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In search of the lost language

The case of adopted Koreans in France

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Introduction

Studies of language attrition have often focused on language loss and interference in a contact situation and hence involve individuals who at some point could have been considered as 'bilingual'. Under such circumstances it is difficult to determine the degree of 'attrition' due to erosion from disuse and that resulting from interference from another language. These confounding factors complicate the understanding of mechanisms leading to language attrition. Many of these studies are also primarily aimed at evaluating morphosyntactic and lexical modifications in the attrited language, excluding phonology, an aspect of language known to be acquired within the first year of life (Werker & Tees 1983), and therefore quite relevant to the study of L1 attrition.

The present study addresses these two issues. Firstly, it considers individuals who, at a relatively early age, were extracted from their native linguistic and cultural environment only to be immersed in a radically different milieu, requiring the acquisition of a new language and rapid adaptation, to the detriment of the native language which had become obsolete. These individuals were then not fluent in both languages, or at least not for very long, thus minimising the interference factor.

In this particular case, attrition may result from 'brain plasticity': the brain's capacity to adapt to a changing environment, which is believed to decline with age and brain maturation. The decline in the brain's ability to adapt and to learn is described by the 'critical period hypothesis' as it pertains to

language acquisition (Lenneberg 1967). According to this author, a 'critical period', or a time-frame during which the learning of a given cognitive ability is optimal, applies to language and extends from age two years to puberty. Numerous studies ranging from brain-damaged / hemispherectomised children (Basser 1962) to the extraordinary cases of 'wild-children' deprived of language until relatively late in development (Curtiss 1977), and congenitally deaf individuals having been exposed to sign language at different ages (Mayberry & Eichen 1991; Newport & Supalla 1987), support the claim of maturational mechanisms involved in L1 acquisition.

On the other hand, the maturational hypothesis also suggests that exposure to L1 may leave long-lasting traces in the neural circuits involved in language processing, and thereby prevent total L1 loss. Thus, according to this hypothesis, we should expect to find traces of the Korean language at some linguistic level in our population of Korean adoptees, who were exclusively exposed to Korean during the first 3 to 9 years of life, and subsequently isolated from their L1 during 15 to 30 years. Conversely, the absence of remnants of L1 would indicate an overwhelming plasticity and replacement of L1 (Korean) by L2 (French).

Secondly, an important part of this study is devoted to phonology, as it is the first linguistic level acquired by infants, and perhaps one of the last to be lost. Several studies aimed at determining the benefits of exposure to a language in childhood, followed by a long period of disuse and then by relearning several years later, have shown a pronounced advantage in perception and production in the attrited language (Au, Knightly, Jun, & Oh 2002; Oh, Jun, Knightly, & Au 2003; Tees & Werker 1984) relative to unexposed learners. The study by Au et al., however, did not reveal any advantage of early exposure versus late exposure in morphosyntax, suggesting that the mechanisms of language loss, as for acquisition, may be different for diverse linguistic aspects, and that phonology may be particularly resistant to attrition.

Part I: The first behavioural tests and the fMRI study

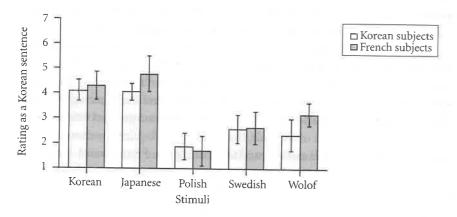
The study by Pallier, Dehaene, Poline, LeBihan, Argenti, Dupoux, & Mehler (2003) involved eight individuals of Korean origin adopted by French families between the ages of 3 and 8 (mean age at adoption: 5.5 years; 2 women and 6 men ranging in age from 20 to 32 years, mean = 26.8). They were recruited with the help of an adoption agency in France. These subjects had not been re-exposed to Korean since their arrival in France, and all claimed to have completely forgotten their native language. Eight native monolingual French speakers (2 women, 6 men ranging in age from 22 to 28 years, mean = 23.5) and unexposed to Asian languages, composed the control group.

These subjects participated in three behavioural tests. The first was a "language identification" test: sixty sentences from five different languages (Korean, Japanese, Polish, Swedish, Wolof) were presented one at a time and subjects were required to give a confidence score between 1 and 7 indicating their degree of certainty that the sentence was Korean. The second test was a "word recognition" test: on each of 24 trials, the subject was required to choose one of two spoken Korean words as the translation of a given French word. The third test used a "speech fragment detection": a sentence was presented followed by a 400 ms speech segment and the subject had to decide whether this fragment appeared in the sentence or not. One-hundred and twenty-eight sentences were presented in four different languages: Korean, French, Japanese and Polish. This task was performed while the subjects were scanned with functional MRI (Magnetic Resonance Imaging).

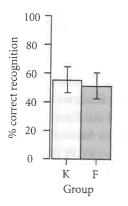
The results from the behavioural tests appear on Figure 1. In the Language Identification task, the Korean adoptees did not recognise the Korean sentences. They tended to confound the Korean sentences with those in Japanese, by giving these higher confidence ratings than the Polish, Swedish and Wolof sentences. The French control subjects' performance on this task followed the same pattern and did not differ significantly from that of the Korean adoptees. In the Word Recognition task, requiring the identification of the Korean word corresponding to a given French word, the performance of the Koreans (56%) and that of the French subjects (52%) did not differ significantly. In the Fragment Detection task, both the Korean and French subjects showed better performance on the French sentences than on those in the other three languages. Once again no significant differences were observed between the two groups.

Two main results emerged from the brain imaging data acquired while subjects listened to sentences and performed the Fragment Detection task. The first result concerned the processing of Korean: no activation specific to Korean was found in the Korean adoptees and thus, there was no detectable difference between the activations elicited by the Polish, Japanese or Korean sentences (see Figure 2). The second result indicated that the brain areas activated by French were comparable in both the Korean adoptees and the French control groups. Activations were mainly found in the left superior temporal sulcus (Wernicke's area) and in the left inferior frontal gyrus (Broca's area), as is expected for L1 processing.

a. Korean sentences identification



b. Korean word recognition



c. Speech segment detection (performed during fMRI)

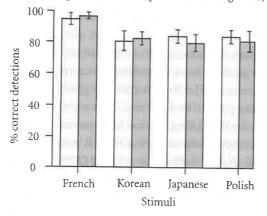


Figure 1. Performance of the Korean adoptees and native French subjects on three behavioural tests.

In general, the results of this first study seem to imply that French has overridden Korean in the brains of the Korean adoptees. However, fMRI technology has its limits and may not be able to reveal subtle traces of Korean left in the microcircuitry of the language processing areas, and the behavioural techniques used in this study may not have been capable of tapping into subthreshold, implicit knowledge that requires other methodologies. The second part of this study is aimed at addressing these issues and further assessing the degree of L1 attrition in our population of Korean adoptees.

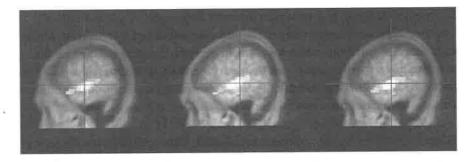


Figure 2. Brain activation patterns of Korean adoptees while listening to Korean (left), Japanese (middle) and Polish (right). All languages activated the superior temporal gyri and there is no statistical difference according to the language of stimulation.

Part II: The new behavioural tests

Five experiments seeking to reveal any possible traces of Korean were designed and are presented here. These behavioural tests concern phonology and lexical knowledge: they include Phonetic Perception, Phonetic Retraining, Sensitivity to Korean Phonotactics, Word and Number Recognition, and Implicit Memory for Series. These experiments are presently being tested and results are reported here only for the Number Series Recognition Task. All experiments took place on a computer which displayed the task instructions, played the stimuli and recorded the responses.

The participants in these studies comprised eighteen Korean adoptees, including some who had participated in the fMRI experiment. The new subjects were either recruited for the first study via the adoption agency or via a cultural association for Korean adoptees, *Racines Coréennes*, assembling adoptees from France, Switzerland and Belgium. Some of the recruits from this latter source have been re-exposed to Korean, either by formal instruction or by a trip or a stay in Korea, or both.

There were two control groups. The first group consisted of twelve native Korean speakers who have been residing in France for several months or years and still regularly speak Korean. They were matched for age and educational level to our group of adoptees. The second control group consisted of twelve native French speakers matched for age and educational level to the Korean adoptees.

Experiment 1: Series of numbers in different languages

Number series are learned early in life and are memorised by rehearsal. Moreover, number words are quite frequent in everyday language. Thus, numbers may be expected to be more resistant to attrition than other types of words. The following experiment specifically tests for the recognition of Korean number series among series from several languages.

Stimuli: Twelve series of numbers (one in each of ten different languages and two in Korean, which has two different counting systems) of the numbers 1 to 10 spoken by native speakers were either recorded or downloaded from the Internet. Korean has one counting system proper used mainly for counting objects. The other system used in Korean is derived from Chinese (Sino-Korean) and is used for years, months, days, minutes, money and telephone numbers. As both of these systems are essential to daily life, we can safely assume that young children acquire both. The other languages used were chosen on the basis of their unfamiliarity for average French speakers (most series were non-Indo-European). Some Asian languages had to be excluded as some of our Korean adoptees had been in contact with these (Japanese, Vietnamese, Mandarin). The other ten series of numbers were in: Greek, Turkish, Hungarian, Finnish, Hebrew, Farsi, Quechua, Tagalog, Thai and Cantonese.

Procedure: Each series was presented once for familiarisation. Three blocks, each containing all series in random order, were then presented to the subjects, who were required to rate each series on a continuum from 1 to 7 indicating their certainty that the series in question was or was not in Korean (1 = sure that series was not Korean, 4 = no idea whether series was Korean and 7 = sure that series was Korean. Intermediate ratings were also accepted).

The results of 9 adoptees and 10 French speakers who performed this task are shown in Figures 3 and 4. An analysis of variance with the factors Group (Adoptees vs. French controls) and Languages revealed a significant main effect of language (F(11,187) = 14.7; p<0.00001), and an interaction (F(11,187) = 2.03; p = 0.03). Welch two sample t-tests comparing the groups for each language showed no significant difference on the Korean (t(13.7) = 1.3; p = 0.20) and Sino-Korean series (t(16.6) = 0.7; p = 0.48); however the French group gave significantly higher ratings on the Cantonese (t(15.4) = 2.18; p = 0.04) and Thai series (t(16.2) = 2.9; p = 0.009) than the adoptees group. The groups did not differ significantly on any other language. Within the Korean adoptees group, paired t-tests were used to compare pairs of languages; these tests re-

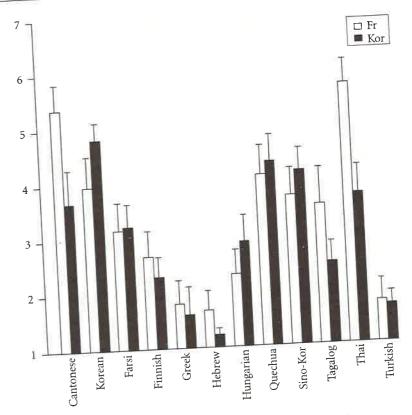


Figure 3. Mean confidence ratings for Number Series in Different Languages (Experiment 5) for the adoptees and for a control group of native French speakers. (1 = sure that series not Korean, 4 = no idea whether Korean, 7 = sure that series is Korean). Error bars indicate s.e.m.

vealed that the ratings on the Korean, Sino-Korean, Quechua, Thai, Cantonese and Farsi series did not differ at the p<.05 significance level.

Though the adoptees attributed the highest score to the Korean number series, there is no explicit recognition of the number series by this group (see Figure 4). Yet, the difference between the two groups on the Cantonese and Thai number series suggests that the representation of Korean is not exactly the same in both groups. Interestingly, Cantonese and Thai are both tone languages, contrary to Korean. Hence, the Korean adoptees may have been more aware that Korean does not use tones than naive French speakers. Thus, these data suggest that the adoptees have a somewhat more precise notion of the sound pattern of Korean than native French speakers.

Figure 4. Individual confidence ratings for the recognition of number series (Experiment 5).

Experiment 2: Phonetic discrimination

The phonetic/phonemic categories of L1 are acquired in the first years of life. It is also known that adults have difficulties perceiving some non-native contrasts. Korean voiceless stop consonants use contrasts which are particularly difficult for monolingual speakers of French. In this experiment, we test the adoptees' ability to perceive such contrasts.

Stimuli: Twenty-four CVCV pseudowords of Korean were recorded by each of two native speakers of the Seoul dialect of Korean (one female and one male). The first syllable always started with a consonant characteristic of Korean: lenis, fortis or aspirated [k], [p], or a lenis or fortis [s], and was followed by [a], [i] or

[u]. The second syllable was constant: 'ma'. (Examples of pseudowords: pima, kama, suma).

Procedure: The stimuli were presented through headphones and responses made on keys on the keyboard. A training session with twelve pairs of pseudowords of French occurred first. The first member of the pair was always pronounced by a male speaker and the second by a female speaker. Then, the 138 pairs of Korean pseudowords were presented. As in the training session, the male speaker appeared first followed by the female speaker. The second stimulus of the pair appeared 500 ms after the first. The following pair was presented 1000 ms after the subject's response. Subjects were required to indicate whether the two words of the pair were the same or different by pressing a given button on the keyboard as quickly and accurately as possible. There were five conditions: Same, and four types of Different, according to the consonant or vowel contrast in question. They were distributed as follows: (1) 48 pairs of Same (P); (2) 48 pairs of Different Vowel (DV); (3) 18 pairs of Different Consonant lenis-aspirated (DC2) and (5) 12 pairs of Different Consonant fortis-aspirated (DC3).

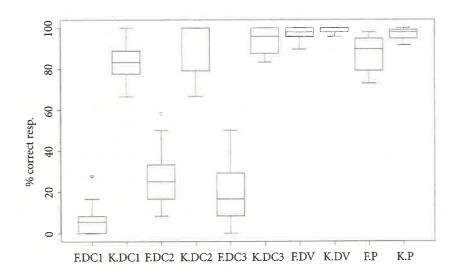


Figure 5. Percentage correct responses in the Phonetic Discrimination task (Experiment 1) in two control groups (native Koreans (K), native French (F) speakers) and the different types of contrasts. (P = Same, DV = different vowel, DC1 = lenis-fortis, DC2 = lenis-aspirated, DC3 = fortis-aspirated)

Results of the two control groups: As shown in Figure 5, both the P and DV categories were easily identified by both native Korean speakers (n = 12) and native French speakers (n = 12). All three DC contrasts were well discriminated by the native Korean subjects and poorly discriminated by the native French speakers with no overlap between groups, thus showing that the DC contrasts are indeed difficult for native French speakers with no previous exposure to Korean. The DC1 contrast (lenis-fortis) is apparently the most difficult for the French subjects.

Experiment 3: Phonetic retraining

Assuming that the results of the previous experiment show that the adoptees are not better than native French speakers at perceiving the Korean contrasts, it may still be possible that the adoptees will learn such contrasts faster than the native French speakers with an intensive phonetic training program.

Stimuli: Four minimal triplets of Korean words and four minimal triplets of Korean pseudowords, all commencing with either a lenis, fortis or aspirated [p], were chosen as the stimuli for this experiment. Each of the 8 words/pseudowords was recorded by 6 native speakers of Korean (3 female and 3 male). There were 4 tokens of each stimulus per speaker. Thus, a total of 96 different stimuli were recorded by each speaker (8 words x 3 types x 4 tokens). The vowel following the [p] was variable.

Procedure: There are 15 training sessions in total. Each session lasts approximately 30 minutes. The sessions are spread over 3 weeks, totalling 5 sessions per week. During the course of each session subjects are presented with 6 blocks of 64 stimuli each. Each block trains the subject to identify one of two types of [p], presented at the beginning of the block. Hence, only one consonant contrast (lenis-fortis, lenis-aspirated or aspirated-fortis) is presented in a given block in order to facilitate the learning of these different types of [p]. There are thus 3 different blocks per session, each repeated once: a total of six blocks per session. The first six sessions are all single speaker sessions. The following sessions become progressively more difficult by a gradual mixing of stimuli by different speakers: two speakers for Session 7 and all six speakers by Session 15.

In each block and session, the subject's task is the identification of the type of [p] heard, by pressing the corresponding key on the keyboard. Feedback is given after each trial in order to enhance the learning process.

Three tests of generalisation to other words using the Korean [p]'s as well as to other consonants sharing the same characteristics are administered after the 15 training sessions. The first test involves new real words of Korean beginning with the different types of [p] and is composed of two blocks. One block is composed of words spoken by one of the speakers heard in the training sessions and the other is composed of words pronounced by a new speaker. The second test is the Phonetic Discrimination described above and the third involves words and pseudowords of lenis/fortis/aspirated [t].

Experiment 4: Sensitivity to phonotactics

Consonant clusters (e.g. pr, sl...) such as those existing in English or French do not exist in Korean or in Japanese. It has been demonstrated that Japanese speakers perceive an illusory vowel within foreign consonant clusters (Dupoux, Kakehi, Hirose, Pallier, & Mehler 1999). This phenomenon is known as vowel epenthesis. It is due to the fact that the human speech decoding system uses the phonotactic constraints imposed by L1 to decode utterances. The properties of Korean phonology lead us to expect that native speakers of Korean will perceive an illusory vowel ([u1]) within consonant clusters of French words. If such is the case, it would be interesting to see whether the adoptees perceive French consonant clusters like native Koreans or like native French speakers.

Stimuli: Four pseudowords of Korean were recorded by two native Korean speakers (one female and one male). Two pseudowords involving a change in vowel (ibaki/ibuki) are used in the control condition and two pseudowords presenting a consonant cluster and the epenthetic vowel (asta/asuta) are used in the experimental condition. Each word was modified giving rise to six tokens varying in pitch and speed.

Procedure: Each condition is composed of a training session for familiarisation with each stimulus, presented one at a time, and its corresponding button on the keyboard. Following the training session, series of four consecutive stimuli are presented aurally. There are twenty-four such series in each condition. The subject's task is the identification of the sequence heard during each trial (ex. asta, asuta, asuta, asta). Feedback is given after each trial in order to encourage learning.

Experiment 5: Word recognition

The previous study (Pallier et al. 2003) implemented a word recognition test in which the participants had to choose the translation of a given French word among pairs of spoken Korean words. The participants performed at chance level, suggesting a radical loss of lexical knowledge. To test this hypothesis

further, we implemented a new test with more trials and words taken from a corpus of Korean children's productions (see Appendix). In this new task the subject was presented with one Korean word per trial and had to choose the correct translation among two French words.

Stimuli: Sixty common Korean words, thought to be known by children (52 of which were taken from a corpus compiled by Choi & Gopnik 1995) and recorded by a native speaker of Korean, were presented aurally. One-hundred and twenty common French words, sixty of which were the translations of the Korean words and sixty of which were matched for written lexical frequency (New, Pallier, Ferrand, & Matos 2001) were presented visually on the computer screen.

Procedure: In a given trial, subjects first heard a Korean word twice and then were presented with two French words simultaneously on the screen. The task was a forced choice recognition whereby the subjects indicated which of the two French words was the translation of the Korean word.

Experiment 6: Implicit memory for series of days of the week, months and numbers

Experiment 1 and 5 used recognition tests which assess explicit memory for Korean words. We tried to devise a test that would tap into implicit memory for series learned in early childhood: days of the week, months and numbers. The test is based on the "Mere Exposure Effect" which reveals a preference for familiar items vs. unfamiliar items (Kunst-Wilson & Zajonc 1980).

Stimuli: Recordings of days of the week in Korean were made. Each day was isolated and later combined with two other days. Series of three days were created. Half of the series were regular (Monday, Tuesday, Wednesday) and the other half were irregular (Monday, Thursday, Sunday).

The same procedure was used for months of the year and numbers in Korean.

Procedure: In each experiment, (days, months and numbers each gave rise to one experiment), a regular series was matched with an irregular series. On a given trial, the subject hears a pair of regular-irregular series and indicates which one he/she prefers by pressing on a button on the keyboard. (The regular series appear first on half of the trials and last on the other half.) There are 14 trials for days, 24 trials for months and 14 trials for numbers.

Conclusion

The study of Korean adoptees having been completely cut-off from their native language and immersed in an L2 environment relatively early in life presents an interesting case to the field of language attrition. A possible mechanism for language attrition due to erosion of an unused language is brain plasticity, and is supported by the experiments described in the first part of this paper. However, fMRI technology has its shortcomings and thus, the behavioural tests presented in the second part of this article, and presently being tested, are aimed at a more detailed assessment of L1 attrition in our population of Korean adoptees. So far, the data obtained on the recognition of the number series suggest 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.

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Appendix

List 1 French translations of the words that were aurally presented in Korean in the Word Recognition Task (Exp. 4)

List 2 French words matched in written frequency to the words in List 1

	List 1	List 2
1 2 3 3 4 5 6 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	chapeau (hat) lumière (light) eau (water) oeil (eye) train (train) poisson (fish) médicament (medication) lait (milk) baguettes (chopsticks) biscuit (cookie) c'est bon (it is good) c'est petit (it is small) c'est piquant (it is spicy) c'est lourd (it is heavy) c'est pareil (it is the same) ouvre la porte! (open the door!) réveille-toi! (wake-up!) descend! (come down!) va-t'en! (go away!) sors! (go out!) j'ai soif (I am thirsty) j'ai faim (I am hungry) école (school) livre (book) oreille (ear) couteau (knife)	fauteuil (couch) matin (morning) jour (day) jeu (game) cheveux (hair) rideau (curtain) fourmi (ant) doigt (finger) chausettes (socks) sauterelle (grasshopper) c'est nouveau (it is new) c'est vrai (it is true) c'est gelé (it is frozen) c'est plat (it is flat) lave tes mains (wash your hands! emporte-le! (take it!) tourne! (turn around!) laisse-le! (leave it!) devine! (guess!) je suis fier (I am proud) je suis tombé (I fell) famille (family) argent (money) sac (bag) bain (bath)

27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	chaussures (shoes) clef (key) nez (nose) horloge (clock) balle (ball) bonbons (candy) c'est bruyant (it is noisy) c'est beau (it is beautiful) c'est beaucoup (it is a lot) c'est peau (it is not a lot) regarde ici! (look here!) habille-toi (get dressed!) ferme la porte! (close the door!) range! (put your things away!) pousse! (push!) je joue (I play) j'ai peur (I am scared) je ne veux pas! (I do not want to!) je frappe (I hit) je ne sais pas (I do not know) jette! (throw!) donne! (give!) j'ai mal! (I am hurting!) je bois (I drink) lève-toi! (get up!) viens! (come!) assieds-toi! (sit down!) c'est grand (it is big) jamais (never) toujours (always) j'ai froid (I am cold) j'ai chaud (I am hot) c'est rouge (it is red)	parc (park) fruit (fruit) mur (wall) bol (bowl) manche (sleeve) puzzles (puzzles) c'est fatigant (it is tiring) c'est noir (it is black) je suis seul (I am alone) c'est le premier (it is the first) encore (again) tu peux! (you can!) coiffe-toi (comb your hair!) calme-toi! (calm down!) on va te punir! (we will punish you!) prends-le! (take it!) je veux entrer (I want to come inside) je veux le prix (I want the prize) je l'ai pris! (I took it!) je souris (I smile) je le sens (I feel it) essaie! (try!) silence! (quiet!) je suis le premier! (I am the first!) je compte (I count) tire! (pull!) tiens! (hold!) avale! (swallow!) quelques uns (some) moins (less) et alors (and so) j'ai compris (I understood) c'est rapide (it is quick) c'est plein (it is full)
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