First-language decline in healthy aging: implications for attrition in bilingualism

Mira Goral

Language in the Aging Brain Laboratory, Department of Neurology, Boston University School of Medicine, Boston VA Healthcare System, 150 S. Huntington Ave, Boston, MA 02130 USA

Received 10 April 2003; received in revised form 16 June 2003; accepted 24 June 2003

Abstract

Studies of language attrition have focused on the decline observed in individuals’ first-language (L1) or second language (L2) in the context of bilingualism. L1 decline has also been extensively studied in monolingual adults in the context of healthy aging. One language domain that has been found to decline with age is lexical retrieval. This paper focuses on longitudinal and cross-sectional studies of healthy aging, which show that older adults, as compared to younger adults, demonstrate greater difficulty in performing naming tasks as well as accelerated decline in performance over time. Relevant findings of age-related decline in word retrieval and theories that have been proposed to account for it are summarized and their relations to the patterns and theories of lexical attrition reported for bilingual speakers are discussed. It is concluded that despite fundamental differences between these two circumstances of attrition, applying methods and theories from one study area to the other can be beneficial for understanding processes of language attrition.

Keywords: Aging; Bilingualism; Language attrition; Lexical retrieval; Word production

1. Introduction

Language loss has been studied from several different perspectives. Linguists, sociolinguists, neurolinguists, and psycholinguists study patterns of language loss in various populations including aphasia, dementia, healthy aging, and bilingual and multilingual speakers. The different fields often employ different tasks to measure language decline and even use different terms to characterize the phenomenon; for example, the term language attrition has been used almost exclusively in the study of
language loss in the context of bilingualism. It has been suggested that certain components of language are more vulnerable to change than others (Lambert & Freed, 1982; Seliger & Vago, 1991); those components can then be expected to be similarly affected across different populations and circumstances. While aspects of first-language attrition in the context of bilingualism have been compared to certain aspects of language acquisition (Berko-Gleason, 1982), few attempts have been made to compare such processes to those observed in the normal course of language decline across the adult lifespan (De Bot & Weltens, 1991). Yet the study of healthy aging has revealed specific areas of decline and the tasks that have been employed to detect these may prove useful in the study of bilingual language attrition. Moreover, it is conceivable that similar mechanisms underlie the different manifestations of language decline in different populations, in which case the theories that have been developed to account for age-related language decline should apply to other processes of language loss, such as the ones found in bilinguals. It may be useful, then, to consider patterns of language loss across these two populations, bilingual attriters and monolingual (healthy) older adults, with the goal of identifying common processes and their causes.

This paper is a first step toward that goal. I begin by summarizing prominent findings concerning the language deficits that have been reported to accompany healthy aging, particularly those of lexical retrieval during production, and ask how they may differ from patterns of lexical attrition that have been found in the context of bilingualism. I then briefly review current theories that have been proposed to account for age-related language changes, discuss how these theories may differ from those proposed to account for language attrition in bilingualism, and explore common trends as well as benefits that may be gained by applying methods and approaches from these two fields of study.

2. Lexical retrieval during word production in healthy aging

The study of changes in cognitive abilities that accompany aging has yielded evidence of age-related changes in a number of cognitive domains (e.g. memory, attention), but great variability in the patterns and degrees of decline has been reported (Band, Riddernikhof, & Segalowitz, 2002; Light & Burke, 1988; Lovelace, 1990; Salthouse, 1985a). In the study of memory, for example, age-related differences have been reported on tasks that measure working-memory capacity but not on tasks that measure short-term memory capacity or forgetting rate (Bäckman, Small, & Wahlin, 2001; Hartley, 1992; Prull, Gabrielli, & Bunge, 2000). Variability has also been noted in the results of studies that focused on language skills. Several studies of language in the elderly have concluded that at least some language abilities (such as vocabulary, syntax) remain intact (or even improve) across the adult lifespan (Bélard & Lecours, 1990; Botwinick, 1977; Labarge, Edwards, & Knesevich, 1986; Obler & Albert, 1984; Wingfield & Stine-Morrow, 2000), however, recent studies have provided converging evidence that certain language skills decline as individuals grow older. Two of the main areas that research identifies as problematic for older individuals are lexical retrieval during word production (Albert, Heller, & Milberg, 1988; Ardila & Rosselli, 1989; Au et al., 1995; Barresi, Nicholas, Connor, Obler, & Albert, 2000; Borod, Goodglass, & Kaplan, 1980; Bowles, Obler, & Albert, 1987; Burke, MacKay, Worthley, &
Studies that have focused on word production typically employed one of two types of paradigms as a measure of lexical-retrieval ability: picture-naming tasks and analysis of tip-of-the-tongue (TOT) states. Despite several studies that reported no differences between younger and older adults in their performance on picture-naming tasks (Beland & Lecours, 1990; LaBarge et al., 1986; Nicholas, Brookshire, MacLennan, Schumacher, & Porrazzo, 1989; Van Gorp, Satz, Kiersch, & Henry, 1986; Villardita, Cultrera, Cupone, & Mejia, 1985), a growing number of cross-sectional and longitudinal studies have reported consistent decline in performance with increasing age. The cross-sectional studies, comparing groups of younger and older participants, demonstrated that older adults performed significantly less well than younger participants (Albert et al., 1988; Nicholas et al., 1985; Welch et al., 1996). Nicholas et al. (1985), for example, compared four groups of participants: people in their 30, 50, 60, and 70 s, who completed two picture-naming tasks, the Boston Naming Tasks (BNT, Kaplan, Goodglass, & Weintraub, 1976; Kaplan et al., 1983) and the Action Naming Test (ANT, Obler & Albert, 1979). Nicholas et al. (1985) analyzed overall correctness levels, responsiveness to cues, and error types. They found a significant main effect of age for overall correctness, whereby older adults made more errors than younger adults and specifically, the 70-year-old group had significantly higher error rates than all other groups, in both naming tasks. There was also a significant main effect of age for the number of cues given (with a gradual increase in the number of cues required for each age group), but no significant differences among the groups in terms of responsiveness to cues given (i.e., the ability to produce the correct answer following a cue). As for error type, there were several significant differences among the groups, for example, young adults produced more semantically related errors (e.g. harness for yoke) than older adults and older participants produced more circumlocutions (e.g. artistic thing for flowers for trellis) than younger participants. Longitudinal studies using similar material and participants also revealed that performance decreased with increasing age (Au et al., 1995; Ramsay, Nicholas, Au, Obler, & Albert, 1999). Initial signs of decline have been found as early as at age 50 (Au et al., 1995) or even under 40 (Connor, Spiro, Obler, & Albert, under review) but sharp drops in performance were mostly evident at age 70 or over. Moreover, the 70-year-old individuals experienced greater decline over time (Au et al., 1995).

Most studies of picture-naming tasks have compared overall performance, using, for example, percentages of correct responses. In addition, several studies have analyzed error types (Au et al., 1995; Nicholas et al., 1985; Ramsay et al., 1999) or addressed the effects of individual items (MacKay & Connor, 2001). Error types and responsiveness to cues can be crucial to determine ‘where’ in the process of lexical production the difficulty may lie.
For example, it has been demonstrated that most healthy older adults who experience word-finding difficulty during picture-naming tasks could produce a circumlocution response, providing semantic information about the item they could not name, and would benefit from phonemic cues (i.e. the first sound or syllable of the target word), suggesting that it was phonological (rather than semantic) information that was inaccessible. Moreover, MacKay and Connor (2001) compared several short versions of the BNT and found that age-related declines were not equal across all items. MacKay and Connor found that some items were age sensitive, that is, were found to be overall more difficult for older adults than for younger adults, and other items were age stable, that is, did not yield differences in performance between older and younger participants. Interestingly, word frequency did not appear to determine whether an item was age sensitive or age stable. This is consistent with the lack of interaction between word-frequency and age reported in Thomas et al. (1977) but inconsistent with the common finding of more errors on later items on the BNT, items that were selected specifically as less familiar ones.

Studies that used the tip-of-the-tongue phenomenon are also consistent with the word-finding-difficulty complaints of older adults. Studies of naturalistic diary-keeping as well as laboratory-induced tip-of-the-tongue states revealed significantly larger numbers of TOTs for older adults than for younger adults (Burke & Laver, 1990; Burke et al., 1991; Maylor, 1990). In their first experiment, Burke et al. (1991) collected data from 50 older adults (mean age = 71.0), 30 mid-age adults (mean age = 38.7), and 50 young adults (mean age = 19.4), using questionnaires to assess self-reported incidents of TOTs. Participants were interviewed and instructed to keep a diary of their TOTs as they occurred over a 4-week interval. The results showed that both older and mid-age adults reported significantly more TOTs than young adults. It was also found that TOTs for proper nouns were more frequent than those for object names or abstract words for older and mid-age adults, but not for the younger group. Reported feeling of knowing (FOK), i.e. the feeling during a TOT state that one ‘knows’ the target word but ‘can’t get it out’, did not differ among the three age groups. Nor were there any significant effects of education and gender. In their second experiment, Burke et al. presented 21 young adults (mean age = 20.0) and 21 older adults (mean age = 71.3) with trivia-game questions (e.g. “What is the name of the art of Japanese paper folding?”). Participants were asked to answer whether they were familiar with the target word and to rate how certain they were that they could recall it (‘know’, ‘don’t know’, or ‘TOT’). They would then be asked either to recall the target word or, if they did not know the word, to choose among four possible answers. However, if they indicated that they were experiencing a TOT, they would be asked to provide information about the phonological form of the word and then either guess it or choose among the four answer options. Overall correctness did not show a significant age effect, nor did absolute numbers of ‘know’ and ‘TOT’ responses, but older adults did respond ‘don’t know’ significantly less often than did younger adults and ‘TOT’ (to names of people) more often than did younger adults. Furthermore, consistent with the findings of their first experiment, Burke et al. found that older adults had significantly larger proportions of TOTs (i.e. numbers of TOTs on trials for which a ‘know’ response was not made), in particular for proper nouns. Burke et al. took their results as support for their hypothesis that older adults have difficulty accessing at least parts of the phonological information needed for lexical production (see a discussion of their model below).
Only a few studies assessed lexical-retrieval difficulties of older adults during narrative production. Heller and Dobbs (1993) used a video-description task to measure naming abilities in discourse production of young and older individuals. They identified three measures of word retrieval: use of nominal and pronominal references (referring to characters in the video), production of target common-nouns (referring to objects in the video), and an index of hedging. Heller and Dobbs found that among their 90 participants (age range = 28–76), older adults used significantly more unspecified references, significantly fewer correct object labels, and significantly more hedges (e.g. providing more than one label to one entity, commenting on and qualifying the use of certain labels).

Two additional studies that measured word-retrieval difficulties in older adults’ discourse production found limited support for age-related increases in hedging and dysfluency. Cooper (1990) compared the performance of younger and older adults on complex-picture description and found no reliable age-related differences. Schmitter-Edgecombe, Veneski, and Jones (2000) assessed word retrieval in aging using both a confrontation-naming task (the BNT) and a discourse-production task (a picture-description task). On the single-word naming, Schmitter-Edgecombe et al. did not find reliable differences among their three participant groups (young, young-old, and old-old adults). Analyzing word-retrieval performance on the picture-description task, they found an age-related increase in word-retrieval difficulties on two of their measures, namely, reformulations and word substitutions but not on other measures they used (e.g. use of empty words, repetitions).

Whether older adults have significant word-retrieval deficit during discourse production is thus yet unresolved. Moreover, the strategies that may be used by older speakers to preserve their discourse fluency, if they do experience word-retrieval difficulties, have not been thoroughly studied to date.

An additional source of evidence about lexical-retrieval skills in the elderly is data from fluency tasks. In verbal-fluency tests, participants are asked to generate as many words as they can, given a semantic category or an initial letter, in a given time frame (usually 1 min). Age differences have been found on both semantic-fluency tasks (e.g. “tell me all the animals you can think of”) and letter-fluency tasks (e.g. “tell me all the words you can think of that begin with ‘a’”), with some inconsistencies across studies with respect to the effects of the type of fluency task on the magnitude of age-differences (Boone, Miller, Lesser, Hill, & D’Elia, 1990; Brady, Schalman-Bergen, Albert, & Obler, in preparation; Connor, Goral, Obler, Spiro & Albert, in preparation; Parkin & Walter, 1991; Sliwinski & Buschke, 1999; Whelihan & Lesher, 1985). In addition to total number of words retrieved, Brady et al. in preparation assessed the efficiency of the retrieval process, using a switching and clustering analysis based on work done by Troyer, Moscovitch, and Winocur (1997). (Roughly, switching refers to the number of transitions from one sub-category, e.g. farm animals, to another, and clustering, to the number of items within each sub-category) Brady et al. found a linear age-decline in semantic fluency that appeared related to impaired ability to switch among sub-categories; in contrast, clustering performance did not appear to change with age. Several normative studies of verbal fluency revealed that age, gender, education, and ethnicity (as well as bilingual status, for example, whether participants were monolingual or bilingual speakers, see Gollan, Montoya, and Werner (2002)) all appeared to affect verbal-fluency scores and that these effects varied with the number and types of categories given as stimuli (Acevedo et al.,
In summary, it has been demonstrated that performance on lexical-retrieval tasks declines with increasing age. The reasons for this lexical-retrieval difficulty, however, have been controversial. Following a review of relevant findings of lexical retrieval during language production in language attrition in bilingual speakers, several theories that have been proposed in the literature of cognitive aging to account for age-related language deficits are discussed.

3. Lexical retrieval during word production in bilingual attriters

Studies of language attrition in the context of bilingualism have been conducted predominantly by linguists (as compared to psycholinguists or neurolinguists) and have often been broader in their approach than the studies described above. Many early studies of language attrition employed grammaticality-judgment tasks to assess language knowledge and spontaneous- or elicited-speech analyses to assess language production. The language decline found in these studies has been attributed to two co-existing and possibly interacting processes: the decreased use of the language in question (intralanguage processes of attrition) and the influence of one language on the other (interlanguage processes of attrition). As researchers began to address issues of language attrition, most notably in the last 20 years, several distinctions have become critical (Andersen, 1982; Lambert & Freed, 1982; Seliger, 1996; Sharwood Smith & Van Buren, 1991; Weltens, de Bot, & Van Els, 1986). It became clear that studies would benefit from specifying whether they attempt to assess changes in language knowledge (competence) or changes in language use (performance), whether they address first-language attrition (in bilinguals who mostly use their second language) or second-language attrition (in bilinguals who mostly use their first language), and finally, from specifying a baseline proficiency, that is, having a measure of the proficiency level attained in the language in question prior to the process of attrition. This latter point is crucial in the study of bilingualism because bilinguals may or may not attain native-like proficiency in their first language (e.g. when children are brought to a new language environment before completing their first-language acquisition and are immersed in a second language, which becomes their dominant language) or in their second language (e.g. when second-language learners do not reach native-like proficiency in that language). As evidence has accumulated, it has become apparent that one of the first areas of loss is the ability to quickly retrieve target words during speech production (Andersen, 1982; Boyd, 1993; De Bot, 1996; Hansen, 1999; Köpke, 2002; Magiste, 1986; Nakuma, 1997; Obler, 1982).

While an overall review of studies of language attrition is beyond the scope of this paper, I review here several studies that focused on lexical-retrieval decline; for further review see, for example, De Bot and Weltens (1995) and Hansen (2001).

Existing data on lexical-retrieval difficulties in first or second language attrition of bilingual speakers have been based on speakers’ self-report, instances of code mixing and/or code-switching (note that the terms code mixing, code switching, and lexical borrowing have all been used to denote instances of intermixing elements from two
languages within an utterance or discourse; further discussion of these terms and the sub-
types of the phenomenon is beyond the scope of the present paper), analyses of narrative
production, and most recently, experimental tasks such as picture naming. One study that
provided a detailed analysis of word production during narrative production was that of
Olshtain and Barzilay (1991). They studied lexical retrieval in American native speakers
of English (ranging in age from 28 to 56) who had immigrated to Israel as adults at least
eight years prior to the study and were using Hebrew but maintaining English as their
primary language. Olshtain and Barzilay assessed vocabulary accessibility using the frog-
stories task, in which participants were shown a story presented in a series of pictures (with
no text) and were asked to tell the story depicted in the pictures. Because the elicited
speech in this task has to refer to the pictures, specific lexical items can be targeted and
their appropriate production can be assessed. Comparing their participants to a control
group of native speakers of English living in the United States, the authors found that the
Israeli Americans had difficulty producing the target items. They had more variability in
their responses to a given item in the picture stimuli (e.g. the bilinguals produced pond,
swamp, water, body of water, puddle, and other terms, whereas the monolinguals
consistently used either pond or swamp) and their substitutions were often less specific
than the target (e.g. body of water for pond). Virtually all the participants were aware of
their difficulty and commented on it during the task. Olshtain and Barzilay concluded that
it could be the case that in early stages of L1 attrition, fewer lexical items are accessible for
retrieval during language production and that while basic meaning is retained, more
specific selections are less available.

Additional studies of language attrition addressed issues of lexical attrition by
analyzing patterns of code switching and lexical borrowing and assessed phonological,
morphological, and sociolinguistic aspects of these phenomena. Among those, Boyd
(1993) analyzed the use of L2 during L1 production in bilinguals with Finnish or English
L1 living in Sweden; Cohen (1989) documented the attrition of Portuguese, the third
language of a childhood Hebrew–English bilingual; Schoenmakers (2002) assessed L1
attrition of Portuguese migrants to the Netherlands and to France; Turian and Altenberg
(1991) demonstrated the attrition of Russian in a Russian–English childhood bilingual.

Boyd (1993), for example, studied patterns of Swedish-lexemes use among American
and Finnish bilinguals living in Sweden. She analyzed speech-production data collected
by interviewing two groups of adult bilinguals, native speakers of Finnish and native
speakers of English, who had lived in Sweden for at least 10 years. She compared patterns
of phonological and morphological integration of Swedish words during participants’
production in their L1 and found variability in the degree of integration within and across
the groups. While native speakers of Finnish tended to integrate many Swedish lexemes
into Finnish morphology, phonological integration occurred in only approximately 25% of
the cases. Native speakers of English, in contrast, rarely integrated Swedish lexemes,
phonologically or morphologically. The author acknowledged that the differences
between the two groups could be attributed to differences in the morphological and
phonological structures of Finnish and English as well as to differences in the degree of L1
maintenance among the two immigrant groups.

Several recent studies used additional tasks to assess intra- and interlanguage processes
of lexical attrition. In one such study (Ammerlaan, 1996), lexical attrition among Dutch
expatriates living in Australia was assessed by using a picture-naming task and employing a variety of word types. His participants were long-term immigrants who had shifted their primary language from Dutch to English. He found that the number of naming errors in Dutch corresponded to participants’ level of proficiency in Dutch at the time of testing. Moreover, words that were phonologically similar to their translation equivalents in English, participants’ second (and dominant) language, produced less errors than words that were phonologically and morphologically dissimilar. Of interest was the finding that words that were partially similar (for example, words that had similar phonological forms but different meanings) yielded more naming errors, and that this effect, again, was affected by level of Dutch proficiency. (This type of finding is consistent with the effects of cognates versus those of ‘false friends’ found in studies on bilingual processing; see, for example, Dijkstra, van Jaarsveld, and Ten Brinke (1998) and Dijkstra, de Bruijn, Schriefers, and Ten Brinke (2000)).

Many of the studies of language attrition did not neglect to consider sociolinguistic variables such as attitude toward the languages in question, degrees of contact with speakers of those languages, and degrees of language use (De Bot, 2000; Hulsen, de Bot, & Weltens, 2002; Kaufman, 2000; Kenny, 1996; Kouritzin, 1999). A recent study that focused on the effects of social network on first-language maintenance among Dutch immigrants to New Zealand used a picture-naming task as a measure of maintained lexical retrieval in L1 (Hulsen et al., 2002). Hulsen et al. collected data regarding social networks, contacts with the home country, and overall patterns of language use from a group of first, second, and third generation Dutch immigrants in New Zealand and assessed the correlation among these variables and performance (accuracy and response latency) on naming tasks. They found that overall, performance on the naming tasks of the first generation immigrants differed from monolingual Dutch speakers and that performance further decreased from the first generation to the second (and third). Moreover, they found that the relative number of L1 contacts as well as contacts with the home country correlated with L1 naming performance.

In conclusion, there is ample evidence that bilinguals (or multilinguals) who experience decline in their first-language skills (or the skills of any of their languages) face word-retrieval difficulties but there is still need for detailed investigations of such deficits. Moreover, because for the most part different methods have been used to assess word-retrieval difficulty in healthy aging and in bilingual attriters, it is premature to determine whether the deficits found in these two populations are similar or different in nature. Employing tasks designed to identify patterns of lexical-retrieval difficulties with monolingual and bilingual participants will allow a more thorough comparison of findings from the two fields.

4. Theories of age-related deficit

In the study of cognitive aging, several competing theories have been proposed to account for findings of age-related decline and attempts have been made to explain, within these theories, language-related deficits. Salthouse (1988a,b) proposed that with aging, there is a general reduction in resources for cognitive processing. Reduced processing-resources have been used to explain lower performance of older adults on tasks that
measure reasoning, attention, and memory for words and for discourse. However, the term resources is rather a broad one and may refer to different cognitive abilities (e.g. memory capacity, attention span, strategies, ‘mental energy’). Hasher and Zacks (1988) proposed that the cause of older adults’ poorer performance is an inefficient inhibition mechanism that increases vulnerability to distractions and may lead to difficulties concentrating on the task and/or the material at hand. Along similar lines, Cohen (1988) hypothesized that older adults’ decreased performance on memory and comprehension tasks was due to reduced processing capacity. Further attempts to better define the resources needed for processing language (and other domains) yielded notions such as working memory (Wingfield & Tun 1999). Working memory was defined by Baddeley and Hitch (1974, 1994) and Just and Carpenter (1992) as a processing ‘space’ in which information can be temporarily stored and further manipulated. Just and Carpenter proposed a verbal working-memory subsystem that may be specialized for language processing. And indeed, several studies found high correlations between participants’ working-memory span (on tasks such as the reading span test, Daneman & Carpenter, 1980) and their performance on language tasks such as comprehension of complex sentences; these correlations were used to argue that working-memory limitations could account for age-related differences in performance (Kemtes & Kemper, 1997; Stine & Wingfield, 1990). However, a number of studies demonstrated that this correlation was not always present and that general working-memory limitations may not be sufficient to account for specific language difficulties observed in aging (Caplan & Waters, 1999; Wingfield, Waters, & Tun, 1998). Another approach proposed that general cognitive slowing was the underlying cause for what may appear as impaired processing ability (Cerella, 1985; Salthouse, 1985b; Salthouse, 1996). In this framework, many age differences found on (verbal) measures of episodic memory, working memory, verbal fluency, and others, can be accounted for by age-related differences in verbal processing speed (Park et al., 1996; Salthouse & Babcock, 1991). However, there is some evidence that certain age-related differences persist even after the effects of speed differences are removed (Hultsch, Hertzog, & Dixon, 1990).

Mixed results have also been reported for accounts that implicate attention; for example, while no age-related differences could be detected in lexical priming studies (Burke et al., 1987), some differences in processing times of target words were noted (Hartley, 1992). Neurobiological changes in aging have also been studied and processes such as neuronal loss, increases in glial cells, decreases in numbers of dendrites, accumulation of lipofuscin, melanin, and amyloid have been found (Raz, 2000; Salthouse, 1988a); however, the relations among these changes and general or specific attentional loss are not well understood.

How these general theories apply to the specific aspects of language that appear to change with age has remained underspecified. Moreover, only a few attempts have been made to provide more specific accounts for age-related naming difficulty. As mentioned above, Burke and her colleagues have put forward a model of word production and outlined their hypothesis of how aging affects word production. They proposed the Transmission Deficit Hypothesis (TDH) to account for TOTs during word production (Burke et al., 1991; MacKay & Burke, 1990). In their framework, deficit in the transmission of the priming process across nodes in the semantic network—the process in which a node is prepared for activation—leads to inaccessibility of at least part of
the phonological information needed for the production of a word. They hypothesized that in aging, node connections are weakened and priming transmission is reduced. Consequently, older adults experience difficulty producing target words even when they can retrieve the appropriate semantic information and, sometimes, partial phonological information (as in feeling of knowing during TOTs). Thus, prevalence of TOTs among older adults is consistent with TDH, as is the finding that older adults tend to benefit from phonemic cues when they experience difficulty naming pictures (Au et al., 1995; MacKay et al., 2002).

According to Burke and her colleagues, another variable in the TDH is recency of use. That is, whereas connections between nodes become stronger as the frequency with which they are activated increases, connections between nodes of words that are used with decreased frequency weaken. Reduced strength of connections will lead to insufficient transmission of priming and to TOTs. Use, or lack of it, is one of the main reasons implicated in language attrition in the context of bilingualism. We would expect then, based on the TDH, that bilingual attriters might experience similar patterns of TOTs and inability to produce target words upon seeing a picture or hearing a definition, and—like older individuals—would benefit from phonemic cues. Such patterns of naming difficulties may be found via self-report or laboratory-induced TOTs or during item-specific naming tasks, such as picture naming. During discourse, in contrast, speakers can use a variety of strategies to avoid an inaccessible word. These strategies include semantic substitutions and circumlocutions and, in the case of bilinguals, code mixing and code switching. Because it is difficult to identify specific target words in narrative production, relatively few studies have systematically assessed word production during discourse (in healthy aging as well as in bilingualism). Yet to better understand the phenomenon of lexical attrition, analyses of word-retrieval deficit during discourse and the strategies speakers may use to alleviate impaired retrieval processes are warranted.

The TDH addresses aspects of lexical access and activation levels of the lexical network. It does not directly address the question of whether the hypothesized changes in the strength of the connections in the network reflect a transient state (access failure) or actual changes in the lexical representations (degradation of knowledge). Indeed, most studies of age-related deficit of lexical retrieval have not addressed the distinction between language representation (knowledge) and language performance. One study that addressed this issue directly and found evidence for age-related changes in both lexical retrieval and lexical representation was a longitudinal study by Barresi et al. (2000). Barresi et al. focused on the consistency of correct/incorrect responses to items on the Boston Naming Test (BNT) and Action Naming Test (ANT) in a group of 39 adults across three testing times (T1, T2, T3) over a period of seven years. They defined evidence for retrieval deficit instances in which a correct response was given at (at least) one later test time but not at one early test time (e.g. correct at T1 and T3 but not at T2), and evidence for semantic degradation instances in which a correct response was only given at earlier testing time(s) but not at a later time (e.g. correct at T1 and T2, incorrect at T3). They found that a large portion of the errors their participants made could be attributed to lexical-retrieval deficit; however, a sizeable portion of the errors (mostly on the BNT) were consistent with semantic degradation. Furthermore, Barresi et al. found that older adults had significantly more instances of errors consistent with semantic degradation than did younger adults.
The authors concluded that their data could be taken as evidence for some semantic degradation of the lexical representation of older adults. Further study of consistency of item correctness across time as well as across tasks is warranted before conclusions about semantic degradation can be drawn.

It has also been proposed that it is not the linguistic information per se that is at the root of the difficulty, but rather, impaired general search- and retrieval-processes (Best, Nicholas, Obler, & Albert, 1995; Troyer, Moscovitch, Winocur, Alexander, & Stuss, 1998). That is, lexical representation per se can be intact, but the cognitive mechanisms that are involved in initiating a search and completing a retrieval of a target item are impaired. It has been proposed that such a deficit results from impaired executive functions that have been associated with frontal cerebral white matter (McPherson & Cummings, 1997; Moscovitch & Wincour, 1995). In such a framework, lexical-retrieval tasks that rely heavily on initiation of a search process (e.g. verbal-fluency tasks) are more likely to show age changes than tasks that provide the participants with specific information for retrieval (picture-naming tasks). Moreover, increasing the executive demands, as in a verbal-fluency task with alternating categories, would be expected to have a detrimental effect on older adults’ performance. Bilinguals’ ability to appropriately switch between two languages and monitor their language output (Green, 1986; Paradis, 1993) can be hypothesized to rely on similar frontal mechanisms. Comparing lexical-retrieval difficulties in tasks that can be assumed to vary in their demands on executive functioning can further test such hypotheses.

5. Theories of language attrition in bilingualism

With increasing data on language attrition, a number of theories of attrition have been developed. I outline below several approaches that focus on intralanguage processes, addressing issues of order of decline, differential decline, and variables that influence the decline of language skills. I also mention recent studies that address the question of loss versus access deficit. Additional approaches that focus on interlanguage process, such as those that capitalized on patterns of code-switching in language attrition and considered general models of code switching (Jake & Myers-Scotton, 1997), are beyond the scope of this paper.

Several theories of language attrition addressed the issue of order of decline. As mentioned above, an early hypothesis of language attrition was the regression hypothesis (Jakobson, 1941), which suggested that language components might be lost in attrition in the reverse order in which they were acquired. While several studies demonstrated the explanatory power of the regression hypothesis (Hansen & Chen, 2001), it has been accepted that the regression hypothesis cannot account for all cases of observed language decline (Caramazza & Zurif, 1978; Hyltenstam & Viberg, 1993). Furthermore, it has been proposed that additional aspects of the process of language acquisition may determine, at least in part, patterns of language preservation. For example, De Bot and Weltens (1991) asked whether the process of acquisition and the context in which a language was acquired determined the storage or representation of that language and thus might influence the processes of its decline. Montrul (2002) hypothesized that the incomplete systems of L1 of
bilingual attriters may resemble those of L2 learners at advanced stages. Based on this approach, it could be expected that lexical items that are acquired late by L2 learners would be the same items likely to be inaccessible first in L1 attrition.

Addressing not the order of decline specifically but differential patterns of decline is the hypothesis that the more automatic certain language skills are, the less they are likely to be affected by the process of attrition (De Bot & Weltens, 1991). Applied to lexical retrieval, this hypothesis can produce testable predictions about lexical items and language tasks that are likely to be more or less automatic. Segalowitz (1991) set out to test whether increased proficiency in a second language necessarily leads to decreased proficiency and, more specifically, to decreased automaticity in the first language of adult bilinguals. He employed a primed lexical-decision task and manipulated the timing of the presentation (short and long inter-stimulus intervals), the relatedness of the prime-target pairs (semantically related or unrelated), and participants’ expectations (high and low proportions of related/unrelated pairs on the list), and compared response times of more- and less-proficient English–French bilinguals in more- and less-automatic priming conditions. He found that the two groups of participants (‘same-rate bilinguals’, i.e. highly proficient bilinguals, versus ‘different-rate bilinguals’, i.e. less proficient bilinguals) differed in their response times to words in their L1 (the less-proficient bilinguals had faster L1 response times). Moreover, it was particularly in the controlled priming conditions that the highly proficient bilinguals had slower reading times but their automatic processing was at least as effective as the L1 dominant group. Thus, while the findings suggested reduced recognition-speed in L1 with increased L2 skills, there was little evidence for differential automatic L1 processing of more- or less-proficient bilinguals.

Automaticity is assumed to be achieved by frequent and intense practice; indeed, language use has been a key variable in theories of attrition (Andersen, 1982). In identifying vulnerable language components, one of the areas Andersen listed was the lexicon. Because lexical use depends on experience, the degree to which attriters are in contact with speakers of the language in question and with specific lexical items of that language will be relevant to the process of loss. Andersen hypothesized that attriters use and come in contact with only part of the language vocabulary, that is, that they use mostly high-frequency words and mostly words that are related to areas of their current experience. Integrating frequency and markedness, Hansen and her colleagues (Hansen & Chen, 2001) have proposed that both frequency of occurrence and degree of markedness contribute to the order of acquisition as well as attrition of specific language components (e.g. Japanese numeral classifiers in Hansen and Chen (2001)). Two additional variables, age and level of proficiency, have been found to influence the process and rate of language attrition and to be, moreover, highly inter-related. In the context of age-related language loss in monolinguals and in L1 attrition in bilinguals who had completed their L1 acquisition, the level of proficiency (and presumably automaticity) is assumed to be maximal prior to the process of attrition. But this may not always be the case in bilinguals who had begun losing their L1 before its acquisition had been completed, as in children who move to another language environment, and in some cases of L2 attrition. Indeed, Köpke (2002) noted that studies of language attrition in children have been rather consistent in their findings that L1 does show clear signs of attrition (Kaufman, 2000;
whereas studies with adult immigrants (who presumably have achieved high automaticity in all their first-language skills) have yielded mixed results regarding the degree to which their first language undergoes attrition (De Bot, Gommans, & Rossing, 1991; Köpke, 2001; Olshtain & Barzilay, 1991). Others have found that the younger the children and the lower the language proficiency, the faster the attrition process progressed (Bahrick, 1984; Hansen, 1999; Kaufman & Aronoff, 1991).

More recently, additional theoretical frameworks, including psycholinguistic approaches, have been developed (Hansen, 2001; Köpke, 2002), and several researchers have focused on retrieval deficit (as compared to language loss). Köpke (2002) discussed the Activation Threshold Hypothesis (ATH) proposed by Paradis (1985, 1993) to account for differential recovery in polyglot aphasia and applied it to the study of language attrition. Within the framework of the ATH, it is assumed that linguistic items have activation thresholds that change on the basis of frequency and recency of use. Low activation thresholds yield faster and easier access than higher thresholds. Relative activation thresholds can account for the language-selection patterns in polyglot aphasia and in bilingualism in general. Köpke employed the ATH in the study of language attrition and predicted that due to the reduced use of L1, thresholds of L1 components would have higher activation levels and that because L2 components would have lower thresholds, errors resulting from L2 interference would be expected. The author studied bilinguals, native speakers of German, who had immigrated after the age of 14 to either Canada or France and had been in their L2 environment for at least seven years. She focused on lexical retrieval and on morpho-syntax features (such as appropriate use of prepositions) and compared the two groups of bilinguals to a group of monolingual German speakers on a picture-description task, a sentence generation task, and a grammaticality-judgment task. Köpke found that in the picture-description task, both bilingual groups had significantly more word-finding difficulties and more lexical errors (as well as, not unexpectedly, more instances of code switching) than the control group. Although further statistical testing was not reported, it appears that the bilingual group living in Canada had more instances of lexical errors and code switching than the group of bilinguals living in France. Morpho-syntactic and syntactic processes, in contrast, did not seem to be as susceptible to attrition. The results, thus, were not conclusive in terms of the predictions of the ATH; while the clear lexical deficit observed in the description task would be predicted by the ATH, similar predictions were not confirmed for syntactic and morpho-syntactic performance. Further study, the author concluded, was needed to determine whether the ATH was a useful framework for the study of attrition.

A more specific hypothesis of lexical-retrieval decline in bilingualism was advanced in Olshtain and Barzilay (1991), who proposed that language attrition degraded the speakers’ lexicon and reduced the degrees of specification available. In their study (see above), it appeared that the participants suffered reduced accessibility to specific-lexical items; instead, they accessed more general items that shared some semantic features with the target. The Olshtain–Barzilay account assumes that words of basic meanings are retained but specific lexical items of highly specific concepts are less accessible. Further research evidence is needed to support this hypothesis. If we were to apply such an approach in the study of healthy aging, we would need to employ appropriate stimuli to test whether older adults have more difficulty providing highly specific lexical items but can retrieve
less-specific words. Furthermore, item analysis may reveal high variability among older adults, similar to the variability found in Olshtain and Barzilay among their attriters. Indeed, variability in performance has been reported to characterize findings from older participants (Au, Albert, & Obler, 1989; Nicholas, Barth, Obler, Au, & Albert, 1997).

Furthermore, several researchers have addressed the question of whether the difficulties that attriters experience reflect changes of language representation or could be attributed to retrieval failure (De Bot & Weltens, 1995; De Bot, Martens, & Stoessel, in press; Seliger & Vago, 1991). De Bot et al. (in press) have demonstrated that residual vocabulary can be accessed even when extensive attrition had taken place. In a series of studies, de Bot and others have found that words that are likely to have been acquired by students of foreign languages are better relearned than completely new words. This approach has been recently applied in additional studies (see the special symposium on language attrition and the savings paradigm in the February 2001 American Association for Applied Linguistic meeting). Whether certain components of language knowledge are lost in language attrition, however, is still debatable and further research is warranted.

6. Common and different aspects

Four types of language-attrition situations have been identified in Van Els (1986): L1 loss in L1 environment (aging); L1 loss in L2 environment (loss of L1 by immigrants); L2 loss in L1 environment (loss of L2); L2 loss in L2 environment (loss of L2 by aging immigrants). The present paper focuses on the first two. Reviewing lexical-retrieval difficulties experienced by the two populations, healthy elderly monolinguals and bilinguals who undergo language attrition, revealed certain common aspects and accounts that can be shared between the two fields of study. One language skill that appears to be impaired in both populations is the ability to quickly and accurately access target words. This deficit may manifest itself in word substitutions and in slower speech production, and in increased hesitations, pauses, repairs, and false starts. Most studies report that participants who experience word-retrieval difficulties use strategies to compensate for their deficits. These strategies include intralanguage strategies that are likely to be found in both populations, such as avoidance, use of alternative forms by rephrasing, and circumlocuting, and interlanguage strategies unique to bilinguals, such as lexical borrowing and code switching.

In bilingual attriters, two forces potentially influence apparent lexical-retrieval difficulties, namely, decreased use and influence of the other language. In healthy aging, there may be a component of decreased language use; for example, we may expect that older individuals have fewer opportunities to use certain components of their vocabulary, especially if they no longer work or if their social interactions are limited. In both populations, speakers may experience increased insecurity in their language skills and their attitude toward their language ability may interact with performance. In all cases of attrition, speakers experience language change over time. The change may be predominantly in the ability to retrieve the target lexical item or in the representation and organization of the lexicon. It is often difficult to find unequivocal evidence for deficit in one of the two aspects but not the other. One method that has been developed by de Bot
and his colleagues to address this issue in bilingualism is the savings approach (see above). Further study of this paradigm and of consistency in performance across time and across tasks will help resolve the issue of knowledge loss in language attrition.

It is conceivable that similar cognitive mechanisms and common neuronal changes underlie the attrition processes in both study populations, but there is currently insufficient data to support or refute such hypotheses. There are, moreover, several differences between the two attriter populations. One important difference between L1 attrition in monolinguals and language attrition (and acquisition) in bilinguals is the result of the mutual effects between the two languages of bilingual speakers. The two languages may be competing for memory and processing resources (Cohen, 1989; Green, 1986; Seliger & Vago, 1991); moreover, features that characterize one language may transfer into the other (Selinker, 1972). Indeed, it has been recognized in the study of language attrition in bilingualism that changes in language representation and/or language use may be due to lack of use and/or due to the influence of contact with another language. The former can be considered an internally induced change and similar processes may be assumed to take place in aging (e.g. simplifications, tendency toward the unmarked, generalizations, substitutions); the latter is an externally induced language change and is relevant for bilingualism only. These two processes, in the context of bilingualism, are not always separate nor easily teased apart (Cohen, 1989; Lambert & Freed, 1982; Seliger & Vago, 1991). In addition, level of language proficiency prior to the process of attrition is often not an issue in the study of healthy aging (but note that vocabulary knowledge, for example, varies even among native speakers of the same language). In contrast, determining level of proficiency is critical in the study of bilingualism. Indeed, there is a lack of good measures of overall as well as specific language skills of bilingual speakers (Clark, 1982; Verhoeven & de Jong, 1992).

7. Remaining issues and conclusion

Several aspects of lexical attrition are still unresolved. These include questions pertaining to specific aspects of the lexicon that may be more or less vulnerable to change, the need for continuous evidence (i.e. language input) and lexical use to maintain language proficiency, the role of mechanisms of search and retrieval in word-finding difficulties, and the underlying neuropsychological processes that may account for the deficit. Applying methods from one type of attrition study to the other and comparing findings from different study populations can answer some of these questions. For example, employing the experimental naming tests that have been used with older participants in studies of bilingual attritors can help define the nature of lexical-retrieval deficit in attritors (e.g. is it task dependent? is access to phonological information dissociable from access to semantic information?) and measuring consistency of performance across tasks and across time can help distinguish changes in performance versus changes of competence of bilingual speakers. In addition, similarities of retrieval breakdown in these different populations may reflect a general vulnerability of the retrieval process, whereas if different patterns of deficits are found for different participant groups, etiology-specific breakdown of subcomponents of the retrieval process could be defined. Moreover, it is likely that elderly
bilinguals would exhibit patterns of language decline that are different from those found for young bilinguals (and/or for elderly monolinguals) and that further distinctions within the process of language attrition would be warranted. To date, only a few studies have focused on processes of language acquisition and attrition in older bilinguals (Clyne, 1977; De Bot & Toke, 1986; Obler et al., 1986; Rosselli et al., 2000).

It should be noted that, in addition to lexical retrieval, other areas of decline have been explored in both monolingual elderly and bilingual attriter populations. One domain (mentioned above) that has been studied in age-related decline is comprehension of complex material. Various studies have demonstrated that older adults have difficulty performing tasks that are based on sentence material they heard or read (Kemtes & Kemper, 1997; Just & Carpenter, 1992; Obler et al., 1991) but several investigators have argued that the older adults’ linguistic processing per se may be intact (Caplan & Waters, 1999). Here, too, careful comparisons of methodology, findings, and underlying assumptions can be beneficial for understanding processes of language-comprehension attrition or decline.

In conclusion, despite substantial differences in some of the variables that have been found to affect lexical attrition in monolingual healthy aging and in bilingualism, similarities in lexical-retrieval deficits and in the strategies used to alleviate the deficit in the two attriter populations can be found. Moreover, differences in findings may be attributed, in part, to different tasks and methods that have been used in the two fields. Theories that have been proposed to account for lexical deficit in aging can be applicable to bilinguals at various stages along the life span. Both research areas can benefit from more diverse assessments of lexical deficit and direct comparisons of findings and their interpretations.

Acknowledgements

I am grateful to Loraine Obler and Marty Albert for their encouragement and their helpful comments on earlier drafts of this paper. I also thank Barbara Köpke and two anonymous reviewers for their helpful comments. This paper was supported in part by the Research Service of the Boston Veteran Affairs Healthcare System and by the National Institute of Aging.

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