

# Speaking Accent-Free in L2 Beyond the Critical Period: The Compensatory Role of Individual Abilities and Opportunity Structures

<sup>1,\*</sup>JÖRG DOLLMANN, <sup>1,2</sup>IRENA KOGAN, and

<sup>1</sup>MARKUS WEIßMANN

<sup>1</sup>Mannheim Centre for European Social Research MZES, Mannheim, Germany and

<sup>2</sup>University of Mannheim, Mannheim, Germany

\*E-mail: joerg.dollmann@mzes.uni-mannheim.de

Given the controversies surrounding the critical period hypothesis on second-language (L2) learning outcomes, this study focuses on the phonological aspect of language acquisition—the strength of the foreign accent in L2. Drawing on data from a large-scale representative data set on immigrant adolescents in Germany—CILS4EU-DE—we first demonstrate that there is a critical period (CP) up to the age of around 10, after which obtaining oral language skills without a foreign accent becomes less likely. Second, we provide evidence that native-like language skills can be achieved after the CP if certain preconditions related to learning efficiency and language exposure are met. Our analyses indicate that higher cognitive abilities and exposure to a language environment with intensive and manifold contacts with native speakers can compensate for disadvantages caused by a late start in L2 acquisition. The results are discussed in the context of the linguistic and sociological scholarship of language acquisition and immigrant assimilation.

## INTRODUCTION

There is considerable evidence that the relationship between second-language (L2) learning outcomes (and here, the accentedness of L2 speech) and the age of a learner can be summarized with a simple rule of thumb: ‘earlier is better’ (Birdsong and Molis 2001: 235). The earlier a person starts acquiring a second language, the better the results will be: younger learners are more likely to speak the L2 like a native speaker. This assumption has been confirmed in numerous studies that have focused on different aspects of language, like pronunciation, accentedness or morphosyntactic, lexical, and collocational abilities (e.g. Patkowski 1980; Scovel 1988; Bongaerts *et al.* 1997; Bongaerts 1999; Abrahamsson and Hyltenstam 2008; Meisel 2011; Sparado 2013; Moyer 2014a). The theoretical concept behind this research is the critical period hypothesis (CPH) of language learning, which posits that up until the beginning

of puberty, individuals are likely to acquire language skills comparable to those of native speakers (Lenneberg 1967).

However, and despite the variety of studies confirming the CPH, the assertion that it is impossible to achieve native-like proficiency after puberty has been challenged: exceptional outcomes show that adult learners can indeed obtain native-like L2 language proficiency (Ioup *et al.* 1994; Nikolov 2000; Nikolov and Mihaljević Djigunović 2006). While some interpret these exceptional outcomes as evidence against the CPH (e.g. Nikolov and Mihaljević Djigunović 2006), others attribute them to the rare success of explicit language learning and investigate the conditions under which native-like language proficiency can be achieved even at a late age (see, e.g. Abrahamsson and Hyltenstam 2008 on the compensatory role of above-average levels of language aptitude).

The current article builds on this strand of research and investigates possible compensatory mechanisms that may allow older learners to achieve native-like language proficiency after the critical period (CP). Following the assumption that language learning at older ages involves pursuing explicit learning strategies, we argue that general cognitive abilities, in addition to specific language aptitude, may increase the likelihood of achieving native-like proficiency after the CP (Meisel 2009; Abrahamsson 2012). Furthermore, we maintain that the language environment plays an important role in these learning processes: more intense contact with the L2 leads to better learning outcomes.

Our study improves upon past research, which was mainly based on case studies or small-N studies, in four ways. First, our analyses use a large Germany-wide representative sample of immigrant youth. Second, we test whether individual and/or contextual conditions help individuals develop native-like language skills after the CP. In contrast to previous studies that investigate the characteristics of exceptional learners post hoc, we formulate testable hypotheses based on the theoretical arguments found in the literature and empirically investigate these assumptions using a large-scale data set of adolescent immigrants. We therefore cover not only exceptional learners but also various other individuals without an a priori differentiation of their linguistic abilities. Third, we focus on the linguistic integration of (children of) immigrants in Germany and therefore on learning a language that does not have an exceptionally high *Q*-value like the English language does; immigrants from outside Europe are not necessarily exposed to the German language prior to migration (De Swaan 2001). The fact that the language learning process primarily takes place *after* migration to Germany (or solely in Germany, for second- or third-generation immigrants) is especially important for understanding of the role of language environments. Finally, and related to the previous point, studying the CPH and possible compensatory mechanisms in Germany or other contexts (e.g. the Swedish context, see Abrahamsson and Hyltenstam 2008) enhances our ability to interpret the results more generally.

The next section describes the CPH and the distinction between implicit and explicit learning and exemplifies which conditions may enhance language acquisition through explicit learning, even after the CP. We then introduce the data, followed by the empirical results. We demonstrate the existence of a CP up until age 10, and show that greater general cognitive abilities (and therefore higher levels of efficiency to learn a new language) can help learners develop native-like oral speech after the CP. Furthermore, we find that learners' more intimate (e.g. within family or in a partnership) or casual (within neighborhood) exposure to a new language contributes to a compensatory effect among older learners.

## HOW LEARNERS' AGE INFLUENCES ACCENTEDNESS IN L2 SPEECH, AND WHAT MAY COMPENSATE FOR A LATE START TO LEARNING

One of the most widely studied factors affecting second-language acquisition (SLA) is the age of the learner (Flege *et al.* 1999). Lenneberg's (1967) seminal work in developing the CPH focused on the acquisition of a first language (L1). Studies based on this school of thought have led to the widespread belief that the language acquisition process should be completed before the end of the CP (i.e. by age 9–12) (e.g. Ioup *et al.* 1994; Flege *et al.* 2006; Abrahamsson 2012; Granena and Long 2013). After this period, language acquisition is assumed to be less efficient, and less likely (or even impossible) to result in perfect language proficiency. Several studies apply this reasoning to the acquisition of an L2 (for a recent objection to this view, see Mayberry and Kluender 2018); they contend that native-like fluency levels are hindered or almost impossible when SLA starts after the CP. While the accentedness of speech and pronunciation are shown to be especially affected by learning an L2 after the CP (e.g. Scovel 1988; Bongaerts 1999; Moyer 2014a, 2014b), other researchers have demonstrated that morphosyntactic, lexical, and collocational abilities might also be influenced by a late start (Patkowski 1980; Meisel 2011; Sparado 2013).<sup>1</sup>

Although the CPH is more than 50-years old, the debate over its underlying causal mechanisms is ongoing (DeKeyser 2000). According to one school of thought, which is mostly in line with the CPH's original assumptions, older language learners are less successful for biological reasons, primarily maturational constraints and changes in the neural system (e.g. Meisel 2009). Yet, a competing school of thought questions the biological explanation, and instead attributes difficulties in language learning at older ages to social, psychological, and educational factors (e.g. Marinova-Todd *et al.* 2000). The rejection of a strict CP after which native-like language skills are impossible to acquire is supported by studies that have observed exceptional outcomes, that is, individuals obtaining native-like L2 skills after beginning to learn a new language after the CP (cf. Abrahamsson and Hyltenstam 2008).

However, there are at least two arguments against exceptions qualifying ‘as definitive, or even valid, counterexamples to the critical period’ (Abrahamsson and Hyltenstam 2008: 482). First, several studies show that upon further scrutiny, perfect language skills in late learners are rather rare or even impossible. Thus, they might be more accurately described as ‘near native’ (e.g. Abrahamsson and Hyltenstam 2009). Second, and more importantly for our study, it is argued that the assumptions regarding the CP only relate to implicit, unintentional language acquisition without a conscious reflection, as takes place in child language learning (DeKeyser 2000; Abrahamsson and Hyltenstam 2008; cf. the Fundamental Difference Hypothesis by Bley-Vroman 1989). Therefore, exceptional outcomes among late learners may not necessarily qualify as counterexamples of the CPH (Abrahamsson and Hyltenstam 2008). They may instead reflect successful explicit language learning strategies that older learners employ in the absence of more implicit ways of learning a language, as observed among children (DeKeyser 2000).

Given these considerations, exceptional outcomes should only occur if the preconditions of adult learners’ language acquisition process are especially favorable. For example, a high level of language aptitude, language talent, or verbal ability is often thought to contribute to a native-like level of language skills even if the learning process started after the CP (Ioup *et al.* 1994; Bongaerts *et al.* 1997; Abrahamsson and Hyltenstam 2008).

General cognitive skills may also be considered an important precondition for successful late language learning. It is often argued that explicit learning processes rely on general problem-solving mechanisms (DeKeyser 2000) or general cognitive learning strategies (Bley-Vroman 1989). Furthermore, ‘explicit inductive learning ability, rote memory ability, and analytical ability’ are considered to be ‘especially relevant to learn a new language intentionally through reasoning, deliberate hypothesis testing, and memorization’ (Granena 2016: 578). Therefore, it seems reasonable to assume that an increasing level of general cognitive skills contributes to the learning success of late language learners, and helps compensate for a late start to learning.

In addition to crucial individual factors such as language aptitude or general cognitive skills, contextual factors are also thought to help compensate for beginning to study an L2 after the CP, and to increase the success of explicit language learning.<sup>2</sup> Here, the quantity and quality of exposure to the L2 is particularly important (Trofimovich and Baker 2006; Moyer 2009). Indeed, one needs regular, extensive contact with the language, which includes the ability to hear and speak it with native or native-like speakers. It has been repeatedly shown that extensive exposure to an L2 and intensive contacts with native speakers increase the probability of native-like L2 proficiency (Bongaerts *et al.* 1995; Muñoz 2014). Furthermore, the positive effects of intensive training in pronunciation and phonetics highlight the importance of exposure in successful L2 acquisition (e.g. Bongaerts *et al.* 1995, 2000).

Therefore, it may be assumed that more extensive exposure to high-quality contacts with L2 contributes to more successful language learning among adults and should therefore compensate for a late age of onset.

To summarize, the findings from previous studies lead us to expect larger constraints in L2 learning among individuals who started learning the language after the CP (H1). However, better general cognitive skills (and therefore a higher efficiency to learn a new language) may help compensate for a late start in L2 learning (H2). Learners who have quantitatively and qualitatively high levels of L2 input are also more likely to learn to speak a foreign language without an accent despite starting after the CP (H3). In the following section, we test these hypotheses empirically.

## DATA AND MEASURES

### Data

The following analyses are based on the data of the sixth wave of the German extension of the Children of Immigrants Longitudinal Survey in Four European Countries (CILS4EU-DE, cf. Kalter *et al.* 2018, 2019). The data collection started in 2010/2011 with the first wave, followed by yearly repetitions up to 2016. The overall sample of 5,820 cases of the sixth wave, comprising a nationwide and representative selection of 19–22-year olds, consists of two subsamples. The first subsample comprises 2,307 cases from the initial sample in wave 1. A school-based sample was used to select these individuals; schools with a higher proportion of immigrants were oversampled. The second subsample consists of 3,513 cases selected from a refreshment sample implemented in the sixth wave. This sample selection was based on municipality level. Using name lists from the sampled municipalities obtained by registration offices, we conducted an onomastic screening of names and oversampled respondents who likely have an immigrant background (Humpert and Schneiderheinze 2016). Both oversampling strategies result in an immigrant proportion of 52 per cent in the final sample. The overrepresentation of immigrants in both subsamples is treated by using design and non-response adjustment weights (CILS4EU 2016; Schiel *et al.* 2016).

Our study uses data from the long version of the survey, which was administered via face-to-face interviews ( $n = 5,074$ ) since it measured accents (this procedure is described in more detail in the next section); we exclude data from the mixed-mode short version of the questionnaire since it did not include the accent measurement. In addition, we only consider respondents with an immigrant background (up to the 3.75th generation, cf. Dollmann *et al.* 2014), which number 2,662 individuals, of whom 2,037 consented to be recorded for the accent measure.<sup>3</sup>

## Measures

Each respondent's accent in the German language was measured during the sixth wave of the survey. The instrument was developed together with phoneticians at the University of Halle-Wittenberg and consists of two parts. First, respondents read aloud a text that was especially designed to reveal accented pronunciation. Respondents were then asked how they felt during the interview, and which parts of the survey they liked most in order to encourage extemporaneous speech. Both parts were recorded and subsequently evaluated and rated by research assistants with a background in subjects with linguistic competencies, like German studies, language studies, or German as a second language. Prior to the evaluation, phoneticians from the University of Halle-Wittenberg extensively trained the evaluators. So, for the current study, we do not use highly qualified listeners like linguists or phoneticians to rate the speech samples, but rather rely on specially trained persons with a relevant background (cf., e.g. Flege *et al.* 2006 used listeners without special training in speech or language). Like in earlier research, we use a 9-point scale to judge the strength of a foreign accent in reading and extemporaneous speech (cf. Southwood and Flege 1999). We rely solely on the accent scores for reading, as this is the most standardized part of the measurement. Furthermore, while all 2,037 respondents agreed to read out the text, some refused to participate in the conversation. However, the results remain largely stable if we use the measurement based on extemporaneous speech or a combined measure (reading and speaking) as a dependent variable.

Respondents' age when they moved to Germany is a central variable for investigating a possible CP and any compensatory effects.<sup>4</sup> This was measured by the question 'How old were you when you moved to Germany?' to which respondents could indicate the age at which they arrived in Germany. Given that age at immigration has a non-linear effect on the persistence of a foreign accent—it increases after the CP—we use dummy variables indicating different age ranges. For our analyses, we differentiate between second- and third-generation immigrants (reference category), and respondents who immigrated at various ages (under 4, 4–9, 10–16, over 16).<sup>5</sup> Especially for the former categories, it is questionable whether respondents were actually German L1 or L2 learners. Unfortunately, we do not have information about the language in which respondents were raised. A single proxy for this information is an item asking whether or not a second language—besides German—was spoken at home at the time the survey was conducted. This variable is included in the analyses.<sup>6</sup>

Another set of crucial variables measures the *efficiency* of explicitly learning a new language at older ages and exposure to the new language; both may contribute to possible compensatory effects of late start. Regarding efficiency, we assessed respondents' cognitive skills using a language-free Culture Fair Intelligence Test, which measures general (i.e. fluid) intelligence (CFT 20, Weiß 2006). The variable ranges from zero to one and indicates the proportion

of correct answers given in the cognitive skills test. Another measure of general cognitive abilities is attendance or completion of the upper-secondary school track, which is the most demanding track in Germany, leading to university entrance certificates. Therefore, respondents were asked during the interview whether they were enrolled in or had completed upper-secondary school.

Furthermore, we use three measures to capture the possible compensatory effects related to differences in *exposure* to the L2. The first focuses on intimate relationships and measures the duration of relationships with a German partner in months. The information was gathered into a life history calendar that recorded all previous relationships starting from the age of 14. The second measure directly captures language use within the family and with friends, constructed from three survey questions indicating whether there is another language spoken at home and how often respondents use this language when communicating within the family and with friends.<sup>7</sup> The third measure gauges (opportunities for) casual relationships by measuring the share of people without an immigrant background in the respondent's immediate neighborhood, ranging between zero and one. In order to obtain this information, respondents' addresses were geocoded and merged with data gathered by a geo- and micromarketing company ('microm'). This data provides information on neighborhoods with an average size of about 500 households (Microm 2017). For the current study, we use information on the ethnic composition of neighborhoods, based on name-based classifications of the members of each household within a specific neighborhood (Mateos 2007), which has proven to work quite well in the German context (Schnell *et al.* 2014).<sup>8</sup> The differentiation between intimate and casual relationships coincides with the concept of strong versus weak ties, as defined by Granovetter (1983).

We also consider additional exogenous control variables in order to ensure that especially the effect of age at arrival, but also the impact of possible compensatory effects, are not driven by compositional differences of different migration cohorts. We include respondents' ethnic background to account for possible ethnic heterogeneity across migration cohorts. We therefore distinguish between individuals arriving from the major sending regions for contemporary immigration flows to Germany: Turkey, Southern Europe, Former Yugoslav Republic (FYR), Former Soviet Union and Central and Eastern Europe (FSU/CEE), and Western Europe (reference category). Regions not classified elsewhere were grouped in a residual category of 'other' countries; adolescents from the Middle East and Northern Africa comprise around 50 per cent of this group.

Furthermore, respondents' educational and socioeconomic backgrounds may differ depending on whether they were late or early arrivals. We therefore consider highest parental level of education, differentiating between no education or no information, general secondary education, intermediate secondary education, upper-secondary education, and tertiary education (reference category). We also include parental occupational status captured by the highest ISEI (International Socio-Economic Index of Occupational Status) score of

both parents. A variable measuring whether the respondent's mother has ever worked outside the home is meant to capture the possible effects of using institutionalized childcare and therefore increased contact with the German language.

We also account for young people's living arrangements (residing with parents or alone) and parental migration experience; both variables provide information about opportunities to practice the German language. We differentiate between individuals residing alone, whose parents were both born in Germany (meaning that the respondent is a third-generation immigrant); those residing alone, with one or both parents born abroad; those living with one or two native-born parents, who is native born; those living with one or two foreign-born parents; and those living with both parents of mixed heritage. Finally, we include respondents' sex and age at the time of the interview in the analyses and control for sampling group (panel or refreshment sample) and rater fixed effects. As in all surveys, we also face the problem of missing values due to item nonresponse. After listwise deletion of cases with missing values, we end up with an analytical sample of 1,843 respondents.

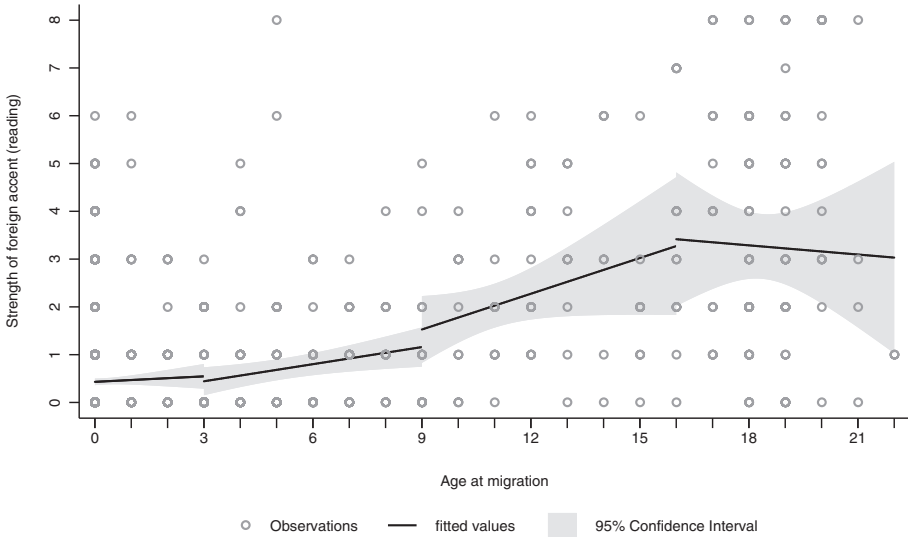
## RESULTS

### Descriptive findings

Figure 1 illustrates that the strength of a foreign accent differs remarkably depending on the respondent's age at arrival. While respondents from the second and third generations score lowest on the foreign accent scale, the strength of the accent increases for older arrivals—especially those who arrive at the age of 10 or older.

While this finding could suggest support for the CPH, it could also be that different ethnic groups with specific problems learning to speak a language without an accent entered Germany at specific ages. We find that this is indeed the case, as the composition of migration cohorts differs considerably with respect to respondents' ethnic backgrounds (see Table 1, which provides a descriptive overview of the variables used in the analyses by age at migration, together with an indication of significant differences between the groups). Among the late arrivals (at age 16 or older), 'other' is the largest category with more than 40 per cent. The majority arrived from the Middle East and Northern Africa, that is, respondents who probably entered Germany as refugees during the past few years. In contrast, immigrants from Turkey are only rarely found among the newcomers (approximately 4 per cent), but they constitute about 19 per cent of all second- and third-generation immigrants, reflecting the longer migration history of this group to Germany. The largest category of immigrants is those originating from the Former Soviet Union and Central/Eastern Europe (43 per cent). However, less than one-third of late arrivals has such a background.





*Figure 1: Age at migration and strength of foreign accent*

*Notes:*  $N = 1,843$ . Results design weighted, robust standard errors. German-borns are set to an age at migration of zero. Observations represent combinations of age at migration and strength of foreign accent

Late arrivals have a rather favorable parental background, especially compared to the second and third generations, but also to the very early arrivals. Those who arrived over the age of 16 have parents with the most advanced socioeconomic position as measured by the ISEI. This may be even more surprising given that the mothers of those late arrivals have the lowest probability of having ever worked outside the home (19 per cent). Finally, we find that late arrivals are most likely to live without their parents. However, as expected, first-generation respondents are most likely to live with one or both parents who were born abroad. This is by far the modal category for all first-generation immigrants who arrived in Germany when they were under 16, and is very common for second- or third-generation immigrants. However, Table 1 also shows that some respondents who were born abroad live with at least one native-born parent. Given the importance of role models in language learning, who themselves may have no (or a weak) foreign accent, it is crucial to consider these cases in the analyses to avoid biases.

## Multivariate results

We first reproduce the descriptive finding of a CP in SLA and the accentedness of a person's speech and explore whether the existence of a CP is robust even

Table 1: Descriptive results

Variables	Group comparison significant*	Age at migration											
		2nd/3rd gen.		Younger than 4		4–9 years old		10–16 years old		Older than 16		All	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Strength of foreign accent: reading (0–8)	2, 3, 4, 6, 7, 8, 9	0.42	0.86	0.60	1.04	0.88	1.33	2.73	2.04	3.32	2.53	0.64	1.26
Cognitive Skills Test (0–1)	1, 2*, 4	0.75	0.14	0.67	0.20	0.70	0.18	0.73	0.20	0.66	0.17	0.74	0.16
Time with German partners (in months)	1, 2, 3, 4, 7, 9	15.52	19.59	8.07	16.13	8.36	15.06	5.00	9.93	2.34	8.87	13.84	18.99
Use of German with family and friends (0–3)	1, 2, 3, 4, 6, 7, 8, 9	2.32	0.86	1.78	0.74	1.74	0.68	1.26	0.72	1.25	1.07	2.18	0.90
Share of Germans in local area (0–1)	3, 4	0.91	0.08	0.90	0.08	0.89	0.09	0.88	0.06	0.89	0.07	0.90	0.08
Age at interview (in years)	4, 7, 9, 10*	20.68	0.84	20.49	0.92	20.53	0.89	20.80	0.92	21.11	0.81	20.68	0.86
Parents' highest ISEI	2, 8*, 9	45.61	19.48	43.64	21.25	37.46	18.71	45.38	22.03	49.95	23.76	45.23	19.91

(On track to) Upper secondary degree	Age at migration											
	2nd/3rd generation		Younger than 4		4–9 years old		10–16 years old		Older than 16		All	
	N	%	N	%	N	%	N	%	N	%	N	%
No	519	50.76	42	50.76	55	48.93	33	57.58	27	43.74	676	50.58
Yes	917	49.24	78	49.24	73	51.07	33	42.42	66	56.26	1167	49.42

Age at migration

	2nd/3rd generation		Younger than 4		4-9 years old		10-16 years old		Older than 16		All	
	N	%	N	%	N	%	N	%	N	%	N	%
<b>Ethnic background</b>												
Turkey	358	19.27	14	6.69	10	6.33	6	4.55	5	3.73	393	16.74
Southern Europe	139	9.84	9	13.46	7	5.42	2	5.23	10	11.54	167	9.78
FYR	103	6.29	7	3.69	7	3.55	4	3.42	5	6.86	126	5.92
FSU/CEE	436	40.50	53	52.81	73	68.36	30	48.26	26	32.06	618	42.63
Western Europe	115	9.21	6	4.61	1	0.33	2	1.93	6	5.53	130	8.10
Other	285	14.89	31	18.74	30	16.02	22	36.61	41	40.29	409	16.84
<b>Sex</b>												
Male	700	54.70	59	59.68	66	57.55	38	58.03	43	52.08	906	55.16
Female	736	45.30	61	40.32	62	42.45	28	41.97	50	47.92	937	44.84
<b>Parents' highest education</b>												
No certificate/missing	73	5.19	16	13.35	13	14.94	9	12.48	10	13.60	121	6.77
Lower secondary degree	271	24.33	14	12.12	12	7.27	8	12.99	8	11.35	313	21.81
Intermediate secondary degree	410	30.15	30	27.58	26	24.67	12	13.20	8	17.88	486	28.72
Upper secondary degree	286	17.85	23	21.28	24	10.86	11	25.53	16	19.15	360	17.99
University degree	396	22.48	37	25.67	53	42.26	26	35.81	51	38.02	563	24.71
Mother never worked												
No	1,369	96.43	110	94.70	119	95.41	60	91.55	80	81.17	1,738	95.52
Yes	67	3.57	10	5.30	9	4.59	6	8.45	13	18.83	105	4.48

Age at migration

	2nd/3rd generation		Younger than 4		4–9 years old		10–16 years old		Older than 16		All	
	N	%	N	%	N	%	N	%	N	%	N	%
Living situation												
Without parents (both born in DE)	98	9.48	0	0.00	0	0.00	0	0.00	1	1.47	99	7.77
Without parents (one or both born abroad)	167	10.28	27	17.47	32	18.93	15	17.82	64	68.63	305	13.74
With one or both parents (born in DE)	346	32.96	7	5.31	3	2.57	1	2.01	2	4.24	359	27.54
With one or both parents (born abroad)	645	37.70	80	70.78	92	78.34	49	79.53	26	25.66	892	42.69
With both parents (mixed)	180	9.58	6	6.45	1	0.16	1	0.65	0	0.00	188	8.26
No other language at home than German												
No	856	48.12	106	90.23	118	88.84	60	93.14	79	81.40	1219	55.60
Yes	580	51.88	14	9.77	10	11.16	6	6.86	14	18.60	624	44.40
Sample												
Panel	499	26.91	41	29.86	48	30.63	16	12.57	0	0.00	604	25.81
Refreshment	937	73.09	79	70.14	80	69.37	50	87.43	93	100.00	1,239	74.19
N	1,436		120		128		66		93		1,843	

Notes: Weighted means and percentages, unweighted N.

\*Numerals indicate statistically significant differences between different groups of age at migration ( $p < 0.05$ ;  $^+ p < 0.10$ ) and refer to the following contrasts:

2nd/3rd generation versus: (1) younger than 4; (2) 4–9 years old; (3) 10–16 years old; (4) older than 16 years.

Younger than 4 years versus: (5) 4–9 years old; (6) 10–16 years old; (7) older than 16 years.

4–9 years old versus: (8) 10–16 years old; (9) older than 16 years.

10–16 years old versus: (10) older than 16 years.

when considering other characteristics, like respondents' ethnic origin, parental background, and living situation. Model 1 of Table 2 illustrates that study participants were found to have a stronger accent when they migrated to Germany after the age of 10, and even stronger if they were over 16. Those who immigrated to Germany before the age of 4 received similar ratings on the accent measure as second- or third-generation immigrants, while those who migrated aged 4–9 were rated as having slightly more pronounced foreign accents.

The finding of a CP remains robust even when considering a wide array of control variables like ethnic group, parental background, living situation, a proxy for learning German as an L2, respondents' sex, and age. The coefficients pertaining to respondents who arrived at the age of 10 or higher are slightly reduced, but remain statistically significant, while a smaller effect for the age group 4–9 years (from Model 1) is no longer statistically significant in Model 2 (for a description of the effects of the control variables, cf. Appendix A1 in Supplementary Material).

In the following subsets of the analyses, we first focus on the influence of cognitive ability, measured by a cognitive test score and academic achievement (enrolment in or completion of upper-secondary education in Germany). Models 3a and 4a in Table 3 show that both proxies for efficiency are negatively associated with a foreign accent: young people with higher cognitive skills or an upper-secondary education are rated as having a less pronounced

*Table 2: OLS regressions predicting strength of foreign accent*

Explanatory variables	M1	M2
Age at migration (ref.: 2nd/3rd gen.)		
<4	0.14 (0.14)	−0.15 (0.14)
4–9	0.44** (0.16)	0.15 (0.16)
10–16	2.23*** (0.34)	1.87*** (0.34)
>16	2.85*** (0.35)	2.56*** (0.34)
Control variables included		X
<i>N</i>	1,843	1,843
<i>R</i> <sup>2</sup>	0.30	0.44

*Notes:* Robust standard errors in parentheses. Results design-weighted.

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , \*\*\*\* $p < 0.001$ .

Table 3: OLS regressions predicting strength of foreign accent: efficiency

Explanatory variables	Cognitive skills test		(On track to) Upper secondary degree	
	M3a	M3b	M4a	M4b
Age at migration (ref.: 2nd/3rd gen.)				
<4	-0.22 (0.13)	-0.07 (0.47)	-0.16 (0.14)	-0.27 (0.20)
4-9	0.13 (0.16)	0.57 (0.68)	0.16 (0.16)	0.34 (0.26)
10-16	1.87*** (0.34)	2.83** (1.05)	1.84*** (0.33)	2.38*** (0.45)
>16	2.49*** (0.33)	5.64*** (1.17)	2.58*** (0.33)	3.29*** (0.50)
Efficiency measure	-1.08*** (0.24)	-0.73** (0.26)	-0.28*** (0.06)	-0.19** (0.06)
x immigrated before age 4		-0.19 (0.57)		0.24 (0.25)
x immigrated ages 4-9		-0.61 (0.90)		-0.33 (0.29)
x immigrated ages 10-16		-1.32 (1.45)		-1.24* (0.57)
x immigrated after age 16		-4.71** (1.63)		-1.23+ (0.63)
Control variables included	X	X	X	X
N	1,843	1,843	1,843	1,843
R <sup>2</sup>	0.45	0.47	0.45	0.46

Notes: Robust standard errors in parentheses. Results design-weighted.

+*p* < 0.1, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.

accent. Does this positive association apply to all respondents, regardless of their age at arrival in Germany, or do we find differential effects for various age-at-migration groups?

In the subsequent analyses, we consider the possible compensatory effects of cognitive skills and academic achievement (proxies for efficiency of learning) as well as exposure to a native language environment, that is, through time spent with a native partner, the extent to which the German language is used with family and friends, and the share of Germans in the respondent’s neighborhood. To this end, we estimate the interaction effects between the age at arrival (for first-generation immigrants) and cognitive test scores,

attendance, or successful completion of an upper-secondary track, duration of a relationship with a German partner, the amount of L2 used with family and friends, as well as the share of native speakers in the neighborhood.

Models 3b and 4b in Table 3 introduce interaction effects with two efficiency measures and the different age-at-arrival groups. Our findings demonstrate that late arrivals are not necessarily disadvantaged with respect to learning to speak a new language without a foreign accent. As hypothesized, they benefit from higher levels of efficiency to learn a new language, as measured by cognitive scores and academic attainment.

Figure 2 visualizes the interaction effects between age at arrival and scores on the cognitive skills test. As around 94 per cent of our analysis sample scored 50 per cent or higher on the test, we plot this range. The figure shows that respondents who migrated after the age of 10 and scored low on the cognitive ability test were rated as having a more distinctive foreign accent. However, the prevalence of foreign accents decreases with increasing cognitive skills, and there are no significant differences at the top of the cognitive test score distribution, which is especially pronounced for those who migrated after the age of 16. Cognitive skills do not affect the accents of those who arrived at an earlier age; all respondents who migrated under the age of 10 were rated as having low levels of accented speech.

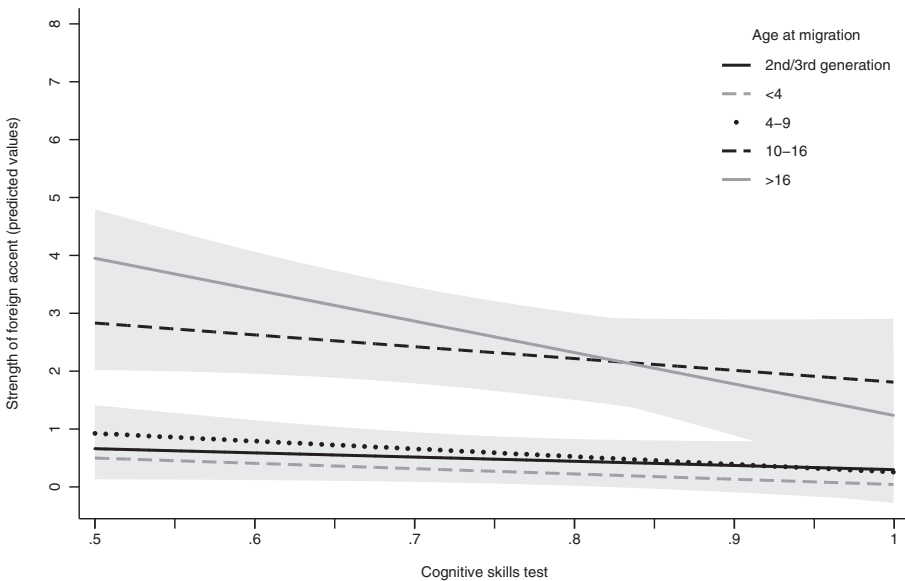


Figure 2: Compensatory effects of efficiency on the strength of foreign accent. Notes:  $N = 1,843$ . Results design-weighted, robust standard errors. Grey areas represent 95 per cent confidence intervals

The next subset of analyses explores whether such compensatory effects are also found for another important precondition of language learning—exposure to native speakers. Models 5a, 6a, and 7a in Table 4 present the results of the effect of exposure to native-like use of the German language on the accent-ness of speech by age at arrival (for the effects of the control variables, cf. Appendix A1 in Supplementary Material).

Each month of being with a native partner, an increasing usage of German with family and friends, and each unit of increase in the share of native speakers in the immediate neighborhood is associated with a less noticeable

Table 4: OLS regressions predicting strength of foreign accent: exposure

Explanatory variables	Months with German partners		Language use with family and friends		Share of Germans in local area	
	M5a	M5b	M6a	M6b	M7a	M7b
Age at migration (ref.: 2nd/3rd gen.)						
<4	-0.16 (0.14)	-0.12 (0.16)	-0.17 (0.13)	0.22 (0.37)	-0.15 (0.13)	0.75 (1.27)
4–9	0.15 (0.16)	0.25 (0.19)	0.11 (0.16)	-0.13 (0.30)	0.14 (0.15)	2.74 (2.17)
10–16	1.85*** (0.34)	2.18*** (0.34)	1.67*** (0.35)	1.64* (0.65)	1.85*** (0.33)	9.68* (4.15)
>16	2.53*** (0.34)	2.50*** (0.35)	2.33*** (0.31)	3.59*** (0.50)	2.56*** (0.34)	9.83*** (2.80)
Exposure measure	-0.00* (0.00)	-0.00 (0.00)	-0.37*** (0.08)	-0.26** (0.09)	-1.93*** (0.46)	-1.13* (0.46)
× immigrated before age 4		-0.00 (0.00)		-0.20 (0.16)		-1.00 (1.39)
× immigrated ages 4–9		-0.01* (0.01)		0.16 (0.15)		-2.92 (2.37)
× immigrated ages 10–16		-0.06** (0.02)		0.10 (0.35)		-8.87+ (4.65)
× immigrated after age 16		0.02 (0.03)		-0.92*** (0.26)		-8.18* (3.23)
Control variables included	X	X	X	X	X	X
N	1,843	1,843	1,843	1,843	1,843	1,843
R <sup>2</sup>	0.44	0.45	0.46	0.48	0.45	0.46

Notes: Robust standard errors in parentheses (cluster robust standard errors in Models M7a and M7b). Results design-weighted.

+*p* < 0.1, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.



foreign accent. Interestingly, and as hypothesized, the effect is especially pronounced for those who arrived in Germany after the age of 10. Here, possible compensatory effects of increasing exposure to native speakers can be observed (cf. Models 5b, 6b, and 7b).<sup>9</sup> However, the results of spending time with a native partner for the group that migrated after the age of 16 deviate from this pattern. This may be due to a skewed distribution on this exposure measure, since few recent migrants had been in a long-term relationship with a native partner. Furthermore, the results for German-language use within the family and with friends also support the compensating role of language exposure for adult learners (i.e. those who migrated after the age of 16).

Figure 3 visualizes the multivariate results from Model 7b—the impact of the share of natives among neighbors. Given that the empirical distribution of the variable ‘natives among neighbors’ in the microm data is largely between 0.7 and 1 (again around 94 per cent of the sample), we plot this range. Again, the two groups that arrived after the age of 10 were rated as having the most pronounced foreign accent in communities with comparably low numbers of native neighbors. The overlapping confidence intervals at the lower end of the scale (0.7) can be explained by the small number of respondents living in communities with comparably few natives. With an increasing share of

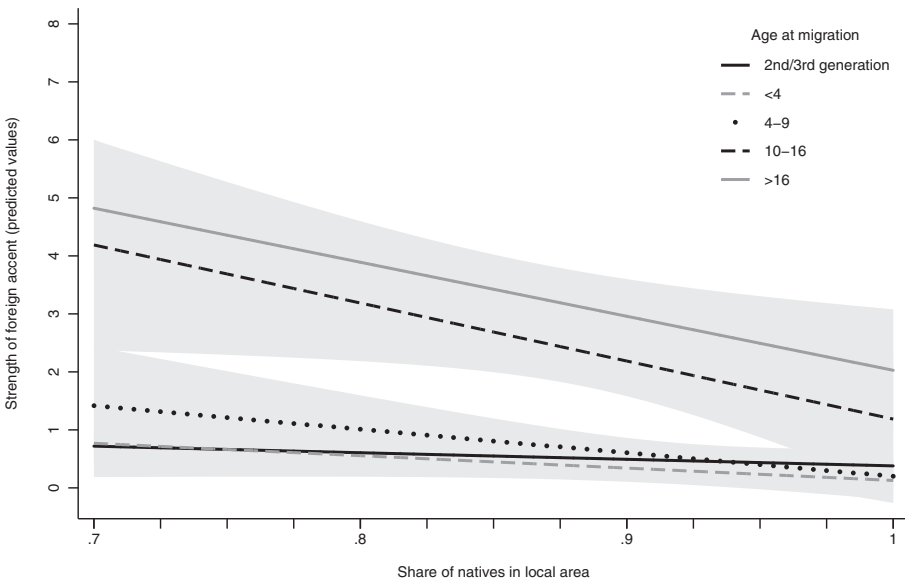


Figure 3: *Compensatory effects of exposure on the strength of foreign accent.* Notes:  $N = 1,843$ . Results design-weighted, cluster robust standard errors. Grey areas represent 95 per cent confidence intervals

native neighbors, the difference in the strength of foreign accents between the different migration cohorts diminishes, although we still find some differences for the group of late arrivals, which may be due to the small number of immigrants in neighborhoods inhabited almost exclusively by natives.

## SUMMARY

In the context of a growing number of immigrants to Germany and the importance of language acquisition for their integration, this study examined: (i) whether there is a CP of language learning, after which native-like proficiency is less likely and (ii) whether greater efficiency and contact with natives can compensate for beginning to learn a language after the CP.

Our results, which draw on large-scale representative data from Germany—CILS4EU-DE—support the existence of a CP with respect to the accentedness of speech. Respondents who arrived after the age of 10 were rated as having a significantly stronger foreign accent than those who moved at an earlier age or who were born in Germany to first- or second-generation immigrants. This CP does not seem to be caused by differences in the composition of migration groups. The finding of a critical or sensitive period is thereby in line with several prior studies (e.g. Oyama 1976; Abrahamsson and Hyltenstam 2008; Granena and Long 2013).

Furthermore, building on recent research that explores the preconditions for so-called exceptional outcomes, that is, successful L2 learners starting after the CP (e.g. Abrahamsson and Hyltenstam 2008), we expand on possible compensatory mechanisms that allow successful language acquisition even for late learners. In addition to language aptitude, talent, and high verbal abilities (DeKeyser 2000), general cognitive skills and a language environment with (quantitatively and qualitatively) beneficial opportunities to be exposed to the L2 also seem to enhance the language learning process. Given that these preconditions seem much less relevant for the children of immigrants or for migrants who arrived in early childhood, the results further support the existence of different language acquisition strategies among young and adult learners. Young learners experience a more implicit, unintended acquisition process, while older learners employ more explicit learning strategies, which makes favorable preconditions more crucial (DeKeyser 2000; Abrahamsson 2012).

Our finding of late L2 learners with exceptional outcomes is not cause for rejecting the CPH. Instead, their existence illustrates the need to study the preconditions that are necessary to achieve native-like outcomes among late learners (e.g. Abrahamsson and Hyltenstam 2008). Our results demonstrate that not only individual conditions, like general cognitive skills, matter. Rather, the language environment is also relevant; in contrast to some of the individual factors described in the literature, this environment is subject to change through individual choices. In addition to the two sets of factors investigated here, other characteristics may be relevant as well, like psychological or motivational factors (e.g. Moyer 2014a, 2014b). Future research

could compare the relative importance of such compensatory mechanisms and investigate their potential interplay. Focusing on these questions may help to enhance our understanding of how late language learning may succeed—an issue that is more important now than ever.

Given that the respondents who agreed to be recorded for the accent measure are likely to have a weaker accent than those who did not agree, our results should be treated as conservative estimates. The inclusion of additional respondents with a stronger accent would have increased the stability and hence the statistical significance of our estimators.

The results must be interpreted with the caveat in mind that part of the stimulus material was reading material, and we did not provide an aural presentation of stimulus (cf. Flege *et al.* 2006: 159). Possible reading problems may therefore be confounded with the presence of a foreign accent. However, the results remain largely robust if we use the measurement based on extemporaneous speech or a combined measure (reading and speaking) as a dependent variable.

Another limitation of the current study is that the data do not allow us to disentangle the causal direction between the strength of a foreign accent and the possible compensatory variables. For example, better language skills may increase the chances of having a native partner and of pursuing an upper-secondary degree, and could change the odds of living in certain neighborhoods. Longitudinal data is therefore needed, and the CILS4EU-DE data is a first step in the right direction: the survey will follow respondents for several years, making it possible to determine the causal relationship between the preconditions and consequences of having a foreign accent.<sup>10</sup> This study is therefore an example of how implementing accent measures in large-scale surveys can improve our understanding of (socio-)linguistic processes.

Furthermore, our exposure measure (with the exception of language use within the family) refers to contact with persons without an immigrant background. This can only be a proxy for exposure to the language of the receiving country, which we cannot observe directly for either intimate or casual relationships. It is of course possible that respondents have contact with immigrants who speak the language of the receiving country like a native (i.e. without an accent), although we consider them to be immigrants as well.

Finally, and as already outlined, using the current data with its sample of a specific birth cohort, age of arrival strongly correlates with length of residence in Germany. Therefore, it is unclear whether we really observe an age at arrival effect and not an effect of length of residence. However, given the findings from previous studies of a much stronger effect of age at arrival and a much smaller or non-existent effect of length of residence (Oyama 1976; Granena and Long 2013), we are confident in the results presented here. Additional sensitivity analyses that exploit the slight variation between age at arrival and length of residence (see Appendix A2 in Supplementary Material) further support this confidence. Therefore, we believe our findings support the CPH rather than reflect respondents' difficulties in language acquisition due to differences in the length of residence.

## NOTES

- 1 However, not only age of onset seems to be relevant for achieving native-like language skills, but also length of exposure. The latter is of course connected, but not perfectly correlated with age of onset and seems to have independent effects on language acquisition over and above age of onset (cf. Trofimovich and Baker 2006, 2007).
- 2 Of course, individual and contextual factors are not necessarily independent, as individual characteristics may influence the selection of specific contexts of language acquisition, which in turn may influence individual factors.
- 3 When comparing those who agreed to be recorded to those who refused, it becomes evident that refusing participants tend to be negatively selected on characteristics associated with a stronger accent, that is, those who arrived at later ages, those with a less advantageous social background, those from linguistically more distant countries, etc. (cf. the different variables described in the next section, results of the comparisons of refusals to participants are available upon request).
- 4 Due to the inclusion of a specific birth cohort (birth years 1994–96), there is a strong correlation between age at arrival and length of residence, making it difficult to disentangle effects of both variables. In Appendix A2 of Supplementary Material, we include additional analyses making use of the (slight) variation between both variables, and the general results remain largely stable when including length of residence in the analyses.
- 5 Other cut-off points were tested, but the results remained stable.
- 6 In order to preserve as many cases as possible, we did not disregard respondents who at the moment of interview indicated speaking only German at home. The information about a second language was collected more than 20 years after the language learning process started within the families and it may well be that there was another language in the family at that time. Results remain robust once excluding the third generation from the analyses: this group mostly frequently stated not having any second language spoken in the family.
- 7 We weighted the time spent with families and friends equally in the analyses (50 per cent time spent with family, 50 per cent spent with friends, so that also the language use with family and friends should matter with 50 per cent each). As a robustness check, we also examined whether results change when using a time share of 25 per cent with the family and 75 per cent with friends and vice versa. However, regardless of the specification, results remain largely stable.
- 8 Since ‘immigrant background’ in the contextual data provided by microm is defined by the name of the residents, a person with a German sounding name, which could as well be an Austrian or a Swiss person, will be defined as someone without an immigrant background.
- 9 We can only differentiate between partners with a German, native background and a partner with other backgrounds. Therefore, Austrian or Swiss partners may serve as a source of native-like German language skills, but are counted as ‘non-natives’ when calculating the share of German partners. In a sensitivity analyses, we included all partners with a possible German language background to the group of ‘natives’, and the results still hold.
- 10 However, at least with respect to the possible compensatory effect of high cognitive abilities in reducing a foreign accent, we are more confident about the causal link between both variables. Studies usually find high correlations between cognitive skills measured at several times within the same individual, even at younger ages (Husén and Tuijnman 1991). One may therefore assume that the cognitive skills scores used here are a good proxy for the cognitive skills in earlier years, and therefore contribute to the reduction of a foreign accent rather than being influenced themselves by a reduced foreign accent.

## SUPPLEMENTARY DATA

Supplementary material is available at *Applied Linguistics* online.

## ACKNOWLEDGEMENTS

We would like to thank Ursula Hirschfeld from the University of Halle-Wittenberg for helping us to develop the accent-measure used in this study.

## FUNDING

This research was funded by Deutsche Forschungsgemeinschaft (grant numbers: KA 1602/8-1, KA 1602/8-2, KO 3601/8-1 and KO 3601/8-2); Forskningsrådet om Hälsa, Arbetsliv och Välfärd (grant number: 2012-1741); NORFACE ERA NET Plus Migration in Europe-programme.

## REFERENCES

- Abrahamsson, N.** 2012. 'Age of onset and native-like L2 ultimate attainment of morphosyntactic and phonetic intuition,' *Studies in Second Language Acquisition* 34: 187–214.
- Abrahamsson, N. and K. Hyltenstam.** 2008. 'The robustness of aptitude effects in near-native second language acquisition,' *Studies in Second Language Acquisition* 30: 481–509.
- Abrahamsson, N. and K. Hyltenstam.** 2009. 'Age of onset and nativelikeness in a second language: Listener perception versus linguistic scrutiny,' *Language Learning* 59: 249–306.
- Birdsong, D. and M. Molis.** 2001. 'On the evidence for maturational constraints in second-language acquisition,' *Journal of Memory and Language* 44: 235–49.
- Bley-Vroman, R.** 1989. 'What is the logical problem of foreign language learning?', in S. M. Gass and J. Schachter (eds): *Linguistic Perspectives on Second Language Acquisition*. Cambridge University Press.
- Bongaerts, T.** 1999. 'Ultimate attainment in L2 pronunciation: The case of very advanced late L2 learners', in D. Birdsong (ed.): *Second Language Acquisition and the Critical Period Hypothesis*. Lawrence Erlbaum.
- Bongaerts, T.S. Mennen, and F. V. D. Slik.** 2000. 'Authenticity of pronunciation in naturalistic second language acquisition: The case of very advanced late learners of Dutch as a second language,' *Studia Linguistica* 54: 298–308.
- Bongaerts, T, B. Planken,, and E. Schils.** 1995. 'Can late starters attain a native accent in a foreign language? A test of the critical period hypothesis', in D. Singleton and Z. Lengyel (eds): *The Age Factor in Second Language Acquisition*. Multilingual Matters.
- Bongaerts, T., C. Van Summeren, B. Planken, and E. Schils.** 1997. 'Age and ultimate attainment in the pronunciation of a foreign language,' *Studies in Second Language Acquisition* 19/4: 447–65.
- CILS4EU.** 2016. 'Children of immigrants longitudinal survey in four European countries', *Technical Report, Wave 1-2010/2011, v1.2.0*. Mannheim University.
- DeKeyser, R. M.** 2000. 'The robustness of critical period effects in second language acquisition,' *Studies in Second Language Acquisition* 22: 499–533.
- De Swaan, A.** 2001. *Words of the World. The Global Language System*. Polity Press.
- Dollmann, J., K. Jacob, and F. Kalter.** 2014. 'Examining the diversity of youth in Europe. A classification of generations and ethnic origins using CILS4EU data,' *Mannheimer Zentrum für Europäische Sozialforschung: Working Paper* 156. Mannheim University.
- Flege J. E., D. Birdsong,, E. Bialystok, M. Mack, H. Sung, and K. Tsukada.,** 2006. 'Degree of foreign accent in English sentences produced by Korean children and adults,' *Journal of Phonetics* 34: 153–75.
- Flege, J. E., G. H. Yeni-Komshian, and S. Liu.** 1999. 'Age constraints on second-language acquisition,' *Journal of Memory and Language* 41: 78–104.

- Granena, G.** 2016. 'Cognitive aptitudes for implicit and explicit learning and information-processing styles: An individual differences study,' *Applied Psycholinguistics* 37: 577–600.
- Granena, G. and M. H. Long.** 2013. 'Age of onset, length of residence, language aptitude, and ultimate L2 attainment in three linguistic domains,' *Second Language Research* 29: 311–43.
- Granovetter, M.** 1983. 'The strength of weak ties: A network theory revisited,' *Sociological Theory* 1: 201–33.
- Humpert, A. and K. Schneiderheinze.** 2016. 'Sprachliche Analyse von Personennamen mit dem "Onomastik-Verfahren"', available at: <http://www.stichproben.de/>.
- Husén, T., and A. Tuijnman.** 1991. 'The contribution of formal schooling to the increase in intellectual capital,' *Educational Researcher* 20: 17–25.
- Ioup, G., E. Boustagui, M. El Tigi, and M. Moselle.** 1994. 'Reexamining the critical period hypothesis: A case study of successful adult SLA in a naturalistic environment,' *Studies in Second Language Acquisition* 16: 73–98.
- Kalter, F., I. Kogan, and J. Dollmann.** 2018. 'Children of immigrants longitudinal survey in four European countries—Germany (CILS4EU-DE)—Full version', Data File for On-site Use. GESIS Data Archive, Cologne, ZA6655 Data File Version 3.0.0. doi: 10.4232/cils4eu-de.6655.3.0.0.
- Kalter, F., I. Kogan, and J. Dollmann.** 2019. 'Studying integration from adolescence to early adulthood: Design, content, and research potential of the CILS4EU-DE data,' *European Sociological Review* Advance access: <https://doi.org/10.1093/esr/jcy051>.
- Lenneberg, E. H.** 1967. *Biological Foundations of Language*. Jon Wiley and Sons.
- Marinova-Todd, S. H., D. B. Marshall, and C. E. Snow.** 2000. 'Three misconceptions about age and L2 learning,' *TESOL Quarterly* 34: 9–34.
- Mateos, P.** 2007. 'A review of name-based ethnicity classification methods and their potential in population studies,' *Population, Space and Place* 13: 243–63.
- Mayberry, R. I., and R. Kluender.** 2018. 'Rethinking the critical period for language: New insights into an old question from American Sign Language,' *Bilingualism: Language and Cognition* 21: 886–905.
- Meisel, J. M.** 2009. 'Second language acquisition in early childhood,' *Zeitschrift für Sprachwissenschaft*. 28: 5–34.
- Meisel, J. M.** 2011. 'Bilingual language acquisition and theories of diachronic change: Bilingualism as cause and effect of grammatical change,' *Bilingualism: Language and Cognition* 14: 121–45.
- Microm.** 2017. *Datenhandbuch 2017*. microm Micromarketing-Systeme und Consult GmbH.
- Moyer, A.** 2009. 'Input as a critical means to an end: Quantity and quality of experience in L2 phonological attainment', in T. Piske and M. Young-Sholten (eds): *Input Matters in SLA*. Multilingual Matters.
- Moyer, A.** 2014a. 'What's age got to do with it? Accounting for individual factors in second language accent,' *Studies in Second Language Learning and Teaching*. 3: 443–64.
- Moyer, A.** 2014b. 'Exceptional outcomes in L2 phonology: The critical factors of learner engagement and self-regulation,' *Applied Linguistics* 35: 418–40.
- Muñoz, C.** 2014. 'Contrasting effects of starting age and input on the oral performance of foreign language learners,' *Applied Linguistics* 35: 463–82.
- Nikolov, M.** 2000. 'The critical period hypothesis reconsidered: Successful adult learners of Hungarian and English,' *IRAL-International Review of Applied Linguistics in Language Teaching* 38: 109–24.
- Nikolov, M. and J. Mihaljević Djigunović.** 2006. 'Recent research on age, second language acquisition, and early foreign language learning,' *Annual Review of Applied Linguistics* 26: 234–60.
- Oyama, S.** 1976. 'A sensitive period for the acquisition of a nonnative phonological system,' *Journal of Psycholinguistic Research* 5: 261–83.
- Patkowski, M. S.** 1980. 'The sensitive period for the acquisition of syntax in a second language,' *Language Learning* 30: 449–68.
- Schiel, S., K. Sandbrink, F. Aust, N. Chudziak, and M. Kleudgen.** 2016. *Methodenbericht. CILS4EU-Projekt: CAPI-Befragung Von Jungen Erwachsenen in Deutschland*. Infas Institut für angewandte Sozialwissenschaft GmbH.
- Schnell, R., M. Trappmann, and T. Gramlich.** 2014. 'A study of assimilation bias in name-based sampling of migrants,' *Journal of Official Statistics* 30: 231–49.

- Scovel, T.** 1988. *A Time to Speak: A Psycholinguistic Inquiry into the Critical Period for Human Language*. Newbury House Publishers.
- Southwood, M. H, and J. E. Flege.** 1999. 'Scaling foreign accent: Direct magnitude estimation versus interval scaling,' *Clinical Linguistics & Phonetics* 13: 335–49.
- Sparado, K.** 2013. 'Maturation constraints on lexical acquisition in a second language', in G. Granena and M. Long (eds): *Sensitive Periods, Language Aptitude, and Ultimate L2 Attainment*. John Benjamins.
- Trofimovich, P. and W. Baker.** 2006. 'Learning second language suprasegmentals: Effect of L2 experience on prosody and fluency characteristics of L2 speech,' *Studies in Second Language Acquisition* 28: 1–30.
- Trofimovich, P. and W. Baker.** 2007. 'Learning prosody and fluency characteristics of second language speech: The effect of experience on child learners' acquisition of five suprasegmentals,' *Applied Psycholinguistics* 28: 251–76.
- Weiß, R. H.** 2006. *Grundintelligenztest Skala 2—Revision (CFT 20-R)*. Hogrefe.