Unlearning and relearning of languages from childhood to late adulthood

Keijzer, Merel; de Bot, Cornelis

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Contexts associated with the unlearning of languages across the lifespan

Merel Keijzer[a] & Kees de Bot[a, b]

University of Groningen, the Netherlands[a] and University of Pannonia, Hungary[b]

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1. Introduction

Under the influence of usage-based linguistics, the term language development is understood to encompass both language learning and unlearning: Individuals throughout their lifespan experience periods of spurts and arrests and their language develops in patterns that are not linear and far from always predictable based on the input. For years, cognitive scientists have studied how the human brain deals with incoming information: How we learn, and how and where this information is retained, including what we know about words, grammatical rules, and so on. This is reflected in the substantial work that has been done within the realms of second language acquisition (SLA) and bilingualism regarding how languages are (best) learned . Also featuring prominently in cognitive science is the question of how memories are retrieved, and what happens in the case of retrieval failure (e.g., Anderson & Spellman, 1995). In contrast, notably less attention has been paid to the other side of the coin: How languages are unlearned. Most work in this domain has been done within the field of language attrition (see review by Köpke, this volume). One of the emerging consensus points among attrition researchers is that individual differences very much make up the attrition outcome. In other words, it is impossible to fully predict the conditions under which language attrition takes place. Individual differences notwithstanding, however, there are contexts in which bilinguals or

multilinguals will almost certainly 'unlearn' one or some of their languages, be it the language(s) they learned as their mother tongue(s) or additional languages learned as second or foreign languages at some point over the lifespan. In our own work, we have underscored the importance of testing the extent to which a language may be completely unlearned and lost to bilinguals (or not) by including a language retraining phase that probes the allegedly forgotten linguistic memories of the attrited language. This chapter will explore language unlearning in contexts mostly associated with the two far ends of the lifespan: (young) children and older adults. More specifically, our review will explore the (fictitious) nature of language unlearning, discussing the empirical evidence that suggests that memories of any language once learned, whether the first or any subsequent one, always leave traces that can be recovered if they are probed with appropriate research methodologies. We will also identify gaps in our knowledge regarding the unlearning of languages pertaining to the middle of the lifespan. Pointing at theoretical and methodological causes of this knowledge gap can itself shed light on the nature of language development, including unlearning. It can also inform future investigations tackling language unlearning across the lifespan.

The chapter is organized as follows. First, we explore what it means to unlearn a language. This is followed by a state-of-the-art overview of the main findings that have shaped our understanding of language unlearning. Both unlearning and relearning are discussed as central facets of language development. We focus on childhood and older adulthood, as this is where most of the relevant research has been carried out. We then discuss the little that is known at present about language unlearning in the middle of the lifespan. While we are fully aware that researchers can differentiate between bilingualism and multilingualism, we will focus on bilingualism and consequently use this term to refer to the learning and unlearning of one of two or more languages within a single speaker. The ultimate goal of this chapter is to answer the question of whether it is even viable to speak of language unlearning.

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2. What does it mean to unlearn a language?

Language unlearning has been used in different contexts and with different meanings in the past. As a term, it presupposes an almost active process of undoing earlier learning. As such, it has most often been used in reference to beliefs about language learning and teaching held by both language learners and teachers and what can be brought into the consciousness sphere. Unlearning refers to changing habits, to becoming aware of teaching and learning strategies that are in need of change (McLaughlin, 1992).

Within the Universal Grammar (UG) tradition, the term unlearning has mostly been used to denote the unlearned language that children possess from birth, under the assumption that they come endowned with whatever abstract knowledge they need in order to learn natural language. This unlearned language is referred to as the 'language of thought'. Innate, inner, and private, it is an internal code that presents a blueprint or set of principles needed for setting parameters upon being exposed to natural language (cf. Malcolm, 1995, p. 73). Fodor (1975), building on the foundations of UG, explicates this by saying "one cannot learn a language unless one has a language" (pp. 63-64). In subsequent UG work within the realm of second laguage acquisition (SLA), unlearning is also used to refer to the effects of negative evidence in changing a previously erroneously used rule in the L2 learner's mind. Thus, UG-based work (both in L1 and L2 learning) essentially builds on the existence of an innate representational system, and on computations that can modify this representational system, to learn or unlearn previously established rules (Malcolm, 1995). The innate representational system and computations "are not consciously accessible" (Fodor, 1975, p. 49).

Largely due to the contribution that Universal Grammar has made to cognitive science, the latter field has been permeated with the belief that the human brain processes information

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much like a computer. Let us give an example from the lexical domain: under the premise of our brain as information processor newly learned words, as well as the rules that tell us how to manipulate them, are stored (see Epstein, 2016 for a more elaborate outline of this example). Upon encountering a new word, it enters a temporary buffer before being transferred to long term storage, from which it can then also be retrieved upon demand. In recent years, this idea has been challenged. As Epstein (2016) notes, computers really do have physical memories which they store and retrieve and can replace upon demand. Organisms (humans) do not. Humans do not have a store of words or grammatical rules, not even memories. As such, linguistic memories cannot be consciously unlearned either. Indeed, framed by a radical embodied cognition framework (Chemero, 2013), the idea that the human brain mirrors a computer in storing and retrieving language in whatever form has recently been completely rejected. Instead, such intelligent behavior as changes in language skills is best captured as a direct interaction between organisms and the world they live in. In other words, depending on a speaker's environmental input, language learning, language unlearning, or even language relearning occurs. By extension, the same experiences shape organisms in different ways, making the results unpredictable; interactions with the environment affect us differently because they build on unique neural structures already in place and themselves formed over a lifetime of unique experiences. That also means that the precise patterns of language unlearning are hard to predict. Radical embodied cognitive science integrates notions from Dynamic Systems Theory, the phenomenological tradition in psychology and ecological psychology. As Chemero (2013, p. 145) mentions, "[radical embodied cognitive science] is skeptical of the explanatory usefulness of mental representations." Leaving out the notion of representations is indeed a radical change since most current psycholinguistic theories lean heavily on this notion.

While it has proven difficult to shake off the information processing metaphor (Epstein, 2016), there is a general consensus that language unlearning results from interactions with the

environment. Nevertheless, different terms have been used for the unlearned language that forms the end result. Past work has interchangeably used the terms language loss, language attrition, language unlearning, and language forgetting, contributing to the current situation where it is unclear what language unlearning entails exactly. In this chapter, we distinguish between those terms at the outset. Specifically, we view language attrition and forgetting as unconcious phenomena taking place within an individual. By contrast, we propose that language unlearning be used to denote a conscious process of changing habits or automatized skills. Language loss, then, is the overarching term to describe both processes. At the same time, we will challenge the use of these very terms, which we will revisit in our final discussion.

3. Can people forget a language?

Language attrition is the loss of language skills in individuals. But can people forget a language? This is an interesting question to pose, because favoring the term forgetting over loss implies that the language skills are not lost forever. At the same time, the question is imprecise: What is meant by forgetting (cf. |Schmid, 2011)? This latter question bears relevance to the time frame in which attrition takes place. Earlier attrition studies typically set the threshold for participant recruitment at a minimum of 10 years immersed in the new language environment, to allow a large enough window for forgetting to take place. However, this traditional approach to language and migration presupposes that a relatively homogeneous (language) group x with a stable and fixed L1x moves to a different but equally stable L2x environment (as evidenced by the group comparisons that characterize the field of attrition). But recently, these very foundations have been challenged by the contemporary social sciences paradigm of mobilities: people, their attributes and ideas are never static, given or fixed but more fluid to begin with; in a top-down manner imposing a minimal timeframe of 10 years following the move of attriters

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bypasses this fact (cf. Brenner, 2004 for a more elaborate discussion). Perhaps partly based on the mobilities paradigm, more recent investigations have shown substantial – and often most – language forgetting to take place in the initial years following the change in the ecology of language exposure. An examplary study is Chang (2012), who looked at L1 American English speakers becoming immersed in an intensive Korean as a foreign language course. The results showed that the participants underwent phonetic attrition in their L1 as little as 6 weeks into the experience, particularly in English stop consonants and vowels, restucturing the vowel space of their English to assimilate to the Korean vowel space. Such short-term attrition is often explained as the L1 needing to be most strongly suppressed in the initial period of coming to terms with an new language, to avoid interference. In his activation threshold hypothesis, Paradis (1993) stipulates that L1 inhibition raises the activation threshold of L1 items, making it hard to access the L1 upon demand. Taking this a step further, subsequent studies have challenged the premise that attrition needs to affect the language system globally and have also pointed out local attrition effects in speakers who, as the participants in Chang (2012), just started learning a second or foreign language and who are not immersed in an L2 environment but instead continue to live and move in an L1 environment (e.g., Bice & Kroll, 2015). Through contributions like these, attrition is placed within a broader framework of activation and inhibition of bilingual language use.

Following such a perpective, Anderson et al.'s (2004) theory of retrieval induced forgetting (RIF) is relevant, although developed in cognitive psychology without being specific to language. Under this theory, it is assumed that when one retrieves a piece of information, related knowledge is inhibited to avoid interference. A classic RIF paradigm consisting of a familiarization, practice, and test phase can demonstrate this. Participants are first presented with a number of category-examplar pairs (e.g.: FRUITS-APPLE, FRUITS-KIWI, DRINKS-WINE). A practice phase then follows in which subjects practice with half the examplars of

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half the categories, being prompted by means of stimuli such as in FRUITS-A. In the final test phase, all exemplars of all categories have to be recalled. Perhaps unsurprisingly, the practiced items are recalled easiest due to a clear facilitation effect, but - more interestingly - examplars from unpractised (baseline) categories are more easily recalled than unpractised exemplars from practiced categories (so in this case DRINKS-WINE is easier to recall than FRUITS-KIWI). This is explained through inhibition mechanisms that are needed to keep exemplars from the same category from impinging on the practice item. Bringing all of this back to L1 attrition means that when a word for a certain concept is retrieved in the L2, subsequent retrieval of the corresponding (translation) L1 item should be harder to do.

Levy, McVeigh, Marful, and Anderson (2007) looked at attrition data invoking RIF. Their goal was to test the theory's prediction with a sample of L1 American students taking a semester of Spanish at college. They found that these students became progressively slower to name an L1 English item after the same item had been named 10 times in Spanish. Interestingly, when the word prompt was semantic in nature (e.g. naming the word *snake* upon seeing *venom – s.....*), only a facilitation effect occurred; the retrieval induced forgetting effect instead characterized phonological prompts (i.e. presenting a prompt that rhymed with the target word; the same word *snake* but this time with the phonological prompt *break – s.....*). Although the numerically small effect of this study has been critiqued , this research has offered an important step in understanding the nature of forgetting linguistic information.

Indeed, with the introduction of RIF as a framework to study attrition, the threshold of 10 years needed for attrition effects to become noticeable is challenged. . With that, the irreversible nature of forgetting can be examined more closely: within the RIF framework, L1 will be reactivated upon more L1 input. However, Linck, Kroll, and Sunderman (2009) investigated RIF in a group of L2 Spanish learners from an L1 American English background who went on an exchange semester to Spain, and who continued to show retrieval induced

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forgetting effects in their L1 English even up to six months following their arrival back in the US.

Extending the insights from RIF and other forgetting theories further to the lifespan, one of the most robust predictors of attrition so far has been age at emigration, classified more accurately perhaps as age at onset of bilingualism: (young) children invariably show more attrition and do so quicker than their adult peers undergoing the same experience. At the other end of the lifespan, in advanced age, there are also a number of phenomena that are invariable associated with language forgetting: changes due to normal aging as well as phenomena like aphasia. A more detailed review of both these lifespan contexts can lead to a better understanding of what language forgetting is and does. Given the insights brough to this field through retrieval induced forgetting, however, it is crucial to not only examine language decline that results from inhibition, but also to relate this to how that language developed in the first place and also whether it can be relearned and the circumstances that facilitate such relearning, or reactivation.

4. Forgetting and relearning of a home language in children: International adoptees and heritage speakers

Language attrition studies invariably report least individual variation in young children. Moreover, age at emigration or –more accurately – age at onset of bilingualism is one of the most robust predictors of whether attrition will occur, with the general rule of thumb being that the younger children are when they moved and came into contact with a new language, the more L1 attrition they will show (Schmid, 2011). Theoretically, this has been explained as a reverse critical period: Maturational constraints are at work so that a gradual decline can be seen in the susceptibility to attrition as the age of onset of bilingualism increases (Bylund,

2009). While order-wise this seems to be a robust finding, it does of course not imply that language forgetting is inevitable in child migrants. Empirically, when testing child migrants in their L1 at a later age, and in the presence of either sudden or gradual decreases in exposure to the L1, a methodological conundrum is the question whether what is tapped is a manifestation of L1 attrition or of incomplete L1 acquisition. Indeed, especially at a pre-literate age, the only substantial remaining source of L1 input the child receives is generally from the parents and at home. Because of this, rather than L1 attrition, the term home language attrition can perhaps better capture what goes on in this population, but this terminological nuance is not yet established within the field. Indeed, within a more nuanced view of language development that does not strictly adhere to the acquisition-attrition dichotomy, it becomes less interesting to talk about incomplete acqusition vs. loss. Moreover, the role of literacy in particular is more substantial than has previously been assumed. Köpke (2007, see also this volume) already noted that literacy - through the multimodal coding it induces - can attenuate attrition. Referring to so-called literacy anchoring, Schmitt (2010) sees literacy as an opportunity for both a constant as well as varied source of input. For this end of the lifetime spectrum, then, literacy pertains to how something is learned, or rather consolidated, and how this in turn impacts on what is retained or forgotten.

With these general home language attrition or maintenance principles in mind, two main contexts are invariably associated with home language attrition at young ages: the language loss found in international adoptees and that of heritage language speakers, alternatively referred to as speakers of ethnic minority languages or community languages..

In the most dramatic of these contexts, international adoptees stop using their first language immediately following their adoption and subsequently show a very steep attrition curve of their first language, making them virtually indistinguishable from native speakers of their new language environment within mere years following their adoption, both in relation to

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L2 and L1 proficiency levels (Isurin, 2000). Their language abilities in the new language once they begin school years, moreover, appear to be largely similar to age-matched peers, except for some better receptive than productive ability and some slight differences in some but not all areas of grammar (Glennen, 2015). Very intriguing here is the question if traces of the allegedly forgotten language can be found years after adoption.

One of the first and most oft-citedstudies to have looked into this question is a study by Ventureyra, Pallier, and Yoo (2004) involving 8 Korean subjects adopted into Francophone families between the ages of 3 to 8. In their mid to late twenties at the time of testing, the subjects reported no recollection of the Korean language, and this was corroborated by behavioural tests. More importantly, event-related fMRI evidence revealed no specific cortical activation in these subjects when listening to Korean stimuli. They were, in fact, no different from a group of native French controls. When being tested using French stimuli, the adoptees again showed similar activated brain areas as the French controls, although the activation site for the French natives was more extensive. Ventureyra et al. use this finding as converging evidence against the existence of a critical period, as learning a language early in life should leave long-lasting traces in the neural circuit, but instead French here appears to have overridden Korean in the adoptees' brains. Using more fine-grained follow-up tests of, among others, a recognition number series, the investigators were able to differentiate between phonological and semantic memory, but only minimally. These finding led the authors to claim that "the adoptees have a somewhat more precise notion of the sound pattern of Korean than the native French, but no explicit access to knowledge of Korean lexical items" (Ventureyra et al., 2004, p. 219). Anecdotal reports of retraining in this subject pool, where previous experience with Korean should facilitate learning the language, did not amount in significant findings either: Many of the adoptees had visited Korea (with visits ranging from a few days to a few months) and/or had taken Korean language courses. None showed a significant recovery

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of Korean in comparison with the French controls, who had never been exposed to Korean. In short, despite substantial early-life exposure to Korean, virtually no traces of the language were found in this group of international adoptees.

Especially the last facet, the reactivation/retraining component, was taken up years later by two independent psycholinguistic investigations, but with different results. Choi (2014), also focusing on Korean as a first language but in the context of international adoptees residing in Dutch-speaking families in the Netherlands, looked at how the first language facilitated retraining of both phonological comprehension and production of Korean sounds. The adoptees were between the ages of 23 and 41 (mean age: 31.66) at the time of testing, and they had been adopted between 3 and 70 months, with a mean of 21.38 months. In an initial comprehension paradigm, the Korean adoptees and a group of Dutch controls were trained in identifying distinctive Korean alveolar aspirated (lenis and fortis) sounds. At the pretest, the two groups did not differ significantly from each other, but midway through the training, the Korean adoptees showed a superior performance, both on the trained sounds but also on similar but untrained sounds. Although the Dutch controls did catch up, making the two groups indistinguisahble again at the posttest, this result was interpreted by Choi as evidence that the phonetics of a childhood language are saved as a linguistic memory. This was underscored by a follow-up experiment also reported by Choi (2014), where both groups were taught to produce these same sounds and their efforts were assessed by native Korean speakers. As a result of the training, both the adoptees and Dutch controls markedly improved, as apparent from the native speaker assessments, but only the Korean adoptees' realizations were most often identified as target-like and were generally assessed more positively. This savings finding (see later in this chapter) corroborates earlier findings by Singh, Liederman, Mierzejewski, and Barnes (2011) and Pierce, Klein, Chen, Delcenserie, and Genesee (2014).

Zhou (2016) carried out a similar investigation with Chinese (both Mandarin and Cantonese) international adoptees in the Netherlands. Furthermore, a crucial difference was that her speakers were tested as children, ranging from 4;0 to 10;0 years of age at the time of testing. They had then been cut off from exposure to their first language for 5 years on average. Here too, following a perceptual training phase, the Chinese adoptees were better able to recognize phonological contrasts in their respective first languages (Mandarin or Cantonese) compared to age-matched Dutch controls. This study again provides evidence for first language traces, even following very brief exposure regimes and with that contrasts Ventureyra et al's earlier findings.

These extreme cases of language loss and relearning can also be mirrored in a less dramatic setting: that of heritage language speakers. The loss in these cases is due to environmental influences typical in bilingual families, in general, which can either be directly linked to a geographical move, such as is the case with international migration, but often seem to organically arise out of the very bilingual situation that bilingual children find themselves in, where exposure to the two or more languages of the child is almost certain to be uneven and potentially subject to discontinuities due to the language of schooling, temporary travel, differential parenting roles (main language of communication used by which parent), and so on. In examining heritage learners who had been exposed to that heritage language in early childhood, but for whom exposure then stopped or diminished greatly, it has been repeatedly found that they attained higher levels of proficiency upon being re-exposed to the language than those with no previous experience (e.g., Au, Knightly, Jun, & Oh, 2002). Heritage language learning is interesting in this context, as it has often been classified as involving high degrees of attrition. Rothman (2007) has challenged this premise, pointing out that what is seen instead in heritage speakers is complete acquisition of an attrited variety. In other words, the main source of input in heritage learner is compromised, reflected in the heritage speakers' output. While it is most certainly possible that the main source of input deviates from the input these

heritage speakers would have received in an environment where their heritage language is the majoity language, we here return to our earlier discussion of the fluidity of the concept of language development: in our view, it is less informative to talk about incomplete acquisition vs. attrition or indeed the full acquisition of an attrited variety. What is interesting instead, is the unique interplay between the environment and the bilingual individual and how this is reflected in the individual's language output. Indeed, Gonzo & Salterelli in a seminal paper written some decades ago (1983) have already suggested that in such heritage language users there is typically a cascade effect; the generation who migrated undergoes attrition which leads to a new variant that serves as input to the children, but that is also only partially transmitted to the next generation, so the decline is a combined effect of intragenerational attrition and intergenerational incomplete transmission and rather than an attrited form of a heritage language, the resulting linguistic reality may be more accurately described as a contact variety, worthy of investigation in its own right, much along the lines as creolization has been studied.

The studies reviewed in this section all show the importance of combining the two crucial factors of input and age in predicting childhood language loss. At the same time, it is also important to emphasize the less dramatic bilingual bases and contexts in childhood that are associated with attrition, beyond international adoption and children of immigrants learning a heritage language. Indeed, there are contexts in which children unlearn their L1 as a consequence of family arrangements like divorce, travel, or intermarriage (see Gonçalves, Chapter 3, this volume, for more on language learning and use in linguistically mixed couples). It is furthermore important to note that there is a good portion of from-birth bilingual children, growing up in bilingual families, and who are thus most accurately labeled bilingual first language acquirers, that end up losing their productive language ability in their home language without any apparent reason like travel or migration, in the absence of an abrupt change or major turning point in the lifespan (see discussion in De Houwer, 2009). Instead, language loss

in such cases seems to evolve organically out of language use patterns and environmental influences within bilingual families. Indeed, while the terms L1 and L2 attrition, and also L2 acquisition, may be used liberally by attrition and second language acquisition researchers alike, for many bilingual families, these distinctions will not be so clear cut. While important to point this out, the caveat does suggest that organic self organizational mechanisms within bilingual families are highly unpredictable in terms of the language attrition they render.

In short, there is abundant evidence for unlearning and relearning in bilingual contexts in (early) childhood. What appears to be most pertinent within this end of the lifespan, is how language unlearning is associated with type and contexts of learning (e.g., literacy anchoring or of the quality and amount of input in the child's two or more languages for heritage learners). And even that with all these factors in place, the outcome is largely unpredictable.

5. Forgetting and relearning of languages across the adult lifespan

The other end of the lifespan, older adulthood, is another context in which language changes, including loss of language skills, are most prevalent. There are, in general, intriguing mirror symmetries between childhood and older adulthood, which have linguistically been captured in Jakobson's (1941) regression hypothesis. Also sometimes labeled "last in first out", the hypothesis stipulates that those linguistic features that are acquired late in children are also the first ones to go in language forgetting settings. Abundant evidence for regression has been found in the pathological domain, noting similarities in agrammatical structures produced by children and aphasics (e.g., Caramazza & Zurif, 1978; Kolk, 2001). For non-pathological language attrition, in migrant populations most notably, evidence for regression has been found in the domains of morphology and syntax (see, for example, Keijzer, 2007, de Bot & Weltens,

1991). Yet the occurrence of mirror symmetries – between child language and either pathological or non-pathological language loss - by itself does not explain why such convergences occur at both ends of the lifespan. Keijzer (2010) argued that the regression hypothesis can be best theorized in contemporary thinking within the vantage point of cognitive competition. Specifically, she argues, competition explains the similarities in surface forms or errors between children and older individuals showing either pathological or non-pathological language loss, but it stems from vastly different sources. In children, cognitive systems are not yet fully matured, showing compromises along the way. In aphasia, likewise, cognitive resources are in constant competition. In attrition situations, on the other hand, competition mostly stems from two languages that compete for limited cognitive resources.

A confounding factor is that many attrition participants are older adults; most attrition studies adopt a recruiting strategy of a minimum threshold of 10 years of immersion in an L2 environment, combined with a minimum age of at least 16 upon moving. A very pertinent issue then becomes how forgetting effects can be separated from normal aging effects (Goral, Libben, Obler, Jarema, & Ohayon, 2008;), especially in the lexical domain, as this is most vulnerable to both atrition and aging effects (see overview by Higby, Lerman, Korytkowska, Malcolm, & Obler, forthc.). Indeed, cognitive resources tend to decline in normal aging, as manifested in working memory and processing speed reductions as well as executive control compromises (see Higby et al., forthc.).

Within this framework, the context that renders the most predictable language loss is age-associated pathology: degenerate diseases such as Alzheimer's are prevalent in advanced age and are known to impact on language use. Most notably, the semantic and pragmatic systems of Alzheimer's patients are impacted, frequently leading to communication problems (Ferris & Farlow, 2013). Placed in a bilingual context, in recent years most attention has been expended in the benefits associated with bilingualism in attenuating such degenerate diseases

Substantial work has also been done on how aphasia differentially affects different language systems in bilingual patients (Paradis, 2001). Very interesting is the line of work done in relearning language once loss has taken place in bilingual aphasia. An important question is whether both languages of the individual recover in parallel or whether differential or selective recovery of one over the other language occurs. Parallel recovery appears to be most common (Paradis, 2001), but Fabbro (2001) points out that recovery patterns in bilingual aphasia cannot reliably be predicted because of the intricate interplay between an individual's lesion type, lesion site, the type of aphasia that results from it, and the contexts in and extent to which the languages had been used prior to the onset of aphasia. Interestingly, cross-language treatment has shown that rehabilitation of one language can positively affect the recovery of others in bilingual aphasics (Goral, Levy, & Kastl, 2010). Very much in line with the recent discussion about the bilingual advantage in attenuating aging effects, Alladi et al. (2016) looked at general cognitive recovery of stroke patients and found that, even though the age at which they were affected by a stroke did not differ for monolinguals and bilinguals, bilinguals did recover faster from it, on a cognitively-general level, irrespective of language recovery patterns.

Compared to pathological language loss in degenerate diseases or following a stroke, non-pathological L1 attrition is far less certain to lead to language loss (see also Köpke, Chapter 19, this volume). It does, however, see a similar trajectory as its pathological counterpart with regard to which aspects of language are affected, and what the recovery pattern is. In one of the few longitudinal studies on L1 attrition, de Bot and Clyne (1994) looked at changes in spontaneous speech in Dutch and German immigrants in Australia, who had been tested by Michael Clyne in the early 1970s and retested in 1987. The evidence suggested very little change over time. Particularly declarative knowledge (e.g., the gender of nouns) did not change over the 16 years of the study. What was witnessed were some small but significant declines in lexical richness, operationalized as type token ratio. In 2005, some of the subjects who had been

last tested in 1987 were visited again.. By that time, many had moved into a Dutch-medium home for the elderly and now showed signs of reversion, in that their L1 Dutch seemed to have improved while their English had deteriorated. This is reflected in de Bot and Clyne's (1989) twin hypotheses of first language reversion and second language attrition: As immigrants grow older, they tend to use the L1 more than they did in middle age and simultaneoulsy they tend to forget L2 vocabulary and lose grammatical rules that they used in middle age. Although anecdotal evidence abounds – coming from elderly migrants themselves or their children or caretakers - very few empirical investigations have taken up these hypotheses. Clyne himself (2011) speaks of a reversion myth that has – without empirical foundation - informed migrant aged care to great degrees. From the inhibition/activation perspective proposed by RIF and Paradis's (1993) activation threshold hypothesis, the reversion that is anecdotally reported can perhaps better be captured through cognitive decline that characterizes normal aging, making it harder to suppress a language in bilingual contexts with advanced age. Indeed, L1 interferences on the L2 should then be reported as much as L2 interferences on the L1, and there is tentative evidence to suggest this (Keijzer, 2011).

In short, very much in line with what has been found for childhood unlearning, only the most extreme form of context renders predictable unlearning: that of pathological language loss that follows from neurodegenerate diseases or aphasia brought about by a stroke. The less dramatic bilingual contexts and the language unlearning and relearning that occurs in advanced age have rendered less clearly defined predictions of language unlearning. At this end of the lifespan, much can be gained from studies that actively attempt to disentangle effects due to normal aging versus language loss, and effects due to pathological versus non-pathological language loss.

6. The great unknown: language unlearning and relearning in (middle) adulthood and the savings account

Whereas in (early) childhood and older adulthood there are at least some contexts where language unlearning will almost without fail occur, the vastness of years between both these ends of the lifespan has rendered less convincing or less consistent unlearning effects and instead individual differences very much characterize attrition findings here (for an in-depth overview, see Köpke, Chapter 19, this volume). In general, language unlearning comes about through an intricate interplay between speaker internal factors and external environmental influences. And it is especially the environmental influences that show greatest variability in middle adulthood. As a consequence, many bilingual lifespan investigations do not focus on this group. That this oversight may be more detrimental than is often assumed is reflected in the fact that middle agers' cognitive performance is at its peak, not showing age-related detriments the way cognitive compromises in children or older adults do and that in turn can impact on language). In other words, focusing on middle agers can uniquely separate language forgetting effects from cognitive decline/maturation confounds, albeit that because of combined work and family commitments, the cognitive system of midlife adults is taxed. The majority of what we know about language unlearning in adulthood comes from L2 studies that have looked at residual knowledge of foreign and second languages learned later in life and following years of non-use. Generally, studies – despite self-reports by speakers that substantial attrition has taken place – have found more retention than L1 attrition of such skills (cf. Hansen, 1999). This has been taken as evidence for what has been labeled the savings/relearning paradigm.

The savings/relearning paradigm was introduced by 19th-century German psychologist Hermann Ebbinghaus. In his 1885 book, Űber das Gedächtnis [On Memory], he reports on experiments in which the only participant, himself, memorized 169 lists of 13 nonsense syllables until he could reproduce them correctly. Next, after periods varying between 20

minutes and a month, he relearned a list he had learned previously and additionally learned a similar, new list of nonsense syllables. The relearning reflects the advantage of relearning old, forgotten words over new words, and in his experiment it was operationalized as the difference between the number of trials needed to learn a previously learned list and a new one. In the beginning, forgetting took place rather quickly, but the rate of forgetting decreased as a function of time. This observation led to the assumption that information, once it has been transferred to long-term memory, is never completely lost.

Not until the 1970s did a number of experimental psychologists give new impetus to research on the relearning paradigm. Nelson and colleagues (Nelson, 1978) investigated the properties of the (linguistic) information stored in the memory trace and found that part of it is acoustic in nature. Nelson also concluded that relearning served a trace-strengthening function: The relearning trial resulted in an increased overall amount of memory strength, which would be sufficient for successful retrieval (Nelson, 1978). MacLeod investigated the relearning effect in the case of translation equivalents (1976) but also savings for pictures and words (1988). Surprisingly, his experiments showed that savings was only detected by recall, and not by recognition tests, which made him conclude that "relearning facilitates the retrieval of information, rather than (or perhaps in addition to) increasing its trace strength" (MacLeod, 1988, p. 209).

The savings paradigm was first applied to language attrition research by de Bot and Stoessel (2000). They compared the learning scoreson a Dutch language test of two participants, both German adults who had spoken Dutch as children during a 4-year stay in the Netherlands, with those of a group of control subjects who had not been exposed to Dutch before. On average, the experimental participants scored better on the relearning task than the control group. They also administered a within-subjects test, consisting of old words taken from the original Dutch list of high-frequency words and a number of Dutch low-frequency words. Both subjects

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appeared to have a significant relearning advantage for old over new items, confirming that residual lexical knowledge was still present in memory.

The study by de Bot and Stoessel was the first of a series of studies of savings in vocabulary relearning of languages acquired under natural exposure. They are reviewed by Hansen, Umeda, and McKinney (2002), who also conducted their own study on language attrition and savings of Japanese and Korean as L2s. Investigating a large sample of 304 native speakers of English after their return to North America from a stay in Japan or Korea lasting from 18 to 36 months, Hansen et al. found a considerable savings effect. They suggested that subsequent research into relearning should address the question of which variables affect the size of savings, for instance the original proficiency in the attrited language and age. A study that focuses on the role of one such potential variable is the one by Schneider, Healy, and Bourne (2002). In two experiments, they gave groups of non-French-speaking college students (64 students in the first and 48 students in the second experiment three trials of training on French-English vocabulary pairs and subsequently tested them on these pairs. In a second session 1 week later, participants were retested and then retrained on the same pairs, in both translation directions. The researchers found that the size of savings during relearning increased when during the first session students had been trained on the more difficult items.

Research into savings was extended to the relearning of vocabulary of languages acquired under classroom conditions. De Bot, Martens, and Stoessel (2004) reported on a series of experiments in which they compared the learning scores of newly acquired L2 words versus words students of an L2 are likely to have acquired in the past. In all three tests, there appeared to be a significant savings effect for the old over the new words.

The last study involving the relearning paradigm that we want to mention here is an experiment by Bowers, Mattys, and Gage (2009), in which a group of 7 native English speakers

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tried to relearn the phonology of a language (Hindi or Zulu) they had learned in childhood and from which they had afterward been completely separated (see also our discussion on child heritage speakers above). At first there was no evidence that the participants had retained any knowledge of their childhood language, but after some practiceparticipants under 40 years of age appeared to have regained sensitivity to phoneme contrast in the language concerned. However, in participants over 40 years of age there were no signs of relearning. Likewise, young control participants who had not been exposed to Hindi or Zulu before showed no learning. The authors concluded that even when adults have not retained any explicit memory of their childhood language, they may still have preserved

traces of implicit knowledge of that language.This finding is reminiscent of the international adoptees study results we discussed above.

7. Avenues for future investigation of language unlearning

Unlearning in middle adulthood is in need of further investigations, but throughout the lifespan, there are more learning, unlearning and relearning arenas that deserve more attention in the future. Although in this chapter we have reviewed bilingual contexts, in many situations of both learning and unlearning more than two languages are involved. Although there is work on multilingual development in children as well as change patterns that characterize multilingual aging ,combining these lines of work would lead to valuable insights into language learning and unlearning as well as the constraints under which they operate. In that same vein, it is imperative to understand more about language learning and unlearning in bidialectals (see Chevrot & Ghimenton, Chapter 26, this volume). Speakers who speak both a standard language variety and a dialect are often overlooked in bilingualism studies. This is counterintuitive given the speculation that a bidialectal background will facilitate the learning of additional languages

(Han, 2015). Knowing how language learning and unlearning take shape in two language varieties that are as maximally close as possible on a typological level can greatly inform our understanding of the nature of language unlearning.

Secondly, although literacy anchoring has been singled out as a safeguard against attrition effects because of the multimodal coding it entails (Schmitt, 2010), the loss of gestures or indeed attrition effects in multimodal language users is a largely uncharted territory (but see a number of papers in the edited volume Sign Languages in Contact, edited by Quinto-Pozos, 2007). In recent years, the interest in gestures as part of both L1 and L2 communication has developed considerably (see Gullberg, de Bot, & Volterra, 2008). The study of gestures is technically complicated since the coding of gestures in three dimensions (or four, if velocity of movement is taken into account) is particularly complex, as is the allignment with the spoken speech signal. This perhaps leads to memory anchoring in a very powerful way. But as there is no standard for gesturing in any language, it is hard to show the role of cross-linguistic influence in gestures and, as such, to assess the forgetting or unlearning of gestures. Constructing a workable paradigm here can be very important to understand the nature of language forgetting.

More generally, there is much to be won if future investigations were to directly take up the notion of what it means to unlearn a language, in fact bringing it full circle to how investigations of this sort have started (see section 2), but this time taking on board all that we have learned from language attrition studies in the meantime. An important question to pursue, also in view of what has been discussed in this chapter, is whether language unlearning can ever be conscious. We have argued that active unlearning only pertains to the undoing of earlier learned habits, not knowledge itself and, in fact, attrition by definition is not conscious, although speakers may become consciously aware of their own language loss. Nevertheless, there are some studies to suggest that even language forgetting can be conscious to some extent. Freud (1899) signalled that some memories are too painful and are consequently suppressed to a level

beyond conscious awareness. This behavior is mainly viewed as a self-defense mechanism. Freud's ideas have been contested repeatedly and the brain mechanisms underlying motivated forgetting remain largely unknown, but there are examples where suppression seems to be at work. For example, Schmid (2002) looked at the language attrition of L1 German of three groups of German Jews who migrated to the US from WWII Germany: One wave came before the nazi regime, one during it, and the final group was unable to get away from Germany until after World War II. There was an incremental pattern of attrition, with those individuals who were most traumatized (i.e., those who had experienced most of the war) showing most attrition. Another example is a case study by Footnick (2007), who reports on a case study of an individual who had undergone an involuntary conflictual experience with his first language (Mina, a native language of Togo) during childhood, such as the use of that language being forbidden in school or at home. He apparently showed an almost complete loss of his first language: "The conflict may have resulted in the language becoming inaccessible. […] The loss of a hidden language is a rapid process in which the entire language, except a few words, disappears for a short time, due to psychological events involving conflict concerning the use of the language" (p. 171). Interestingly, through a regression-based hypnosis study, the suppressed language was brought back, and the bilingual subject was able to produce it again under hypnosis, at the childhood proficiency level he had attained before exposure to the language stopped.

This directly speaks to the savings account. The relatively small investment and outcomes of relearning as opposed to learning anew is a direct attestation of such residual knowledge (de Bot, Martens, & Stoessel, 2004). This links back up to the relearning studies done in adoptees. It would also imply that language unlearning in essence is a fictional concept, a position that is underscored by the various studies reviewed in this chapter. Moreover, unlearning cannot be studied in isolation. Instead, language learning, unlearning, and relearning are part of the

broader construct of bilingual language activation and suppression, that organically follow from changes in a speaker's input. This observation fits in well with a usage-based perspective on language development that views language acquisition and language attrition or forgetting as two sides of the same coin that alternatively characterize a speaker's language spurts and arrests throughout his or her lifetime.

8. Conclusion

This chapter has explored contexts associated with the unlearning of language across the lifespan. Although there most certainly are contexts, most notably in early childhood and older adulthood, in which unlearning takes place, this does not answer the question of what it means to unlearn a language. This is underscored by most theories of forgetting that have been discussed in this chapter (i.e. retrieval induced forgetting, dynamic systems theory, regression, activation threshold hypothesis) merely detailing the observable details of language forgetting, but not their underlying bases. Based on the savings account, but also on what past studies have shown in terms of reactivation and relearning in even the most extreme cases of unlearning a language, such as that of international adoptees or in pathological cases such as aphasia, it appears that language unlearning in and by itself does not occur. Speculating as to the reason of this is that language far exceeds the status of a skill. Contrary to the name that Lambert and Freed (1982) gave to the first conference on the topic of attrition, *The Loss of Language Skills,* language may well be markedly distinct from other skills in that it permeates all domains of life and it is always present in the environment, in whatever form. Its enormous complexity is likely to lead to a level of anchoring that subsequently becomes very difficult to lose. Echoing the claims made from a radical embodied cognition framework (Chemero, 2013), the complexity of the language system or systems for bilinguals cannot be captured in a simple shelve system where linguistic memories are stored and from which they can be retrieved. Instead, a complex

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network is formed, building on and relying on environmental input, in nonlinear never fully predictable ways. The task of research into multilingual learning, unlearning, and relearning is to illuminate this complexity.

Commented [MK2]: And that is also true for atrtrition insoghts.

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