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Quantitative analyses in a multivariate study of language attrition: the impact of extralinguistic factors

Monika S. Schmid *University of Groningen, The Netherlands* and **Elise Dusseldorp** *TNO, Quality of Life* and *Leiden University, The Netherlands*

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Most linguistic processes – acquisition, change, deterioration – take place in and are determined by a complex and multifactorial web of language internal and language external influences. This implies that the impact of each individual factor can only be determined on the basis of a careful consideration of its interplay with all other factors. The present study investigates to what degree a number of sociolinguistic and extralinguistic factors, which have been previously demonstrated or claimed to be relevant in the context of language attrition, can account for individual differences in first language (L1) proficiency. Data were collected from attriting populations with German as their L1: one in a Dutch language context (n = 53) and one in a Canadian English setting (n = 53). These groups were compared to a reference group of Germans in Germany (n = 53). Overall, the proposed outcome measures (derived from both formal tasks and a free speech task) are argued to be stable and valid indicators of attrition effects. The predictor variables under investigation are shown to fall into several reliable factor groups, for example, identification and affiliation with L1, exposure to German language and attitude towards L1. These are the factor groups that have, so far, been considered the most important for the process of L1 attrition or maintenance. However, the predictive power exercised by these factor groups in the present study is shown to be relatively weak.

Address for correspondence: Monika S. Schmid, English Department, Faculty of Arts, University of Groningen, PO Box 716, 9700 AS Groningen, The Netherlands; email: m.s.schmid@rug.nl

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I Theoretical framework

1 Multifactorial research designs in bilingualism

First language (L1) attrition is a stage in the development of bilingual competence that is often likened to second language acquisition (e.g. Sorace, 2005) in that speakers appear to develop aspects of language use which are similar to phenomena that can be witnessed in advanced or near-native second language (L2) speakers. In some areas where mature, non-attrited L1 speakers categorically apply certain rules or features, both L2 speakers and L1 attriters often show a certain amount of optionality. Furthermore, it has been well established that in both groups (L2 learners and L1 attriters) there is variation with respect to ultimate levels of attainment or loss: the proficiency level of some speakers will become or remain so high that they will be perceived as 'normal' native speakers in virtually all situations of language use, and perform at or near native-speaker levels on a large range of linguistic tasks, while others will be much less proficient.

There is considerable debate on which factors will determine this variability among individual learners or attriters: what is it in the neuro-psychological make-up or external circumstances/environment of one speaker that either enables him or her to attain/maintain near-native proficiency or causes his or her language skills to fossilize at a lower level? A variety of factors have been advanced in this debate; they comprise such diverse aspects as:

- language aptitude (Hyltenstam, 2007);
- emotional and attitudinal factors (Schumann, 1994; 1998; Schmid, 2002);
- ethnic affiliation and identification (Giles *et al.*, 1977; Yağmur, 1997);
- amount of exposure to and use of the language in question (Paradis, 2004; 2007).

Until recently these factors were considered chiefly in isolation from each other. Current research, however, emphasizes the fact that various

factor groups should not be investigated separately, since there is probably interdependence and interaction (e.g. de Bot *et al.*, 2007).

This assumption provides a challenge for investigations into the development of bilingual proficiency, since it assumes combined influence of predictor variables. These variables often concern a wide variety of areas or speech situations. Researchers are therefore faced with a multitude of factors. One way forward in this dilemma is the formation of composite determinants (i.e. an average or sum-score for a group of variables) representing underlying constructs that account for the main sources of variation.

On the basis of a large-scale investigation of one L1 (German) in two L2 environments (English and Dutch), the present study investigates the impact of different external factor groups on a range of linguistic tests. While trying to cast our net as widely as possible by investigating language use and attitudes in a variety of situations, we also demonstrate in what manner such data can be reduced into compound factors. The research design described here is currently applied in a number of ongoing investigations of a variety of languages, so that it will become possible in the near future to test the methods described here on different populations and attritional settings.

2 Language attrition

The term 'attrition' refers to a change in the native language of the bilingual who is acquiring and using an L2. This change may lead to a variety of phenomena in L1, such as:

- interferences from the L2 on all linguistic levels, e.g. phonetic (Major, 1992; 1993), lexical (Schmid and Köpke, 2009), morphosyntactic (Gross, 2004; Schmitt, 2004; 2010; Gürel, 2007; Tsimpli, 2007) or pragmatic (Dewaele, 2004) levels;
- a simplification or impoverishment of the L1 (e.g. Seliger and Vago, 1991); or
- insecurity on the part of the speaker manifested by frequent hesitations, self-repair or hedging strategies (e.g. Schmid and Beers Fägersten, 2010).

It has been well established that there typically is some degree of language attrition among migrant populations. Potential attriters are usually outperformed by non-attriters on a variety of instruments, such as grammaticality judgements (e.g. de Bot *et al.*, 1991; Grosjean

and Py, 1991; Pelc, 2001), picture verification tasks (Tsimpli *et al.*, 2004), naming tasks (e.g. Ammerlaan, 1996; Schoenmakers-Klein Gunnewiek, 1998; Hulsen, 2000) and cloze or fill-in tests (Hakuta and d'Andrea, 1992; Gürel, 2000; Montrul, 2002). Free or elicited speech from attriters also typically differs from non-attrited data in areas such as phonological, morphological and syntactic accuracy (e.g. Giesbers, 1997; Yağmur, 1997; Leisiö, 2001), lexical diversity (e.g. Olshtain and Barzilay, 1991; Schmid, 2002), lexicosemantic L2 interference (e.g. Jarvis, 2003; Ben-Rafael, 2004; Pavlenko, 2004) or hesitation phenomena (Nakuma, 1997; Yukawa, 1997; Schmid and Beers Fägersten, 2010; for a more comprehensive overview of studies on language attrition, types of instruments and findings, see Schmid, 2004).

3 Predictors in language attrition

Within-group investigations into the factors that might condition performance across individuals have proved challenging. There appears to be little consensus on the effect that personal and circumstantial factors can have on the attritional process (for a comprehensive overview, see Köpke and Schmid, 2004).

It is important in the study of language attrition to distinguish predicting and confounding factors: there are a number of individual and environmental factors that may influence the performance of any speaker on certain tests to some extent (such as biological age). Other factors, such as language attitudes, may be relevant for all bilingual populations, while only a subgroup of factors, such as the length of time since emigration, will be specific to an attritional setting. Furthermore, their influence may be highly task dependent. For example, the education level of an individual speaker may be a highly significant predictor variable on a formal task (e.g. a cloze test) but not play any discernible role in free speech (see Köpke, 1999; Köpke and Schmid, 2004; Schmid and Köpke, 2009).

The following extralinguistic factor groups have traditionally been assumed to be relevant for investigations of language attrition:

a General factors:

- Biological age. Age can affect some cognitive processes, which will lead to impaired performance on some tasks (e.g. Burke, 1997) as well as in overall discourse behaviour (Williams and Harwood,

2004: 121–22). On the other hand, there is evidence to suggest that the cognitive ageing effect is, to some degree, delayed or counterbalanced in active bilinguals (e.g. Bialystok *et al.*, 2006). Some tasks have been shown to be more sensitive to ageing effects (e.g. naming tasks) than others that are more impervious (e.g. grammatical and metalinguistic judgements).

- Sex. The way in which female and male speakers acquire, use and process language is probably one of the most controversial topics in linguistics today. Female speakers have often been observed to be quicker learners than males, both in L1 (e.g. Larsen-Freeman and Long, 1991: 204) and L2 acquisition (for an overview, see Major, 2004). Recent neurolinguistic findings about sex-based differences in lateralization (e.g. Kansaku and Kitazawa, 2001; Hill *et al.*, 2006) and the reliance on declarative and procedural memory (Ullman, 2004) also indicate the possibility of different strategies used for some tasks. The only investigation to date that has tested the impact of sex on language attrition (Köpke, 1999) found no effect on any task.
- Education level. Level of education is likely to influence performance on some tasks, particularly more formal ones.

b Factors pertaining to bilingual populations:

- Age at onset of bilingualism/at emigration. Theories and findings on the effect of age at onset on ultimate attainment in L2 acquisition are often controversial and contradictory (e.g. Birdsong, 2006). Where L1 attrition is concerned, there is considerable cumulative evidence to suggest a clear-cut and dramatic age effect, which can be localized roughly between the ages of 8 and 13 years (Köpke and Schmid, 2004; Pallier, 2007; Byland, 2008). Attrition that sets in before that age can be virtually complete, while speakers for whom the onset of attrition is beyond this period typically experience only very limited language loss. There does not seem to be any further age effect on L1 attrition beyond puberty (Köpke and Schmid, 2004).
- Attitudes and (ethnic) affiliation. There is a substantial body of research into the role of attitudes, motivation and emotions for the development of bilingualism, providing compelling evidence that these factors are among the most important for predicting success in the ultimate attainment of second and foreign language learners,

whether for socioethnic or for neurobiological reasons (Schumann, 1994; 1998; Masgoret and Gardner, 2003). Attempts have also been made to establish a similar link between emotive factors and language attrition, and there are a small number of studies that indicate that a positive attitude towards the L1 and the culture of origin may indeed be conducive to L1 maintenance, while negative feelings, and particularly traumata, may lead to a higher level of attrition (Schmid, 2002; Ben-Rafael and Schmid, 2007).

c Factors specific to attrition:

- Contact with and use of the L1. One of the basic predictions of psycholinguistic research with respect to L1 attrition is that language loss can be attributed to language disuse, while rehearsal of information can maintain accessibility (e.g. Paradis, 2007). The accessibility of items in either language system depends on what has been called the 'activation threshold' of the item, and this threshold is a function of frequency and time (e.g. Paradis, 1993; 2004). Disuse of a language system should affect accessibility of lexical items most immediately, but will eventually also impact on grammatical knowledge (Paradis, 2004; 2007). In other words, the less often a bilingual uses one of her languages, the more difficult she will find it to retrieve the correct lexical and grammatical information from memory under the time pressure of on-line language use.

  This prediction seems theoretically and intuitively evident. However, it lacks empirical corroboration: Only two studies report that those participants who used their L1 on an extremely infrequent basis showed more attrition over time (de Bot *et al.*, 1991; Köpke, 1999) than those with more frequent contact. On the other hand, another study found a negative correlation, suggesting that the attriters who used their L1 on a daily basis had more difficulty completing some tasks (Jaspaert and Kroon, 1989).

  The main criticism that can be applied to these investigations is that they fail to distinguish different types and contexts of L1 use, lumping them all together under one single factor. An attempt at a more detailed analysis of the impact of L1 use on the basis of Grosjean's model of language mode (Grosjean, 1998; 2001) was presented by Schmid (2007). This investigation was unable to demonstrate any substantial or systematic predictive power of frequency of L1 use for performance on linguistic tasks.

4 Research questions

The present study attempts to provide a template for a multifactorial analysis of language attrition, based on the following research questions:

1) Do linguistic skills, as measured by a variety of instruments, show signs of attrition in the population under investigation? Is there a difference between the deterioration of skills as measured by formal tasks and those evident in naturalistic linguistic performance?
2) Can the items used to measure sociolinguistic and extralinguistic factors outlined above be combined into composite variables? It is desirable to get a thorough overall picture of the factors involved in language attrition, but at the same time to arrive at the smallest possible number of reliable factors for the statistical analysis in order to increase reliability.
3) What is the predictive power of sociolinguistic and extralinguistic factors (see question 2) for the deterioration of linguistic skills (see question 1), and which factors are protective?

II Method

1 Participants and study design[1]

The study comprises an investigation of 159 native German speakers, divided into three groups: one group of bilingual speakers ($n = 53$) in the area of Vancouver, Canada (CA group); one group of bilingual speakers ($n = 53$) in the Netherlands (NL group) and a reference group ($n = 53$) in the area of the Lower Rhineland, Germany (RG group). The language of the environment for the Canadian group is thus English, and Dutch for the group in the Netherlands (none of the participants in the bilingual groups had ever lived in Francophone Canada or in the Frisian speaking area of the Netherlands). All participants in the bilingual groups were at least 17 years of age at the time of emigration, and all had lived in the second language environment for more than 15 years (see Table 1).

As far as possible, the three groups were matched according to sex and education. The NL and RG groups contained 35 women and 18 men,

[1] Due to the scale of the test battery, it is not possible to include an appendix containing all tasks and questionnaires. The full battery is available upon request from the first author of this article. Versions for languages other than German exist or are in the process of being developed.

Table 1 Participant characteristics by group

	Bilingual groups				Reference group			
	CA (n = 53)		NL (n = 53)		RG (n = 53)		Total (n = 159 / n = 106)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	63.2	10.9	63.4	9.6	60.9	11.6	62.5	10.7
Age at emigration (AGEEMI)	26.1	7.2	29.1	7.5	–	–	27.6	7.5
Length of residence (LOR)	37.1	12.4	34.3	11.1	–	–	35.7	11.8

Notes: CA = Canadian group (bilinguals); NL = Dutch group (bilinguals); RG = reference group.

the CA group contained 34 women and 19 men. Education (EDU) was measured by a variable with four levels:

- Level 1 comprised those participants who attended school until the end of the German *Volksschule* or *Hauptschule*.
- Participants in level 2 completed the German *Realschule* or *Mittlere Reife*.
- Participants in level 3 had obtained the *Abitur* or *Fachabitur*; and
- Participants in level 4 had received a university degree.

Slight differences across the groups on this factor (see Table 2) are the outcome of the overall composition of the migrant groups in Canada and the Netherlands: the largest wave of German immigrants to Canada were skilled labourers with a low level of formal schooling, who were attracted by the Canadian government in the 1950s. Immigrants to the Netherlands, on the other hand, were usually more highly educated specialists with more targeted career prospects. The groups did not differ significantly in age ($F(2,156) = .89$; $p = .41$), length of residence ($F(1,104) = 1.51$, $p = .22$) or education ($\chi^2(6) = 2.49$, $p = .87$). The test battery was administered once in the home of the participant, although a small number of participants preferred to meet at the university.

2 Measures

Overall German language proficiency per participant was measured by a number of instruments, which will be referred to as the outcome variables. Sociolinguistic and extralinguistic variables were established on

Table 2 Distribution of education across groups

	CA (n = 53)	NL (n = 53)	RG (n = 53)	Total (n = 159)
Level 1	13	9	13	35
Level 2	22	21	23	66
Level 3	5	6	6	17
Level 4	13	17	11	41

Notes: CA = Canadian group (bilinguals); NL = Dutch group (bilinguals); RG = reference group.

the basis of a sociolinguistic and personal background interview. For the two bilingual groups, a number of variables pertaining to L1 use in daily life as well as to language attitudes and linguistic and cultural affiliation were also established. These variables are referred to as the predictor variables.

a Measures of L1 proficiency (outcome variables): German language proficiency was assessed by means of the following instruments:

- A C-TEST (see Grotjahn, 1987), which is a fill-in test where the participant is presented with a text from which parts of words have been removed following a pre-determined schema and is asked to complete the missing parts. The empirical validity of the C-TEST as a measure of general proficiency has been amply demonstrated (e.g. Klein-Braley, 1985; 1997). Each text was between 80 and 100 words in length and contained 20 gaps. The C-TEST score was computed as the number of times a gap was filled in correctly (including acceptable variants); a high score on the C-TEST reflects high proficiency, with a possible range of 0–100.
- Two semantic verbal fluency (VF) tasks, where participants are asked to name as many items in a specific lexical category as they can within the space of 60 seconds. The verbal fluency task has been found to be highly reliable in a variety of populations (Roberts and Le Dorze, 1998). The two stimuli used were 'animals' on the one hand and 'fruit and vegetables' on the other. The final VF measure was an averaged measure of the score on the two individual tasks.[2] A high score on the VF task reflects high proficiency.

[2] For seven of the 159 informants, only one of the two VF tasks was available due to equipment failure. In these cases, the single score was used.

- A grammaticality judgement task (GJ), in which participants were presented with sentences on a laptop computer in written and audio format simultaneously. The overall test consisted of 48 items, of which 22 were ungrammatical. The ungrammatical items were classified into various grammatical categories, based on mistakes that had frequently occurred in the data from a previous investigation of L1 attrition of German (Schmid, 2002). If the participant had identified a sentence as ungrammatical, he or she was then asked to indicate what the correct alternative would be. Every target-like response on an ungrammatical item was awarded one point, so that the maximum total score on this task was 22, reflecting a high proficiency. This score was then recalculated to a score between 0 (0% correct) and 1 (100% correct).
- A film retelling task (Perdue, 1993), in which the participants were asked to watch and then retell a 10-minute excerpt from the silent Charlie Chaplin movie *Modern Times*. The speech sample elicited in this way was transcribed and coded in CHAT format and subsequently analysed with the help of the CLAN tools (http://childes.psy.cmu.edu). The following measures were established for each speech sample:
  - The lexical diversity measure D (see McKee *et al.*, 2000). D is a measure of lexical diversity, which is based on type–token frequencies. Unlike type–token ratios, however, D is not sensitive to text length and can therefore be compared across speech samples of varying length. A high D-score reflects high proficiency.
  - The frequency of empty pauses (EP), standardized per 1000 tokens. A high score on EP reflects low proficiency.
  - The frequency of repetitions (RP), standardized per 1000 tokens. A high score on RP reflects low proficiency.
  - The frequency of retractions (RT) or self-corrections, standardized per 1000 tokens. A high score on RT reflects low proficiency.
  - The overall frequency of errors (ERR), standardized per 1000 tokens. A high score on ERR reflects low proficiency.

b Sociolinguistic and extralinguistic aspects (predictor variables): Information on personal background, language use and language attitudes was elicited by two instruments: a sociolinguistic and personal background questionnaire (SPBQ) and the attitude and motivation test battery (AMTB); for details, see Gardner, 1985; Masgoret and

Gardner, 2003. For the bilingual groups, the SPBQ contained a total of 78 questions with:

- a number of binary or yes/no variables (such as sex);
- a set of ordinal variables (such as education level);
- a large number of 5-point rating scales on factors such as L1 use in daily life, with family and friends, cultural affiliation, language preference; and
- some true interval variables such as age and length of residence in the country of emigration.

The scores on the 5-point rating scales were coded in the following way:

- 0 = never/only L2;
- 0.25 = seldom/mainly L2;
- 0.50 = sometimes/both L1 and L2;
- 0.75 = frequently/mainly L1; and
- 1 = very frequently/always/only L1.

There were also some open autobiographical questions, which will not be included in the present analysis. The questionnaire for the reference group also contained the personal background items and some questions on language attitudes, but did not include questions on frequency of L1 use or language/cultural preference.

From the AMTB, four subscales were chosen:

- attitudes towards speakers of the L1 in the L2 country (ATTL1INL2);
- attitudes towards speakers of the L1 in the country of origin (ATTL1);
- attitudes towards speakers of the L2 (ATTL2); and
- attitudes towards foreign language learning in general (ATTLG).[3]

The questionnaire contained 32 statements with which the participant was invited to agree or disagree on a 5-point Likert scale. The scores on the response scales were coded in the following way:

- 0 = totally disagree;
- 0.25 = tend to disagree;

[3] Since the target group had acquired the language under investigation as a first language in a naturalistic setting, questions pertaining to the language learning situation were not included.

- 0.50 = neutral;
- 0.75 = tend to agree; and
- 1 = totally agree.

Of the 106 participants in the bilingual groups, 99 filled in this questionnaire. The predictor variables were classified into:

- personal background variables (measured by the SPBQ);
- language use, exposure, and linguistic/cultural affiliation and identification (measured by the SPBQ); and
- attitudes (measured by the AMTB).

3 Data analysis

To investigate to what degree the language skills of the populations under investigation showed signs of attrition, analyses of covariance (ANCOVA) were performed. For each language proficiency measure (outcome variable), AGE and EDU were used as covariates while group (CA, NL, RG) and SEX were used as independent variables. Also, the interaction between group and SEX was included. By correcting for age and education, the possibility that significant differences between groups were due to differences in these background variables was excluded. A priori contrasts were used to examine if the language skills of the RG participants differed significantly from the skills of either the CA or the NL participants.

In order to create composite variables from the questions in the SPBQ, principal component analyses (PCA) were performed, with varimax rotation where necessary to increase the interpretability of the factors. The items with a high loading ($\geq .40$) on a component were selected. For the selected items, a reliability analysis was performed. Items were removed on the basis of an increase in Cronbach's α (Cronbach, 1951). Scores on the composite variables were computed as the person mean of the scores on the remaining items.

To investigate which composite variables could predict language attrition for the two bilingual groups, hierarchical multiple regression analyses (HMRA) and canonical correlation analyses were performed. HMRAs were used to predict individual outcome variables separately on the basis of a number of composite predictors; canonical correlation analyses were used to inspect the relationship between a set of predictor variables and a set of outcome variables. The latter type of analysis is suitable where a group of outcome variables is conceptually related to

each other (as is the case for the free speech variables measured in the film retelling task). In these analyses, SEX, group (CA VS. NL), education (EDU) and length of residence (LOR) were included as background variables. LOR correlated highly with AGE (r = .78), preventing the inclusion of both factors as predictors. We therefore opted for the attrition-specific variable LOR over the general variable AGE, since the focus of this analysis was to assess the change of proficiency on the basis of factors related to bilingualism.

In the HMRA, the background variables were entered in the first step, and the other predictor variables (i.e. the composite variables) were entered in the second. The forward selection method was used for the second step in order to select the predictors that had the highest impact. In the canonical correlation analyses, background variables and other predictor variables were combined into one set. The variables with a canonical loading (i.e. correlation of the variable with the corresponding canonical variate) higher than or equal to .40 were selected, first in the predictor set and then (after re-doing the analysis) in the outcome set.

In order to keep the ratio between the sample size and the number of variables in the analyses equal to or higher than 10 (Tabachnick and Fidell, 1989), separate analyses were performed for the different classes of composite variables used. A two-sided significance level of .05 was used to identify important predictors.

III Results

1 Indications of language attrition

The distribution of the language proficiency variables was inspected within each group using histograms and standard Q–Q plots. Four variables calculated on the basis of the film retelling task (EP, RT, RP and ERR) were severely positively skewed. A log-transformation was applied to these four variables in order to normalize them.

The results from the ANCOVA (Table 3) indicate a difference between groups on all language proficiency variables except the grammaticality judgement task (which was eliminated from subsequent analyses). For all other measures, the contrast tests showed that the reference group outperformed both bilingual groups, except for the D measure, where the difference between the Canadian Germans and the reference group was not significant, while the difference between the Dutch Germans and the reference group was.

Table 3 Results of ANCOVA per outcome variable and descriptive statistics of each group

	Effect of group corrected for covariates	Significance	Partial η^2	R^2	CA		NL		RG	
					Mean	SD	Mean	SD	Mean	SD
VF	$F(2,154) = 13.8$	< .01	.16	.26	20.2	4.6	20.9	4.7	25.1	4.7
C-TEST	$F(2,154) = 10.5$	< .01	.13	.34	75.3	11.6	77.2	13.9	82.2	8.9
GJ	$F(2,154) = 1.1$	.35	.01	.21	0.8	0.1	0.8	0.1	0.8	11.0
D	$F(2,154) = 5.9$	< .01	.07	.13	70.5	17.1	63.9	15.7	75.4	17.9
EP	$F(2,154) = 6.3$	< .01	.08	.11	16.2	15.8	16.2	15.1	6.3	9.6
RT	$F(2,154) = 4.9$	.01	.06	.10	17.0	9.5	17.0	9.7	12.4	8.1
RP	$F(2,154) = 9.5$	< .01	.12	.13	4.9	5.7	3.6	3.5	0.2	2.9
ERR	$F(2,154) = 45.3$	< .01	.38	.44	9.0	6.2	8.0	6.6	1.7	2.5

Notes: CA = Canadian; NL = Dutch; RG = Reference group. The *F*-tests for EP, RT, RP and ERR were performed with the log-transformed variables. The descriptive statistics are based on the original variables.

The effect of sex was only significant for errors (ERR), indicating that, in general, the female participants had fewer errors in the free speech task than the males. The interaction effect of group by sex showed a trend effect ($p = .065$) for the C-TEST. In the reference group the males outperformed the females on the C-TEST, while in both bilingual groups the females outperformed the males. No other interaction effects were found. The effect sizes (partial η^2) show that the group effect was larger for the formal tasks (VF and C-TEST) than in free speech, except for the variable ERR, which showed the largest group effect: The bilinguals made far more errors than the reference group. The variance-accounted-for (R^2) was highest for ERR and lowest for RT.

2 Composite predictor variables for attrition

a Language use, exposure and linguistic identification: Two questions in the SPBQ were directed at overall L1 use: one item asked how frequently the L1 was spoken in daily life, the other which language was used most in daily life. The variance of the latter variable was very low. The correlation between the 2 items was moderate ($r = .29$), confirming the suspicion that very global statements about L1 use may not be valid indications of actual language use and preferences by migrants (Schmid, 2007), since answers apparently depend on subtle differences in the formulation of the question. It was therefore decided not to use these global statements in the further analyses.

The SPBQ contained a total of 16 items on bilingual mode L1 use, that is, the use of L1 within the family and friends, scored on a 5-point rating scale (see Appendix, Table 7 for the questions). A subgroup of these items – questions about the use of the L1 with grandchildren – had an extremely high proportion of missing values (varying between 54% and 62% across the bilingual groups). Since they did not apply for all informants, these items were deleted from further analyses. The principal component analysis for the remaining 12 items revealed three components (explaining 82.4% of the total variance): the partner items had a high loading on the first rotated component, the children items on the second and the friends items on the third component. Three composite variables were calculated as the mean score for each participant on the corresponding items:

- BIMODPART: L1 use with partner; 4 items, Cronbach's $\alpha = 0.98$;
- BIMODCHILD: L1 use with children; 4 items, $\alpha = 0.92$; and
- BIMODFRIEND: L1 use with friends; 4 items, $\alpha = 0.82$.

The variables correlated moderately ($r = 0.36$, between BIMODCHILD and BIMODFRIEND; $r = 0.41$, between BIMODPART and BIMODFRIEND; $r = 0.44$, between BIMODPART and BIMODCHILD).

A second principal component analysis was performed for another set of 23 items from the SPBQ:

- 5 items pertaining to intermediate mode L1 use: use of L1 for professional purposes, use of L1 in German language clubs or institutions, membership of such clubs, language of church service (where applicable), frequency of use of L1 at church functions;
- 2 items pertaining to monolingual mode L1 use: use of L1 in distance communication with the country of origin, e.g. via telephone or email; frequency of visits to Germany;
- 4 items pertaining to receptive L1 exposure: to music with German texts, to German language radio, to German TV and to written German through books and newspapers;
- 3 items pertaining to the predominance of L1 in inner language: thinking, dreaming and counting;
- 6 items pertaining to linguistic identification (see Appendix, Table 8); and
- 3 items pertaining to intergenerational L1 maintenance (see Appendix, Table 9).

The scree plot suggested three principal components, together explaining 42.4% of the total variance (see Table 4). For each of the rotated components, we selected the items with a high loading. In this manner, the following composite variables were derived:

- AFFILL1 (Identification and affiliation with L1, 8 items selected from Table 4, first column; Cronbach's $\alpha = 0.83$). The variable COUNT was subsequently removed from this composite variable, as the reliability analysis showed an increase in Cronbach's α if item deleted.
- INTERMEDL1 (Intermediate mode L1 use, 4 items selected from Table 4, second column; $\alpha = 0.79$). The variables L1CONT and L1READ were removed according to the results of the reliability analysis.
- EXPOSUREL1 (Exposure to L1, 3 items selected from Table 4, third column; $\alpha = 0.74$). The variables L1MUSIC and GOBACK were removed according to the results of the reliability analysis.

Table 4 Result of principal component analysis with varimax rotation of 23 SPBQ items

Label	Component			Question
	1	2	3	
THINK	.81			Which language do you think in?
DREAM	.80			Which language do you dream in?
PREFLG	.69			In which language do you feel at home?
PREFCULT	.58			In which culture do you feel at home?
MAINTL1	.56			How important is maintaining your L1 to you?
EMOTL1	.55			Which language has the most emotional significance for you?
CHILDL1	.50			How important is it to you that your children are proficient in German?
COUNT	.40			In which language do you count and do maths?
LGSERV		.77		What is the language of the church service you attend?
L1CHURCH		.73		What language do you use at church functions?
L1CLUBS		.69		How often do you use German in a German language club?
L1CLUBMEMB		.56		Are you a member of a German language club?
L1READ		.50		How often do you read German books and/or newspapers?
L1CONT		.48		How often do you use German in distance communication with friends or family in Germany?
L1RADIO			.79	How often do you listen to German radio?
L1TV			.71	How often do you watch German TV?
L1VISITS			.67	How often to you visit Germany?
L1MUSIC			.49	How often do you listen to music with German text?
GOBACK			.45	Would you like to move back to Germany, circumstances permitting?
L1WORK				How often do you use German for professional purposes?
CHILDADM				Do you admonish your children to speak German?
CHILDLESSONS				Do/did your children attend German lessons?

Note: Component loadings ≥ .40 are displayed.

The correlation between these variables was moderate through low (r = 0.33, between AFFILL1 and INTERMEDL1; r = 0.26, between AFFILL1 and EXPOSUREL1; r = 0.19, between INTERMEDL1 and EXPOSUREL1).

The last three variables listed in Table 4 did not show a high factor loading on any of the three factors; these variables were therefore included separately in the subsequent analyses.

b Language attitudes: As was pointed out above, the ABMT is a validated and standardized test instrument. The data elicited from our participants showed a high reliability of the four subscales (ATTL1: α = 0.87, ATTL1INL2: α = 0.81, ATTL2: α = 0.89, ATTLG: α = 0.81). The intercorrelations ranged from 0.15 (between ATTL1 and ATTLG) to 0.54 (between ATTL1INL2 and ATTL1).

3 Relationship between sociolinguistic and extralinguistic factors and language attrition

In order to establish the impact of the sociolinguistic and extralinguistic factors on language attrition, several analyses were performed on the data from the two attriting groups (n = 106).

In the first instance, three multiple linear regression analyses were performed for both C-TEST and VF. In each regression, the personal background variables were entered in the first step. In the second step, the first analysis included the bilingual mode variables BIMODPART, BIMODCHILD and BIMODFRIEND (see Appendix, Table 10), the second one the intermediate and attitudinal variables AFFILL1, INTERMEDL1, EXPOSUREL1, L1WORK, CHILDADM, CHILDLES (see Appendix, Table 11). The four AMTB subscales were entered in the third analysis (see Appendix, Table 12).

For the VF score, only L1WORK and ATTL1 were selected as predictors (the respective standardized co-efficients of these variables were β = .31, $p < .01$ and β = –.25, $p < .05$). None of the background variables was significantly related to VF. A regression model including only L1WORK and ATTL1 explained 15% of the variance of VF: More use of German for professional purposes was related to a higher VF score, while a more positive attitude towards L1 was associated with a lower VF score. For the C-TEST score, only BIMODPART (β = .19, p = .05) and L1WORK (β = .30, $p < .01$) were selected as predictors. For this variable, there was furthermore a significant effect of education. A regression model including EDU, BIMODPART and L1WORK explained 40% of the variance on the C-TEST. A higher education, more use of L1 with partner and more use of L1 at work were related to a higher C-TEST score.

The results of the canonical correlation analyses for the film retelling task variables showed three important relationships. The first one pertains to the bilingual mode composite variables (see Figure 1). The combination of the variables EDU, LOR, BIMODPART and BIMODCHILD was significantly related to the variable D (ρ, the canonical correlation,

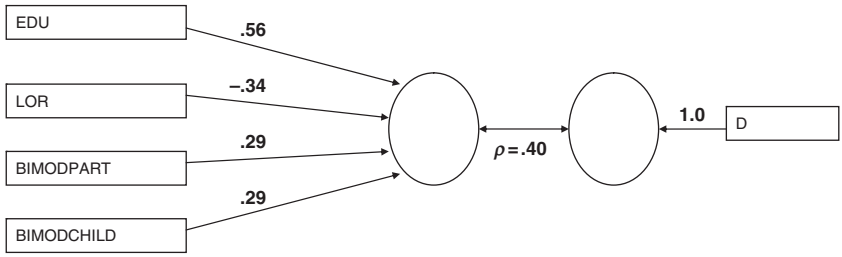

Figure 1 Relationship between personal background variables, bilingual mode composite variables and free speech

Notes: The variables with a canonical loading of higher than .40 are selected. The standardized canonical coefficients are displayed. Because only one outcome variable, the D measure, was selected, the result is comparable to a multiple regression model.

equals .40, $p = .01$): A higher level of education, shorter LOR, and more use of L1 with partner and with children were associated with a higher D score. The other free speech outcome variables were removed here because their canonical loading was below .40 (see Section II.3 above).

Where language use in the intermediate mode is concerned, a combination of the variables EDU, LOR, L1WORK and INTERMEDL1 was significantly related to a combination of the variables D and ERR ($\rho = .39$, $p = .02$): A lower education level, a longer LOR, less use of L1 at work and more use of L1 in the intermediate mode was associated with a lower D score, and more errors in the free speech task (see Figure 2).

The final analysis investigated the impact of the AMTB variables. Here the analysis revealed that a combination of the variables EDU, SEX, LOR, ATTL1 and ATTL1INL2 was significantly related to a combination of the variables D, and ERR ($\rho = .47$, $p = .001$): A lower education level, male gender and a more positive attitude towards L1 was associated with a lower D score and more errors in the free speech task. The standardized coefficient of ATTL1INL2 was very low, indicating that the influence of this variable was not unique (and mostly captured by ATTL1) (see Figure 3).

4 Joining the results

In order to shed further light on the predictor variables that have emerged from the analyses described above as having a significant impact on the outcome variables, the bilingual groups were divided into subgroups. The aim of this analysis was to determine whether specific subgroups among the bilingual participants could be identified whose performance

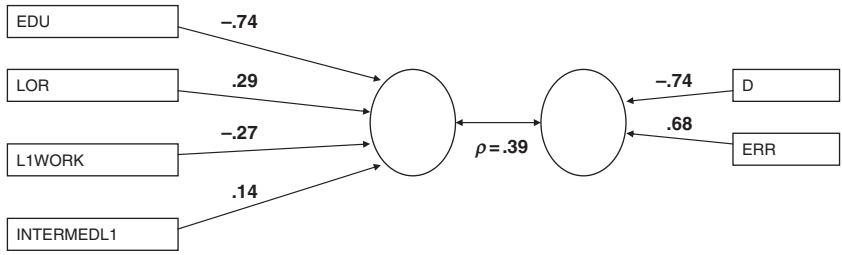

Figure 2 Relationship between personal background variables, intermediate mode composite variables and free speech

Notes: The variables with a canonical loading of higher than .40 are selected. The standardized canonical coefficients are displayed.

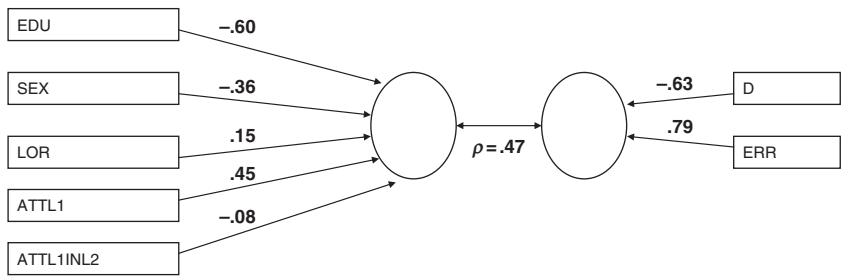

Figure 3 Relationship between personal background variables, attitude variables and free speech

Notes: The variables with a canonical loading of higher than .40 are selected. The standardized canonical coefficients are displayed.

on the language tasks did not differ from that of the reference group. In other words, the purpose was to identify those language use and attitude factors that had a protective effect against the attritional process. In order to determine this, ANCOVAs were performed with the grouping variable as between factor and SEX, EDU and AGE as covariates. The comparison was conducted on those outcome variables that had been shown to be significantly affected by the predictor variables in the analyses above.

The first subgroups of bilinguals were based on the variable L1WORK: those bilinguals who had indicated that they used L1 for professional purposes 'sometimes' or less were merged into one group ($n = 86$) and those who used L1 'frequently' or 'very frequently' ($n = 20$) formed another; the reference group of Germans in Germany formed the third group. Using contrasts, we compared both subgroups with the reference group. The effect of the grouping was significant (Table 5): The contrast tests indicated that the bilinguals who used L1 at work

Table 5 The impact of use of L1 at work, with partner, and children. Results of ANCOVA per outcome variable and descriptive statistics of each group. The grouping variable consisted of three groups: the bilinguals were divided into two subgroups based on L1work (Table 5a), BIMODPART (Table 5b) and BIMODCHILD (Table 5c), and the reference group formed the third group. The effects are adjusted for the background variables (education, sex and age).

Table 5a Effect of grouping based on L1WORK

		Significance	Partial η^2	R^2	Bilinguals with infrequent use of L1 at work (n = 86)		Bilinguals with (very) frequent use of L1 at work (n = 20)		RG (n = 53)	
					Mean	SD	Mean	SD	Mean	SD
VF	$F(2,154) = 19.92$	< .01	.21	.27	20.0	4.3	23.1	5.3	25.1	4.7
C-TEST	$F(2,154) = 13.22$	< .01	.15	.35	74.3	12.7	85.3	8.5	82.2	8.9
D	$F(2,154) = 4.42$	.01	.06	.11	66.3	17.1	72.1	13.5	75.4	17.9
ERR	$F(2,154) = 49.30$	< .01	.40	.44	9.0	6.6	6.1	4.7	1.7	2.5

(Continued)

Table 5 *(Continued)*

Table 5b Effect of grouping based on BIMODPART

		Significance	Partial η^2	R^2	Bilinguals rarely using L1 with partner ($n = 64$)		Bilinguals (very) often using L1 with partner ($n = 40$)		RG ($n = 53$)	
					Mean	SD	Mean	SD	Mean	SD
VF	$F(2,153) = 17.53$	< .01	.19	.26	20.2	4.8	21.1	4.3	25.1	4.7
C-TEST	$F(2,153) = 11.44$	< .01	.13	.33	74.1	13.3	79.0	11.1	82.2	8.9
D	$F(2,153) = 5.03$	.01	.06	.11	65.5	15.1	70.1	19.1	75.4	17.9
ERR	$F(2,153) = 48.26$	< .01	.40	.44	8.7	7.0	8.4	5.1	1.7	2.5

Table 5c Effect of grouping based on BIMODCHILD

		Significance	Partial η^2	R^2	Bilinguals rarely using L1 with children ($n = 63$)		Bilinguals (very) often using L1 with children ($n = 30$)		RG ($n = 53$)	
					Mean	SD	Mean	SD	Mean	SD
VF	$F(2,139) = 15.8$	< .01	.19	.24	20.1	4.5	21.8	4.7	25.1	4.7
C-TEST	$F(2,139) = 8.45$	< .01	.11	.29	74.6	12.2	79.4	10.7	82.2	8.9
D	$F(2,139) = 4.00$	.02	.06	.13	65.7	16.7	71.7	15.4	75.4	17.9
ERR	$F(2,139) = 53.19$	< .01	.44	.47	8.9	6.2	7.9	3.8	1.7	2.5

(very) often did not differ significantly from the reference group on any outcome variable except for ERR. For this variable, they did perform worse than the reference group. The bilinguals who did not often speak L1 at work performed worse than the reference group on all outcome variables.

The second and third subdivision was based on the reported use of the L1 with partner and with children, respectively. For each of these two variables, two subgroups were created: speakers who indicated that they used German with their partner or with their children sometimes or less formed one group, while those who indicated (very) frequent use of the L1 formed another; the reference group formed the third group. The effect of this grouping was significant (Table 5): the contrast tests for use of L1 with partner indicated that the bilinguals with a high BIMODPART did not differ significantly from the reference group on two outcome variables: the C-TEST and D. The bilinguals who rarely used German with their partner performed significantly worse than the reference group on all outcome variables. The contrast tests for BIMODCHILD obtained similar results: only those bilinguals who (very) often used L1 with their children did not differ significantly from the reference group on the C-TEST and D.

The last subdivision investigated the impact on attitude towards L1 as measured by the AMTB. Three subgroups were created on the basis of ATTL1: participants without a positive attitude towards L1 (i.e. a score of $< .50$, $n = 17$), those with a neutral/slightly positive score (i.e. a score higher or equal to .50 and lower than .75, $n = 48$), and those with a very positive score ($\geq .75$, $n = 30$). The reference group formed the fourth group. The effect of grouping was significant (Table 6): the contrast tests indicated that participants without a positive attitude towards L1 did not differ significantly from the reference group on two outcome variables (C-TEST and D). The other two groups performed worse than the reference group on all outcome variables.

IV Discussion

The first result to emerge from the present investigation is that, in the population under investigation here, language attrition is a fairly robust phenomenon: both bilingual groups were outperformed by the reference group. The only exception here was the grammaticality judgement

Table 6 The impact of attitude towards L1

	Effect of grouping based on ATTL1	Sig.	Partial η^2	R^2	Bilinguals without positive attitude towards L1(n = 17)		Bilinguals with neutral/positive attitude towards L1 (n = 48)		Bilinguals with very positive attitude towards L1 (n = 38)		RG (n = 53)	
					Mean	SD	Mean	SD	Mean	SD	Mean	SD
VF	F(3,147) = 11.93	< .01	.20	.27	21.8	5.2	21.2	4.5	19.0	4.3	25.1	4.7
C-TEST	F(3,147) = 5.77	< .01	.11	.31	79.1	10.6	78.0	12.3	72.1	13.8	82.2	8.9
D	F(3,147) = 4.34	= .01	.09	.14	71.1	15.1	69.4	18.3	60.3	14.5	75.4	179
ERR	F(3,147) = 34.30	< .01	.42	.47	9.5	7.2	7.6	5.4	10.1	7.4	1.7	2.5

Notes: Results of ANCOVA per outcome variable and descriptive statistics of each subgroup: the bilinguals are divided into three subgroups based on ATTL1. The reference group formed the fourth group. The effects are adjusted for the background variables (education, sex, and age).

task, where there was no difference in the group scores. There are two possible explanations for this finding: either the underlying grammatical knowledge of the bilingual participants has not changed, allowing them to detect ungrammatical or unacceptable structures as well as they did before their emigration, or the battery of sentences used in the task was too easy and led to a ceiling effect. Although great care was taken in constructing the test,[4] this latter explanation cannot be excluded.

All other measures returned lower scores across the bilingual samples. The answer to the first research question is therefore that there are signs of attrition in the linguistic skills of the population under investigation here, evident both in performance on formal tasks and in naturalistic performance. We can conclude that linguistic skills are, to some degree, vulnerable in the attritional process. This finding confirms general observations made in language attrition research, which suggest that long-term residence in a different linguistic environment will usually have some detrimental consequences for the L1.

Our second research question concerned the possible combination of a variety of personal background and attitudinal factors into composite variables. The quantitative-deductive approach taken here represents an innovation in language attrition research: there have been few studies to date which have analysed the predicting factors in language attrition in a multivariate design, and those which have (e.g. Yağmur, 1997; Hulsen, 2000; Schmid, 2007) established composite factors on the basis of inductive and theoretical predictions. It is therefore an important step for attrition research to establish the empirical validity of composite factors previously assumed on theoretical grounds. The principal component analyses resulted in a number of composite factors that correspond well with the theoretical predictions: items relating predominantly to attitude and identification fell into one group of variables, and the distinction of L1 use according to language mode (Grosjean, 2001), which had been applied in previous investigations of L1 attrition (Schmid, 2007), also received empirical validation. On the other hand, it was demonstrated that caution should be applied where overgeneralizations are concerned: there were low correlations between some of the contexts of L1 use, even those that would appear to fall under the

[4] The ungrammatical sentences that were tested in the grammaticality judgement task were semantically adapted versions of ungrammatical structures that had been produced by attriters of German in an earlier study (Schmid, 2002). In addition, all sentences were pre-tested on (non-attrited) L1 speakers of German.

same general theoretical heading (e.g. frequency of use of the L1 with the partner and with friends).

Third, it was investigated to what degree the composite variables established in response to question 2 could predict the scores on the outcome variables. In other words, the question was to what degree the personal background, linguistic behaviour and environment and language attitudes would impact on the deterioration of linguistic skills in the attritional process. In order to determine this, the effects of the predictors on the outcome variables were assessed by means of multiple linear regression analyses for the formal tests (VF and C-TEST) and canonical correlation analyses for the set of variables collected from the naturalistic speech task.

Interestingly, the impact of the personal background variables (L2 group, LOR, SEX, EDU) was more marked with respect to the outcome variables related to naturalistic language performance than to those measured by the formal tasks. Here, there was only one significant effect: a higher education level led to a higher score on the C-TEST. The impact of education level on this particular task has been demonstrated before (e.g. Yağmur, 1997) and is probably not related to the attritional process as such (more highly educated speakers will outperform those with less formal education in any population). For the free speech variables D and ERR, the canonical correlations showed an impact of LOR and EDU, suggesting that lexical diversity in the L1 diminishes with a longer emigration span, that speakers who have lived in an L2 environment for a long time make errors, and that the more highly educated speakers outperform those with a lower education on both those measures.

A further interesting outcome of the present investigation was the lack of correspondences that the analyses detected between the outcome measures and the language use and attitude factors. The only variable with a substantial and consistent impact was L1WORK: the use of German for professional purposes appears to have had a protective effect against language attrition. On the outcome variables measured by the formal tasks and on the lexical diversity measure D, those informants who stated that they used their L1 at work on at least a weekly basis were indistinguishable from the monolingual Germans; they did, however, make more errors in free speech than did the reference group.

The use of the L1 in bilingual mode situations – that is within the family or with friends – had a less clearly discernible impact on language attrition: L1 use with friends did not appear to play any role at

all, while those speakers who stated that they spoke German within their family (very) frequently outperformed the others on two measures (C-TEST and D). Verbal fluency and the frequency of errors in free speech, however, were unaffected by this factor. The lack of a consistent impact of these factors on the attritional process is quite remarkable, since in a migrant setting, the circle of family and friends would appear to be the context par excellence where L1 use is practised. When asked about their own perception of their L1 proficiency, migrants often establish a causal link to this factor ('my L1 is good/bad because I have a lot/very little opportunity to use it').

Also remarkable is the absence of an impact of the cultural and linguistic affiliation factors measured in the SPBQ on the outcome measures, such as the preferred culture or preferred language of the participants. Even more strikingly, the attitude towards the L1 measured by means of Gardner's AMTB (Gardner, 1985) had an effect that was contrary to what had been predicted: a more positive attitude towards speakers of the L1 (both in the country of emigration and in Germany) was linked to lower lexical diversity (as measured both by the VF task and by the D measure in free speech) and to more errors in free speech. This is a very puzzling finding which goes against all predictions made on the attritional process, and which we confess ourselves at a loss to explain.

To sum up, the answer to our third research question has to be a tentative one: the composite factors established on the basis of the SPBQ and AMTB can go only some way towards predicting the deterioration of linguistic skills as measured in the outcome variables. The most powerful predictor appears to be the use of the L1 for professional purposes. Language use in more informal settings appears to have a very limited protective function with respect to L1 attrition, while the impact of attitudes and affiliations emerges as doubtful from the data under observation here. Finally, the one outcome variable that appeared unaffected by all factors measured here was also the one for which the overall group effect of bilinguals vs. reference group had been strongest: the overall amount of errors in free speech. Given the debate on whether or not an increase in errors can be taken as a direct reflection of diminished proficiency, that is an interesting finding: the fact that even those subgroups that are in all other aspects indistinguishable from the reference group (e.g. speakers who use L1 very frequently for professional purposes) have more errors strongly suggests that these may indeed simply be 'performance' phenomena or slips of the tongue, not indications

of a change in underlying knowledge. In other words, as the activation of the native language system decreases due to non-use, the resources needed to produce naturalistic speech increase. Due to this 'overload', less attention is available for monitoring, resulting in an increase of speech errors.

Similarly, there is a set of outcome variables that is entirely unaffected by any of the factors considered here, namely the variables pertaining to fluency in free speech (EP, RP, RT). While the bilingual groups are clearly different overall from the reference group with respect to these variables (their free speech is less fluent), neither the amount of use that they make of their first language nor their attitude nor any of the personal background variables seem to play a role in this. Fluency may therefore not be conditioned by these factors, on which the individual participants in the bilingual groups differ, but by the factor which they all have in common, namely extensive exposure to L2 in their daily lives. In other words, a decrease in fluency may not so much be the outcome of the fact that L1 has become more difficult to access, but that L2 has become harder to inhibit (see also Schmid, 2007).

V Conclusions

The present investigation has attempted to unravel some of the complexities involved in a multifactorial design for language attrition research. Given the complexities of the development of a first language in a second language context, it appears vital to investigate the impact of factors pertaining to language use and language attitudes in far more detail than has previously been done. The research design proposed here has identified a number of factor groups, based on Grosjean's model of language modes and on Gardner's Attitude and Motivation Test Battery, which can be empirically validated on the basis of the data under investigation in the present study. In this manner, the first step towards a standardized test battery for language attrition research has been taken. It is to be hoped that further studies may apply this design for investigations of language attrition in different settings and determine whether empirical validation can be provided.

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VI References

Ammerlaan, T. 1996: 'You get a bit wobbly…': exploring bilingual lexical retrieval processes in the context of first language attrition. Unpublished doctoral dissertation, Katholieke Universiteit Nijmegen.

Ben-Rafael, M. 2004: Language contact and attrition: the spoken French of Israeli Francophones. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 165–87.

Ben-Rafael, M. and **Schmid, M.S.** 2007: Language attrition and ideology: two groups of immigrants in Israel. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 205–26.

Bialystok, E., Craik, F. and **Ryan, J.** 2006: Executive control in a modified antisaccade task: effects of aging and bilingualism. *Journal of Experimental Psychology: Learning, Memory and Cognition* 32, 1341–54.

Birdsong, D. 2006. Age and second language acquisition and processing: a selective overview. *Language Learning* 56, 9–49.

Burke, D.M. 1997: Language, aging, and inhibitory deficits: evaluation of a theory. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 52, 254–64.

Byland, E.S. 2008: Age differences in first language. Unpublished PhD dissertation, Stockholm University.

Cronbach, L.J. 1951: Coefficient alpha and the internal structure of tests. *Psychometrika* 16, 297–334.

de Bot, K., Gommans, P. and **Rossing, C.** 1991: L1 loss in an L2 environment: Dutch immigrants in France. In Seliger, H.W. and Vago, R.M., editors, *First language attrition*. Cambridge: Cambridge University Press, 87–98.

de Bot, K., Lowie, W. and **Verspoor, M.** 2007: A Dynamic Systems Theory approach to second language acquisition. *Bilingualism: Language and Cognition* 10, 7–21.

Dewaele, J.-M. 2004: Perceived language dominance and language preference for emotional speech: the implications for attrition research. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 81–104.

Gardner, R.C. 1985: The attitude/motivation test battery: technical report. Available online at http://publish.uwo.ca/~gardner/docs/AMTBmanual.pdf (July 2009).

Giesbers, H. 1997: Dutch in Indonesia: language attrition or language contact. In Klatter-Folmer, J. and Kroon, S., editors, *Dutch overseas: studies in maintenance and loss of Dutch as an immigrant language*. Tilburg: Tilburg University Press, 163–80.

Giles, H., Bourhis, R. and **Taylor, D.** 1977: Towards a theory of language in ethnic group relations. In Giles, H., editor, *Language, ethnicity and intergroup relations*. London: Academic Press, 307–48.

Grosjean, F. 1998: Transfer and language mode. *Bilingualism: Language and Cognition* 1, 175–76.

—— 2001: The bilingual's language modes. In Nicol, J.L., editor. *One mind, two languages: bilingual language processing*. Oxford: Blackwell, 1–22.

Grosjean, F. and **Py, B.** 1991: La restructuration d'une première langue: l'intégration de variantes de contact dans la compétence de migrants bilingues [The reconstructing of a first language: integration of contract forms into the competence of bilingual migrants]. *La Linguistique* 27, 35–60.

Gross, S. 2004: A modest proposal: explaining language attrition in the context of contact linguistics. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 281–97.

Grotjahn, R. 1987: How to construct and evaluate a C-Test: a discussion of some problems and some statistical analyses. *Quantitative Linguistics* 34, 219–53.

Gürel, A. 2000: Linguistic characteristics of second language acquisition and first language attrition: Turkish overt versus null pronouns. Unpublished doctoral dissertation, McGill University, Montréal.

—— 2007: (Psycho)linguistic determinants of L1 attrition. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 99–119.

Hakuta, K. and **d'Andrea, D.** 1992: Some properties of bilingual maintenance and loss in Mexican background high-school students. *Applied Linguistics* 13, 72–99.

Hill, H., Ott, F., Herbert, C. and **Weisbrod, M.** 2006: Response execution in lexical decision tasks obscures sex-specific lateralization effects in language processing: evidence from event-related potential measures during word reading. *Cerebral Cortex* 16, 978–89.

Hulsen, M. 2000: Language loss and language processing: three generations of Dutch migrants in New Zealand. Unpublished doctoral dissertation, Katholike Universiteit Nijmegen.

Hyltenstam, K. 2007: The incidence of nativelikeness among second language users: a maturational account. Keynote address. *The 6th International Symposium on Bilingualism*. Hamburg, May/June 2007.

Jarvis, S. 2003: Probing the effects of the L2 on the L1: a case study. In Cook, V., editor. *Effects of the second language on the first*. Clevedon: Multilingual Matters, 81–102.

Jaspaert, K. and **Kroon, S.** 1989: Social determinants of language loss. *Review of Applied Linguistics* 83/84, 75–98.

Kansaku, K. and **Kitazawa, S.** 2001: Imaging studies on sex differences in the lateralization of language. *Neuroscience Research* 41, 333–37.

Klein-Braley, C. 1985: A cloze-up on the C-test: a study in the construct validation of authentic tests. *Language Testing* 2, 76–104.

—— 1997: C-tests in the context of reduced redundancy testing: an appraisal. *Language Testing* 14, 47–84.

Köpke, B. 1999: L'attrition de la première langue chez le bilingue tardif: Implications pour l'étude psycholinguistique du bilinguisme [First language attrition in late bilinguals: implications for psycholinguistic investigations of bilingualism]. Unpublished doctoral dissertation, Université de Toulouse–Le Mirail, Toulouse.

Köpke, B. and **Schmid, M.S.** 2004: First language attrition: the next phase. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 1–43.

Larsen-Freeman, D. and **Long, M.H.** 1991: *An introduction to second language acquisition research*. New York: Longman.

Leisiö, L. 2001: Morphosyntactic convergence and integration in Finland Russian. Unpublished doctoral dissertation, University of Tampere.

Major, R.C. 1992: Losing English as a first language. *Modern Language Journal* 76, 190–209.

—— 1993: Sociolinguistic factors in loss and acquisition of phonology. In Hyltenstam, K. and Viberg, A., editors, *Progression and regression in language*. Cambridge: Cambridge University Press, 463–78.

—— 2004: Gender and stylistic variation in second language phonology. *Language Variation and Change* 16, 169–88.

Masgoret, A.-M. and **Gardner, R.C.** 2003: Attitudes, motivation, and second language learning: a meta-analysis of studies conducted by Gardner and associates. *Language Learning* 53, 123–63.

McKee, G., Malvern, D. and **Richards, B.** 2000: Measuring vocabulary diversity using dedicated software. *Literary and Linguistic Computing* 15, 323–37.

Montrul, S. 2002: Incomplete acquisition and attrition of Spanish tense/aspect distinctions in adult bilinguals. *Bilingualism: Language and Cognition* 5, 39–68.

Nakuma, C. 1997: Loss of communicative competence: measurability and description of a method. *International Review of Applied Linguistics in Language Teaching* 35, 199–209.

Olshtain, E. and **Barzilay, M.** 1991: Lexical retrieval difficulties in adult language attrition. In Seliger, H.W. and Vago, R.M., editors, *First language attrition*. Cambridge: Cambridge University Press, 139–50.

Pallier, C. 2007: Critical periods in language acquisition and language attrition. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 155–68.

Paradis, M. 1993: 'Interference' in bilingual speakers. *International Journal of Psycholinguistics* 9, 133–45.

—— 2004: *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.

—— 2007: L1 attrition features predicted by a neurolinguistic theory of bilingualism. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 121–33.

Pavlenko, A. 2004: L2 influence and L1 attrition in adult bilingualism. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 47–59.

Pelc, L.A. 2001: L1 lexical, morphological and morphosyntactic attrition in Greek–English bilinguals. Unpublished PhD dissertation, City University of New York.

Perdue, C. 1993: *Adult language acquisition: cross-linguistic perspectives*. Cambridge: Cambridge University Press.

Roberts, P.M. and **Le Dorze, G.** 1998: Bilingual aphasia: semantic organization, strategy use, and productivity in semantic verbal fluency. *Brain and Language* 65, 287–312.

Schmid, M.S. 2002: *First language attrition, use and maintenance: the case of German Jews in Anglophone countries*. Amsterdam/Philadelphia: John Benjamins.

—— 2004: Language attrition research: an annotated bibliography. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 317–48.

—— 2007: The role of L1 use for L1 attrition. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 135–53.

Schmid, M.S. and **Beers Fägersten, K.** forthcoming (2010): The development of disfluency markers in L1 attrition. To appear in *Language Learning* 60(4).

Schmid, M.S. and **Köpke, B.** 2009: L1 attrition and the mental lexicon. In Pavlenko, A., editor, *The bilingual mental lexicon: interdisciplinary approaches*. Clevedon: Multilingual Matters, 209–38.

Schmitt, E. 2004: No more reductions!: to the problem of evaluation of language attrition data. In Schmid, M.S., Köpke, B., Keijzer, M. and Weilemar, L., editors, *First language attrition: interdisciplinary perspectives on methodological issues*. Amsterdam/Philadelphia: John Benjamins, 299–316.

—— 2010: When boundaries are crossed: evaluating language attrition data from two perspectives. Bilingualism: Language and Cognition 13(1).

Schoenmakers-Klein Gunnewiek, M. 1998: Taalverlies door taalcontact? Een onderzoek bij Portugese migranten [Language loss through language contact? An investigation of Portuguese migrants]. Unpublished doctoral dissertation, Katholieke Universiteit Brabant.

Schumann, J.H. 1994: Where is cognition? Emotion and cognition in second language acquisition. *Studies in Second Language Acquisition* 16, 231–42.

—— 1998: The neurobiology of affect in language. *Language Learning* 48: Supplement 1.

Seliger, H.W. and **Vago, R.M.** 1991: The study of first language attrition: an overview. In Seliger, H.W. and Vago, R.M., editors, *First language attrition*. Cambridge: Cambridge University Press, 3–15.

Sorace, A. 2005: Selective optionality in language development. In Cornips, L. and Corrigan, K.P., editors, *Syntax and variation: reconciling the biological and the social*. Amsterdam/Philadelphia: John Benjamins, 55–80.

Tabachnick, B.G. and **Fidell, L.S.** 1989: *Using multivariate statistics*. 2nd edition. New York: HarperCollins.

Tsimpli, I. 2007: First language attrition from a minimalist perspective: interface vulnerability and processing effects. In Köpke, B., Schmid, M.S., Keijzer, M. and Dostert, S., editors, *Language attrition: theoretical perspectives*. Amsterdam/Philadelphia: John Benjamins, 83–98.

Tsimpli, I., Sorace, A., Heycock, C. and **Filiaci, F.** 2004: First language attrition and syntactic subjects: a study of Greek and Italian near-native speakers of English. *International Journal of Bilingualism* 8, 257–77.

Ullman, M. 2004: Contributions of memory circuits to language: the declarative/procedural model. *Cognition* 92, 231–70.

Williams, A. and **Harwood, J.** 2004: An intergroup perspective on intergenerational relationships in the family. In Nussbaum, J.F. and Coupland, J., editors, *Handbook of communication and aging research*. Mahwah, NJ: Erlbaum, 115–38.

Yağmur, K. 1997: *First language attrition among Turkish speakers in Sydney*. Tilburg: Tilburg University Press.

Yukawa, E. 1997: L1 Japanese attrition and regaining: three case studies of two early bilingual children. Unpublished doctoral dissertation, Centre for Research on Bilingualism, Stockholm University.

Appendix

Table 7 SPBQ questions pertaining to bilingual mode language use

	0	.25	.5	.75	1.0
What is the native language of most of your friends and acquaintances?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
What language do you mostly use with your friends and acquaintances?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
How often do you speak German with your friends and acquaintances?	never	rarely	sometimes	frequently	all the time
What is the language you speak most often with your friends and acquaintances?*	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do you use when you speak with your partner?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language does your partner use when he or she speaks with you?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did you use to speak with your partner when you came here?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did your partner use to speak with you when you came here?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do you use when you speak with your children?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do your children use when they speak with you?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did you use with your children when they were little?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did your children use with you when they were little?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do you use when you speak with your grandchildren?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do your grandchildren use when they speak with you?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did you use with your grandchildren when they were little?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language did your grandchildren use with you when they were little?	only L2	mainly L2	both L2 and L1	mainly L1	only L1

*This question was included in the AMTB questionnaire sent approximately 6 months after the data collection to check the consistency of responses.

Table 8 SPBQ questions pertaining to linguistic identification

	0	.25	.5	.75	1.0
How important is maintaining your L1 to you?	not at all	not very much	neutral	important	very important
In which culture do you feel at home?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
In which language do you feel at home?	never	rarely	sometimes	frequently	all the time
Which language has the most emotional significance for you?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Which language do you most identify with?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Would you like to move back to Germany, circumstances permitting?	definitely not	not very much	neutral	somewhat	definitely

Table 9 SPBQ questions pertaining to intergenerational L1 maintenance

	0	.25	.5	.75	1.0
How important is it to you that your children are proficient in German?	not at all	not very much	neutral	important	very important
Do you admonish your children to speak German?	only L2	mainly L2	both L2 and L1	mainly L1	only L1
Do/did your children attend German lessons?	never	rarely	sometimes	frequently	very frequently

Table 10 Multiple linear regression analysis, bilingual mode factors

Variable	VF		C-test	
	Beta	*p*-value	Beta	*p*-value
SEX	.037	.729	.114	.230
GROUP	.043	.680	.075	.418
EDU	.108	.342	.407	.000
LOR	–.163	.157	–.099	.329
BIMODPAR	rm	rm	.188	.051
BIMODCHIL	rm	rm	rm	rm
BIMODFR	rm	rm	rm	rm

Notes: rm = removed. For verbal fluency (VF), R^2 = .058, $F(4,86)$ = 1.333, p = .264. For C-test, R^2 = .281, $F(5,85)$ = 6.632, p = .000.

Table 11 Multiple linear regression analysis, other language use and affiliation factors

Variable	VF		C-test	
	Beta	*p*-value	Beta	*p*-value
SEX	.022	.828	.084	.361
GROUP	.016	.870	.026	.777
EDU	.048	.662	.349	.001
LOR	–.164	.142	–.101	.310
L1WORK	.311	.003	.301	.002
AFFILL1	rm	rm	rm	rm
INTERMEDL1	rm	rm	rm	rm
EXPOSUREL1	rm	rm	rm	rm
CHILDLES	rm	rm	rm	rm
CHILDADM	rm	rm	rm	rm

Notes: rm = removed. For verbal fluency (VF), R^2 = .152, $F(5,84)$ = 3.011, p = .015. For C-test, R^2 = .315, $F(5,84)$ = 7.709, p = .000.

Table 12 Multiple linear regression analysis, AMTB factors

Variable	VF		C-test	
	Beta	*p*-value	Beta	*p*-value
SEX	.090	.362	.166	.064
GROUP	.074	.456	.008	.925
EDU	.074	.493	.458	.000
LOR	–.123	.261	–.054	.575
ATTL1	–.246	.021	rm	rm
ATTL2	rm	rm	rm	rm
ATTFOR	rm	rm	rm	rm
ATTL1INL2	rm	rm	rm	rm

Notes: rm = removed. For verbal fluency (VF), R^2 = .131, $F(5,92)$ = 2.775, p = .022. For C-test, R^2 = .379, $F(4,93)$ = 9.017, p = .000.