses only addressed memories that were represented linguistically and in one language; memories labeled both or no-language were not included in analysis.

We employed Multi-Level Modeling (MLM) to examine the conditions that support language-dependent recall. MLM accounts for within-person variance resulting from the nesting of memories, has a vertical data structure that allows all contributed data points to be included in analysis rather than only complete cases, and enables the testing of cross-level interactions. The null model indicated sufficient variability at both Level 1 (memory level) and Level 2 (person level) to proceed (e.g., Nezlek, 2001; Raudenbush & Bryk, 2002). Results indicated that 18% of the variance was between-person ($\tau_{00} = 17.72, z = 2.35, p = .009$) and 82% was within-person ($\sigma^2 = 82.88, z = 15.20, p < .001$). All analyses included AaE as the dependent variable and CWL as an independent variable.

We tested whether second-language proficiency or age of immigration moderated the relationship between AaE and either language of thought or CWL. Language of thought and CWL were included at the level of the memory while proficiency and age of immigration were at the level of the person. Language-dependent recall was found if CWL predicted AaE. We tested for cross-level interactions. Both proficiency and age of immigration were grand mean centered to prevent issues of multicollinearity (see Appendix for equations).

Replicating previous findings, internal language predicted AaE, indicating that Spanish-thought memories were earlier than English-thought memories, $\gamma_{20} = -5.89$, $t = -4.18$, $p < .001$. CWL did not predict AaE, $\gamma_{10} = -1.11$, $t = -1.14$, $p = .25$. Age of immigration predicted AaE, $\gamma_{01} = .85$, $t = 4.48$, $p < .001$, so that participants who immigrated at younger ages tended to report earlier memories than those who immigrated later, a finding expected based on the above bump analysis. Although there was no main effect of Proficiency, $\gamma_{02} = 0$, $t = -.05$, $p = .96$, the predicted cross-level interaction with CWL emerged, $\gamma_{12} = .12$, $t = 2.39$, $p = .02$, such that participants with low proficiency tended to report earlier memories for Spanish than for English cue words but there was no evidence of a relationship between CWL and AaE among higher proficiency participants (see Figure 4). There were no other significant interactions. The model explained 73% of the between-person variance and 10% of the within-person variance.

Discussion

Lifespan Memories Distribution

The present findings resolve a discrepancy in the literature regarding the effect of immigration on the reminiscence bump. Consistent with Schrauf and Rubin (1998, 2001), we found an increase in the number of memories that dated from the period surrounding the bilingual participants' immigration to the United States. This difference was apparent when we centered memories around the age at which immigration occurred, allowing us to include all the participants in comparing the number of memories contained in 10-year bins that alternatively preceded, included, or followed their relocation.

The results not only provide support for Schrauf and Rubin's (1998, 2001) results but suggest an explanation for the absence of the immigration bump in Marian and Neisser's (2000) investigation. The paucity of memories from the period surrounding immigration that Marian and Neisser (2000) reported was likely an artifact of their method. In their study, participants were required to respond in only the language in which they were addressed by the interviewer. The period surrounding immigration would be characterized by a language transition for many individuals, with events transpiring in both the native-language and the majority-language of the new location. Events that took place before or after immigration are more likely to be encoded in the dominant language of the cultural environment. Our results lead us to conclude that when memory reports are restricted to the language of the interviewer, participants may activate a filter at recall that limits the accessibility to memories from a context consistently encoded in the language of the interviewer. Further, we assume that under these conditions, all memories are available, but those from a consistent language context are more likely to be recalled. Our results also provide support for a period of language transition. There were a greater number of code-switches when participants reported memories surrounding immigration than from all other time periods combined. Hence, the restricting of code-switches in the Marian and Neisser (2000) study may have inadvertently restricted the reporting of memories from this time period, filtering out memories from a life period in which the language was inconsistently used.

Language-Dependent Recall

The results of this investigation resolve a second discrepancy in the literature; whether recall is language-dependent in cross-language immigrants. We found that second-language proficiency moderated the relationship between cue word language and age at encoding, thus providing evidence that language-dependent recall is proficiency dependent.

The language-dependent recall examination replicated previous findings for internal language and provided an explanation for previous discrepancies regarding cue word language by identifying second-language proficiency as a moderator of the effect (Marian & Neisser, 2000; Matsumoto & Stanny, 2006; Schrauf & Rubin, 1998; 2001). Language may only be connected to recall among those bilinguals whose second-language proficiency is not yet functionally activating a single conceptual store. This interpretation is further supported by the finding that adults recalling early memories associated with cue words showed a systematic lag between the age at which the word was acquired and the age of the earliest memory associated with that word (Morrison & Conway, 2010). This finding, which is interpreted as reflecting a delay allowing the formation of conceptual knowledge, is also consistent with a developmental model of conceptual representation (e.g. Kroll & Daan Hermans, 2011; Geyer, Holcomb, Midgley, & Grainger, 2011). It appears that as second-language proficiency increases, concepts begin to transcend language easing access to memories associated with the concept regardless of language of encoding. Thus, with increased second-language proficiency, language-dependent recall decreases.

Potential Applications

Several potential limitations on the generalizability of the findings much be considered in exploring potential applications of the results. First, the sample was predominantly female. Second, among bilingual participants, each had immigrated from a Spanish-speaking country to the US. In addition, the necessary range in English proficiency reduced the sample size for some analyses because not all participants were comfortable completing the within-subject language manipulation. This reduction limited the number of variables that could be included at the participant level of the analyses, although we tested a model with age instead of proficiency and found no significant results. An older sample with immigrants who had only immigrated past the age of the traditional reminiscence bump might have been advantageous in examining the lifespan distribution of memories, but the study was designed to have a wide age range to help understand discrepant results between previous studies with college age and older adults with earlier and later ages of immigration. The results replicated the findings obtained by Schrauf and Rubin (1998, 2001), despite the fact that the mean age of our participants was about 30 years younger than that of the earlier sample.

The literature consistently shows an impact of second-language experience on memory recall. We found that the treatment of language within the interviews affected what was recalled among participants with lower levels of second-language proficiency, and that language restriction may explain a paucity of memories surrounding a transition event in previous research (Marian & Neisser, 2000). This finding has very real implications for how psychological research is conducted. More than half of the people in the world use more than one language in daily life and this figure is increasing so that even the traditionally

utilized monolingual samples of convenience (college students and children of affluent families) are shifting toward a greater amount of second-language experience (García & Náñez, 2011; Grosjean, 2010; <http://www.census.gov/prod/2013pubs/acs-22.pdf>). Often, interviews or other tasks are administered by monolingual research assistants without the intention to restrict language. However, language use among multilingual participants is inherently restricted in any study in which the interviewer is not a competent speaker of the languages in which the participant might wish to respond. On the basis of our results and the growing body of literature in this area, we argue that researchers must be mindful of the inherent limitations imposed on participants with access to multiple languages.

References

- Berntsen D, Rubin DC. Cultural life scripts structure recall from autobiographical memory. *Memory & Cognition*. 2004; 32(3):427–442. [PubMed: 15285126]
- Brown NR, Hansen TGB, Lee PJ, Vanderveen SA, Conrad FG. Historically defined autobiographical periods: Their origins and implications. *Understanding autobiographical memories: Theories and approaches*. 2012:160–180.
- Conway MA. Memory and the self. *Journal of memory and language*. 2005; 53(4):594–628. <http://dx.doi.org/10.1016/j.jml.2005.08.005>.
- Conway MA, Haque S. Overshadowing the reminiscence bump: Memories of a struggle for independence. *Journal of Adult Development*. 1999; 6(1):35–44.
- Conway MA, Wang Q, Hanyu K, Haque S. A Cross-Cultural Investigation of Autobiographical Memory On the Universality and Cultural Variation of the Reminiscence Bump. *Journal of Cross-Cultural Psychology*. 2005; 36(6):739–749.
- García, EE.; Náñez, JE, Sr. Bilingualism and cognition: Informing research, pedagogy, and policy. American Psychological Association; 2011.
- Geyer A, Holcomb PJ, Midgley KJ, Grainger J. Processing words in two languages: An event-related brain potential study of proficient bilinguals. *Journal of neurolinguistics*. 2011; 24(3):338–351. [PubMed: 21461123]
- Glück J, Bluck S. Looking back across the life span: A life story account of the reminiscence bump. *Memory & cognition*. 2007; 35(8):1928–1939. [PubMed: 18265609]
- Grosjean, F. *Bilingual: Life and reality*. Harvard University Press; 2010.
- Janssen SM, Chessa AG, Murre JM. Temporal distribution of favourite books, movies, and records: Differential encoding and re-sampling. *Memory*. 2005; 15(7):755–767. [PubMed: 17852723]
- Janssen SM, Murre JM. Reminiscence bump in autobiographical memory: Unexplained by novelty, emotionality, valence, or importance of personal events. *The Quarterly Journal of Experimental Psychology*. 2008; 61(12):1847–1860. [PubMed: 19031155]
- Janssen SM, Rubin DC, Jacques PLS. The temporal distribution of autobiographical memory: changes in reliving and vividness over the life span do not explain the reminiscence bump. *Memory & cognition*. 2011; 39(1):1–11. [PubMed: 21264610]
- Kroll JF, Hermans D. Psycholinguistic perspectives on language processing in bilinguals. *Modeling bilingualism: From structures to chaos*. 2011:15–36.
- Larsen SF, Schrauf RW, Fromholt P, Rubin DC. Inner speech and bilingual autobiographical memory: A Polish-Danish cross-cultural study. *Memory*. 2002; 10(1):45–54. [PubMed: 11747575]
- Marian V, Blumenfeld HK, Kaushanskaya M. The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language and Hearing Research*. 2007; 50(4):940.
- Marian V, Neisser U. Language-dependent recall of autobiographical memories. *Journal of Experimental Psychology: General*. 2000; 129(3):361. doi: [10.1037/0096-3445.129.3.361](https://doi.org/10.1037/0096-3445.129.3.361). [PubMed: 11006905]
- Matsumoto A, Stanny C. Language-dependent access to autobiographical memory in Japanese-English bilinguals and US monolinguals. *Memory*. 2006; 14(3):378–390. [PubMed: 16574592]

- Morrison CM, Conway MA. First words and first memories. *Cognition*. 2010; 116(1):23–32. [PubMed: 20363469]
- Nezlek JB. Multilevel random coefficient analyses of event-and interval-contingent data in social and personality psychology research. *Personality and social psychology bulletin*. 2001; 27(7):771–785.
- Raudenbush, SW.; Bryk, AS. *Heirarchical linear models: Applications and data analysis methods*. 2nd ed.. Thousand Oaks, CA: Sage Publishing; 2002.
- Rubin DC. The distribution of early childhood memories. *Memory*. 2000; 8(4):265–269. [PubMed: 10932795]
- Rubin DC, Berntsen D, Hutson M. The normative and the personal life: Individual differences in life scripts and life story events among USA and Danish undergraduates. *Memory*. 2009; 17(1):54–68. [PubMed: 19105087]
- Rubin DC, Rahhal TA, Poon LW. Things learned in early adulthood are remembered best. *Memory & Cognition*. 1998; 26(1):3–19. [PubMed: 9519693]
- Rubin DC, Schulkind MD. Distribution of important and word-cued autobiographical memories in 20-, 35-, and 70-year-old adults. *Psychology and aging*. 1997; 12(3):524. doi: [10.1037/0882-7974.12.3.524](https://doi.org/10.1037/0882-7974.12.3.524). [PubMed: 9308099]
- Schrauf RW. Bilingual autobiographical memory: Experimental studies and clinical cases. *Culture & Psychology*. 2000; 6(4):387–417.
- Schrauf RW, Rubin DC. Bilingual autobiographical memory in older adult immigrants: A test of cognitive explanations of the reminiscence bump and the linguistic encoding of memories. *Journal of Memory and Language*. 1998; 39(3):437–457. <http://dx.doi.org/10.1006/jmla.1998.2585>.
- Schrauf RW, Rubin DC. Internal languages of retrieval: The bilingual encoding of memories for the personal past. *Memory & Cognition*. 2000; 28(4):616–623. [PubMed: 10946544]
- Schrauf RW, Rubin DC. Effects of voluntary immigration on the distribution of autobiographical memory over the lifespan. *Applied Cognitive Psychology*. 2001; 15(7):S75–S88.
- Steiner KL, Pillemer DB, Thomsen DK, Minigan AP. The reminiscence bump in older adults' life story transitions. *Memory*. 2013:1–8. (ahead-of-print). [PubMed: 23731185]
- Tulving E, Thomson DM. Encoding specificity and retrieval processes in episodic memory. *Psychological review*. 1973; 80(5):352.
- van Heuven WJ, Dijkstra T. Language comprehension in the bilingual brain: fMRI and ERP support for psycholinguistic models. *Brain research reviews*. 2010; 64(1):104–122. [PubMed: 20227440]
- Wilson MD. The MRC Psycholinguistic Database: Machine Readable Dictionary, Version 2. *Behavioural Research Methods, Instruments and Computers*. 1988; 20(1):6–11. <http://www.census.gov/prod/2013pubs/acs-22.pdf>.
- Zebian S, Brown NR. Living in History in Lebanon: The influence of chronic social upheaval on the organisation of autobiographical memories. *Memory*. 2014; 22(3):194–211. [PubMed: 23473445]

Appendix

All multilevel model analyses were conducted with SAS software, Version 9.4 of the SAS system for Windows (Copyright© 2002–2012, SAS Institute Inc., Cary, NC, USA). In each equation, the indices i and t are used to denote individual participants and memories, respectively, where in Level 1, the intercept, β_{0it} is defined as the expected mean age at encoding for memory t of participant i . The error term, r_{it} , represents a unique effect associated with participant i (i.e., how much age at encoding fluctuates within an individual multiple events).

The equations used to test whether English proficiency or age of immigration moderated the relationship between age at encoding and cue word language or internal language were:

$$\text{Level 1: Age at Encoding}_{it} = \beta_{0it} + \beta_{1it}(\text{language of cue}) + \beta_{2it}(\text{language of thought}) + r_{it}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Age of Immigration}) + \gamma_{02}(\text{Proficiency}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{Age of Immigration}) + \gamma_{12}(\text{Proficiency}) + u_{1i}$$

$$\beta_{2i} = \gamma_{20} + \gamma_{21}(\text{Age of Immigration}) + \gamma_{22}(\text{Proficiency}) + u_{2i}$$

The slope coefficients β_{1it} and β_{2it} represent the associated change age at encoding for change in language of cue and internal language respectively. The individual intercept (β_{0i}) and slopes (β_{1i} and β_{2i}) become the outcome variables in the Level 2 equations, where γ_{00} represents the overall mean age at encoding for the sample. Further,

- γ_{01} corresponds to the effects of age of immigration on age at encoding above and beyond the effects of proficiency.
- γ_{02} corresponds to the effects of proficiency on age at encoding above and beyond age of immigration.
- γ_{10} corresponds to the effect of cue word language on age of encoding.
- γ_{11} is the cross-level interaction testing whether the relationship between cue word language and age at encoding depends on age of immigration.
- γ_{12} is the cross-level interaction testing whether the relationship between cue word language and age at encoding depends on participant English proficiency.
- γ_{20} corresponds to the effect of internal language on age of encoding.
- γ_{21} is the cross-level interaction testing whether the relationship between internal language and age at encoding depends on age of immigration.
- γ_{22} is the cross-level interaction testing whether the relationship between internal language and age at encoding depends on participant English proficiency.
- u_{0i} , u_{1i} , and u_{2i} represent the degree to which individuals vary from the sample as a whole.

Figure 1.
Percentage of reported memories per age bin by immigration group.

Figure 2.
Number of reported memories per age bin surrounding the age of immigration for the Cross-Language Immigrant group.

Figure 3.
Percentage of reported memories surrounding immigration that represented a code-switch.

Figure 4.

Interaction between language of cue word and language fluency.

Note: High and Low Fluency values represent 1 SD above and below the mean respectively.

Table 1

Language Experiences of the Bilingual Immigrants(n= 23)as Reported on the LEAP-Q *

LEAP-Q Measures	Mean (<i>SD</i>)	Range
Self-Rated English Fluency (0–10)	6.86 (1.85)	2–9
Years Fluent in English	10.31 (8.09)	0–25.33
% Time Choosing to Speak in English	30.87 (22.19)	0–65
% Time Daily Speaking English	41.74 (23.63)	0–90
Age of Immigration	26.02 (5.71)	14.75–38.17
Years in the US	8.85 (6.27)	1–29

*
Language Experience and Proficiency - Questionnaire

Table 2

Demographic Characteristics by Group for Participants Included in Analyses of the Reminiscence Bump

Demographic Variables	Monolingual Non-Immigrants		Bilingual Immigrants	
	Value	Range	Value	Range
<i>n</i>	13	-	21	-
Mean Age in Years (SD)	40.40 (12.53)	22–63	35.24 (7.08)	28–59
Mean Education in Years (SD)	17.31 (2.21)	12–21	17.05 (2.77)	13–23
Sex (%)	10 female (78%)		20 female (95.2%)	
Race (%)	9 Caucasian (69%)		18 Latina(o) (85.7%)	

Table 3

Demographic Characteristics of the Participants Included in the Analysis of Language-Dependent Recall

Demographic Variable	Value	Range
<i>n</i>	17	
Mean Age in Years (SD)	35.4 (7.55)	28–59
Mean Education in Years (SD)	18 (2.98)	13–23
Sex (%)	16 female (94.1)	
Race (%)	13 Latina(o) (76.5)	