

## **Does simultaneous bilingualism support high proficiency in both languages?**

A comparison of bilingual youth from immigrant families with different ages of onset of L2 acquisition to native monolinguals

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### **INTRODUCTION**

One consequence of migration is that children and adolescents hear and speak two languages in everyday life, the majority language in the country in which they live (L2) and their parents' heritage language (L1). Being bilingual offers many advantages. L1 strengthens family relationships, self-confidence and ethnic identity (Oh and Fuligni 2010; Portes and Hao 2002; Tseng and Fuligni 2000). L2, in turn, is central to the integration process, especially to educational and labor market success (Chiswick and Miller 2009; Dollmann and Kristen 2010; Dustmann and Fabbri 2003; Kristen 2008).

Research on bilingualism has not established yet how often immigrants achieve a high proficiency in L1 and L2. A widespread assumption in language acquisition research is that children who are exposed to two languages very early in life can acquire native-like proficiency in both languages, while starting L2 acquisition at an older age significantly reduces the chances to become highly proficient (Esser 2008; Meisel 2013; Tracy 2014). Recent studies comparing bilingually raised children with monolinguals, however, find overwhelmingly that even children that start L2 acquisition very early lag behind monolinguals in the majority language (Bialystok et al. 2010; Hammer et al. 2014; Hoff 2017; Hoff et al. 2012; Hoff and Ribot 2017; Leseman et al. 2009; Pearson, Fernández, and Oller 1993). The few findings from studies comparing children with different ages of onset of L2 acquisition show mixed evidence whether or not an early learning start is advantageous for L2 proficiency (Bedore et al. 2016; Unsworth 2013, 2016; Unsworth et al. 2014).

Considering that bilingualism on a native-like level depends not only on high proficiency in L2 but also in L1, it is surprising that previous research seldom addresses the question of how the age of onset affects the L1. More specifically, what impact the acquisition of a second language in early childhood has for the proficiency in L1. Some findings indicate that, contrary to the assumptions, a later start of L2 acquisition is more positively related to L1 proficiency than an earlier start (Bedore et al. 2016; Bylund 2009; Karayayla and Schmid 2018). This suggests that simultaneous acquisition of both languages may have opposite effects on L1 and L2, making it difficult to become proficient in both languages.

Empirical evidence on these issues is still mixed for several reasons. First of all, most research focuses either on pre-school or primary school-aged children who are still in a crucial phase of language development (Bedore et al. 2016; Bialystok et al. 2010; Hoff et al. 2012, 2014; Leseman et al. 2009; Unsworth 2013, 2016). Hence, these findings inform about trajectories in language development, but not about ultimate attainment. Second, the samples are often small and highly selective, which limits the validity of the results (Hoff et al. 2012, 2014; Leseman et al. 2009; Pearson, Fernández, and Oller 1993; Unsworth 2016). Third, the studies frequently do not control covariates that influence language proficiency, and in which migrant families usually differ systematically, such as the quantity of language input. And fourth, most research focuses only on vocabulary (Bialystok et al. 2010; Hoff et

al. 2014; Hoff and Ribot 2017; Pearson et al. 1993), which is assumed to be less dependent on age of onset than other linguistic phenomena (Meisel 2013; Unsworth 2016).

Against this backdrop, the current study examines (1) whether adolescents from immigrant families who started to acquire their L2 at a very young age are more likely to achieve (simultaneously) higher proficiency in L1 and L2 compared to adolescents who started L2 acquisition at an older age. Secondly, it is of interest (2) whether adolescents with a very young age of L2 acquisition attain the L2 proficiency level of monolingually raised native peers. This paper uses a sample from the National Educational Panel Study (NEPS) to answer these two questions. The sample includes monolingual German-speaking students without an immigration background and bilingual students from migrant families with Russian or Turkish as their L1. The bilinguals started to acquire the L2 in three different periods of childhood. Since the students were on average 15 years old during data collection, better conclusions can be drawn about the ultimate attainment. The L1 is measured by listening comprehension and the L2 by receptive vocabulary and reading comprehension. The inclusion of characteristics that influence language proficiency and in which native monolinguals differ systematically from bilingual migrants as well as L2 learners with different ages of onset should increase the validity of the results.

## **TYPES OF LANGUAGE ACQUISITION**

In L2 acquisition research, three types of language acquisition are differentiated by the age of first exposure. *Simultaneous bilingual* children are exposed to two languages from birth or short after birth. Depending on the research approach, the age range varies from one (Paradis, Genesee, and Crago 2011) to two years after birth (Grimm and Schulz 2012). This type of language acquisition is also called bilingual first language acquisition because there is no L2 in the chronological sense of the word (De Houwer 2005). Successive bilingual children, on the other hand, first acquire the essential grammatical structures of their first language before they learn a second language later in life. These successive L2 learners are often further divided into early and late bilinguals. *Early successive bilingual* children begin to learn their L2 at about three years and *late successive bilingual* children at six years (Grimm and Schulz 2016). The classification of language acquisition types are mainly the result of empirical studies on the course of (second) language development of young bilinguals. Therefore, these age ranges should not be thought of as categorical rather than continuous. They vary slightly between studies on L2 acquisition of young bilinguals depending on the sample and the language phenomenon under study (Grimm and Schulz 2016).

## **GENERAL DETERMINANTS OF L1 AND L2 PROFICIENCY FOR YOUNG BILINGUALS**

To explain the characteristics of the language acquisition process of simultaneous bilingual children versus successive bilingual and monolingual children, it is useful to refer to models of language acquisition. According to these models, the attained language proficiency in L1 and L2 is the result of a series of learning processes over time that are influenced by three parameters: *efficiency*, *exposure*, and *incentives* (Chiswick 1998; Chiswick and Miller 2007; Esser 2006).

*Efficiency* refers to cognitive capacities, i.e., how quickly and effortlessly a person learns a language (Chiswick and Miller 2007). Accordingly, children with more efficient learning processes have advantages in language acquisition. A particularly important factor influencing learning efficiency is the age of onset of language acquisition. Early childhood is considered to be the most effective and efficient phase of language learning (Genesee

2015). Children thus only need access to one or more languages to acquire them largely untutored in implicit learning processes (DeKeyser and Larson-Hall 2005; Meisel 2013). This thinking is primarily based on the hypothesis of a critical period of language acquisition (Lenneberg 1967). According to this hypothesis, the neural plasticity of the brain that is needed to acquire a language successfully is at its highest level in very early childhood. When it decreases with older age, the efficiency of language learning declines. Hence, more explicit and instructed learning processes become necessary, which require more complex cognitive strategies and are more dependent on exogenous factors (DeKeyser and Larson-Hall 2005). Language learners with an older age of onset have still the opportunity to attain a native-like level. However, the learning success among older learners varies considerably and tends to decrease (Bialystok and Hakuta 1999; Johnson and Newport 1989). At which age the language learning capacity declines and whether this decline is linear, monotonous or only discontinuous at a certain age, is still discussed (Esser 2006). Generally, processes related to learning efficiency promote an additive bilingualism with high proficiency in both languages.

*Exposure* relates to the language learning opportunities that individuals encounter in their environment. These can vary according to time units of exposure and exposure per unit of time (Chiswick and Miller 2007: 6). Previous research has already found clear evidence that the amount of input in the social environment is a crucial factor for language proficiency (Hammer et al. 2014; Place and Hoff 2011; Pearson et al. 1997; Thordardottir 2011; Hoff et al. 2012; Gathercole and Thomas 2009). The importance of language input can be explained best by the time-on-task hypothesis which stems from school effectiveness research. According to this hypothesis, the amount of time that an individual actually spends on learning is essential for the learning success (Carroll 1963). Applied to language acquisition, it is the amount of time in which a child receives input in a language that impacts its proficiency (Hopf 2005). However, the time-on-task hypothesis also shows a dilemma with respect to bilingual language acquisition. For bilingual children, the learning time is divided between two languages. Due to time limitations, they consequently receive, on average, less input in both languages compared to children who obtain all their input in just one language. Thus, in contrast to processes related to efficiency which usually benefit both languages, exposure frequently follows a subtractive logic. The few studies that tested this assumption for the learning environment of the family found partly opposing effects of language input on vocabulary knowledge in L1 and L2 (Duursma et al. 2007; Leseman et al. 2009; Scheele, Leseman, and Mayo 2010).

In addition, opportunities for language learning remain not always the same throughout the life span. On the contrary, they continue to change in a path-dependent manner. Pearson (2007: 401) refers to this as the “input-proficiency-use cycle”. According to this self-reinforcing cycle, access to a language is essential for learning to occur. Many learning opportunities lead to higher proficiency, which in turn increases the language use and thus stimulates more input which subsequently promotes further language development. However, when learning opportunities are limited at the start, children are less likely to reach a proficiency level in a language at which they willingly use it. Instead, they switch to the language they are more proficient in, thereby receive even less input in the other language. Thus, they cannot develop higher language proficiency which further restricts their language use. Consequently, the imbalance in L1 and L2 input can increase during the course of childhood and adolescence.

Exposure not only refers to the quantity but also to the intensity and quality of the language input. Accordingly, children are able to learn more at the same time, when the learning opportunities are more cognitively stimulating. Parents with high language skills or higher educated parents using a more elaborate language frequently offer more of such

high-quality input. These types of language sources can help to compensate for a reduced input.

*Incentives* refer to the motivation for learning a language, such as financial benefits by obtaining higher-skilled jobs (Chiswick 1998) or the intention to stay forever in the receiving country (Kristen, Mühlau, and Schacht 2016). In contrast to adult L2 learners who rely more on explicit learning processes, extrinsic motivation plays a minor role for language acquisition in childhood (Esser 2008). Due to the increased efficiency in early childhood, children usually acquire a language as soon as they have sufficient learning opportunities. Their main motive is the communication with the social environment. Thus, they do not need to be motivated by other external factors. During the following developmental stages, however, peers, friends, siblings or parents can also add or subtract value to a language (Pearson 2007).

## **AGE OF ONSET AND CONSEQUENCES FOR L1 AND L2**

The language acquisition of simultaneous and successive bilingual youth from migrant families varies systematically in terms of the three mechanisms just described: efficiency, exposure and incentives.

As outlined above, simultaneous and successive bilinguals differ regarding their age of onset. First of all, this influences L2 proficiency because it affects the efficiency of the learning process. Simultaneous bilinguals are in a particularly advantageous situation because they begin to acquire both languages during the most efficient phase. According to the critical period hypothesis, this highest level of efficiency increases the chance to achieve native-like proficiency in L1 and L2 (Meisel 2013). However, the older the age of onset, the more the learning success varies. For instance, crucial windows of opportunities for morphosyntax possibly close before the age of four (Meisel 2013). The successive bilinguals thus already begin their L2 acquisition at a slightly less efficient age. It can be assumed that this delay will penalize them in their L2 proficiency as compared to simultaneous bilinguals.

Secondly, simultaneous and successive bilinguals differ in terms of the length of exposure to L2 which is longer when L2 acquisition starts at an earlier age (Genesee 2015). An early successive bilingual child who is exposed to L2 for the first time at the age of three lags behind three years of language input in contrast to a simultaneous bilingual child. A late successive bilingual child must catch up at least six years of missed input to receive the amount of language input of a simultaneous bilingual child. A longer duration of exposure thus additionally improves simultaneous bilinguals' conditions for a higher L2 proficiency compared to successive bilinguals.

The age of onset of L2 acquisition also has consequences for the L1. An earlier exposure to L2 reduces the duration in which a child lives in an environment where it only hears the L1. Simultaneous bilinguals thus already receive a diminished amount of L1 input short after birth compared to successive bilinguals. Hence, the older the children's age at which L2 acquisition begins, the longer they have unlimited exposure to L1. Subsequently, successive bilingual children might profit in their L1 from the longer duration in a L1-only environment, and therefore, develop higher L1 proficiency than simultaneous bilinguals.

In addition, the age of onset probably has long-term consequences for proficiency in L1 and L2. Most importantly because age of onset conditions the amount of language input a child receives across the life course (Flege 2018, 2008; Pearson 2007). For example, earlier exposure to L2 promotes L2 skills that, in turn, facilitate access to L2 environments very early in life. These environments, like friends of the majority society, offer many learning

opportunities in L2 to further improve the language skills. On the contrary, children who start to acquire L2 at an older age, tend to prefer contacts to peers of the same heritage language, with whom they can use their L1. The underlying assumption is that a very early age of L2 acquisition additionally suppresses the already reduced L1 input over the years from childhood to adolescence and thus further expand the L2 input compared to an older age of L2 acquisition (Bedore et al. 2016). Due to those stepwise changes in the amount of input simultaneous bilinguals could develop higher L2 but lower L1 proficiency than successive bilinguals.

Concerning the motivation to acquire L1 and L2, social contacts might play a role since they tend to become increasingly oriented towards one's language preferences. Thus, social relationships could positively reinforce language preferences. Considering the former arguments, simultaneous bilinguals are more likely to favor L2 than successive bilinguals, while the opposite pattern should be evident for L1. As a consequence, social contacts could increase already existing imbalances in the amount of input, and subsequently, encourage simultaneous bilinguals to develop lower proficiency in L1 but higher proficiency in L2 than successive bilinguals.

Taken together, it is expected that a very early age of onset provides better conditions regarding learning efficiency and length of L2 exposure, but less favorable conditions for the amount of L1 input, since it is reduced earlier in life. Accordingly, simultaneous bilinguals should have strong advantages to acquire high L2 skills, while at the same time should have slight disadvantages to acquire high L1 skills compared to successive bilinguals. As a long-term effect of a very early age of L2 acquisition, simultaneous bilinguals probably encounter more L2 but less L1 input in their social environment than successive bilinguals. These differences in the amount of input are likely to enhance the subtractive pattern that simultaneous bilinguals exhibit higher L2 proficiency and lower L1 proficiency than successive bilinguals. The described differences should be more pronounced for late than for early successive bilinguals.

## **DIFFERENCES TO MONOLINGUALS**

If the conditions of simultaneous bilinguals generally promote high L2 proficiency, the question arises whether and why their languages skills still differ from monolinguals that could penalize them in the (second) language acquisition process. Clearly, no difference emerges regarding the age of onset. Simultaneous bilinguals start to acquire the majority language at the same age and at the same period of highest efficiency as monolinguals.

However, they differ with respect to exposure to the majority language. To be more specific, the *amount of input* varies between simultaneous bilinguals and monolinguals. While simultaneous bilinguals acquire two languages (relatively) simultaneously, they receive less input in each language as compared to monolinguals who receive all the input in just one language. Recent findings support the assumption that it makes a difference for bilinguals whether the input is 50 or 100% in one language in order to attain the language skills of monolinguals (Hoff and Ribot 2017). Consequently, a reduced input could be of great disadvantage in the language acquisition process for simultaneous bilinguals. On the other hand, some of the evidence argues for a threshold, according to which a reduced input of 40 to 60% in each of the two languages is sufficient to reach the proficiency level of monolinguals (Thordardottir 2011; Cattani et al. 2014). It is assumed that when the threshold of 40 to 60% input is reached, a saturation effect occurs which does not necessarily lead to further learning processes. If this argument applies, the reduced L2 input would be of no or only of small disadvantage for simultaneous bilinguals.

Further differences emerge because bilingualism is mainly an immigrant phenomenon. Hence, the majority of bilingual children live in migrant families which differ primarily in *quantity and quality of exposure* to monolingual children in native families. First, this is due to the socioeconomic background (SES), which is a broader term for the economic, cultural and educational resources available in the families. Studies show clear evidence that these family resources play an essential role in the language development of children (Hart and Risley 2003; Hoff 2003; Rowe, Raudenbush, and Goldin-Meadow 2012; Huttenlocher et al. 2010; Aikens and Barbarin 2008). The mechanism by which family resources influence language acquisition is the home learning environment. Children from high-SES families usually receive more extensive and cognitive stimulating input that accelerates language acquisition compared to low-SES families. Research shows that better educated mothers speak more frequently to their children, using a greater syntactic complexity of speech and a greater variety of words (Hoff 2003; Hoff-Ginsberg 1991; Hart and Risley 2003). Learning activities such as joint book reading (Hoff-Ginsberg 1991) are also less common in households with lower SES (Yarosz and Barnett 2001; Willard et al. 2015; Kloosterman et al. 2011). In Germany, great disparities exist between immigrant families and non-immigrant families in the distribution of economic, cultural and educational resources (Gebhardt et al. 2013). The reason is a selective migration of individuals with lower educational and occupational qualifications. It is a well-established finding in educational research that the fewer learning-related resources in migrant families greatly contribute to the lower L2 proficiency of bilinguals in comparison to monolinguals (Stanat, Rauch, and Segeritz 2010; Becker 2011).

*Second*, parents in migrant families usually differ from parents in native families in their language skills because due to their immigration they mostly have to learn the majority language as late L2 learners by themselves. Thus, frequently they are less proficient in the L2 as compared to parents in native families who acquired the majority language as their L1 in childhood. Studies support the assumption that non-native speakers are a less high-quality source of language input in the L2 than native speakers (Place and Hoff 2016, 2011). Since simultaneous bilinguals usually do not have two native-speaking parents like monolingual children, this should hamper the L2 development of bilinguals compared to monolinguals.

According to these expectations, the very early age of onset has a positive effect on the L2 proficiency of simultaneous bilinguals, due to the longer duration of exposure and the onset of L2 acquisition in a highly efficient phase. In contrast to successive bilinguals, they should therefore be able to narrow the gap to monolinguals. However, simultaneous bilinguals from migrant families still are confronted with less favorable conditions than native monolinguals, especially in the quantity and the quality of input. These differences should be decisive for the fact that even simultaneous bilinguals cannot completely close the gap to monolinguals.

## DATA AND METHODOLOGICAL APPROACH

### Study design and sample selection

The current study draws on data from the National Educational Panel Study (NEPS). The NEPS is a nationwide study conducted in Germany that provides longitudinal multi-level data for different age cohorts ranging from infancy to adulthood (Blossfeld, Roßbach, and von Maurice 2011). To investigate the effect of age of onset on L1 and L2 proficiency, I use the data of the ninth grade students of starting cohort 4<sup>1</sup> and apply a cross-sectional design. Due to the time consuming testing and questioning, the NEPS collected the data of

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<sup>1</sup> doi:10.5157/NEPS:SC4:9.1.0

the ninth graders in two waves with a short in-between time span of approximately six months. In wave 1 that took place in fall/winter 2010-11 the students participated in a test of receptive vocabulary in German and filled out a questionnaire. In wave 2 in spring 2011, the ninth graders completed tests of general cognitive ability and German reading comprehension. An immigrant subsample of students with at least one parent or two grandparents born in Turkey or the area of the former Soviet Union and with a basic level of Russian or Turkish proficiency was additionally assessed in Russian or Turkish listening comprehension. All tests were conducted in a group setting.

The NEPS applied a stratified random sampling of regular schools using school type as a stratification factor. Within each of the selected schools, all students from two randomly chosen ninth grade classes were invited to participate in the study (Aßmann et al. 2011). For the bilingual sample in this study, I use data from students who completed the Russian or the Turkish listening comprehension test in wave 2. In the German monolingual sample, I include students who participated in wave 1 and 2, had no migration background and were living in a monolingual home environment. In general, cases with item-nonresponse were excluded from the sample. However, the variable of parents' educational qualification had by far the highest share of missing values. Excluding these cases would have reduced the sample size considerably and therefore would have slightly changed the results. Therefore, I added a "missing information" category to the education variable and kept cases with only missing information on the parents' education in the dataset (see Table 1).

In total, the sample in this study ( $N = 6895$ ) consists of 6057 German monolinguals with two native parents and 365 Russian-German and 473 Turkish-German bilinguals from immigrant families, who learned Russian or Turkish as their first language (L1) and German as their second language (L2). The bilingual sample can be further divided into three groups based on their age of onset. The Russian sample comprises 124 simultaneous, 139 early successive, and 102 late successive bilinguals. The Turkish sample includes 242 simultaneous, 191 early successive, and 40 late successive bilinguals (see Table 1).

## Instruments

**Dependent variables.** As an indicator of German language proficiency of ninth grade students, I use reading comprehension and receptive vocabulary.

*L2 reading comprehension.* The NEPS assesses German reading comprehension at the text-level in line with the literacy concept (OECD 2009). The test includes five written stimulus texts of different text types (i.e., an information text, a commenting text, a literary text, an instruction text, and an advertising text) containing 204 to 537 words. To ensure a culture fair test, the texts are specifically designed to be independent of students' prior knowledge and therefore focus on general world knowledge excluding technical terms. Students read the texts and subsequently answer five to seven questions about each text resulting in a total of 31 items. The three main tasks of the questions are (1) to find information in the texts, (2) to draw text-related conclusions as well as (3) to reflect and assess the form or the underlying content of the text. The questions are mostly in a multiple-choice format with four response options. In addition, students have to answer decision-making questions for which they have to judge whether a statement is true or false according to the text or they have to answer matching questions, which, for instance, require students to choose a title for a specific text section (Gehrer et al. 2012, 2013). Students' responses are scaled with item-response theory techniques (IRT) using a partial-credit model that yield estimates of students' German reading comprehension as weighted likelihood estimates (WLE).

*L2 receptive vocabulary.* German receptive vocabulary is used as an indicator of L2 listening comprehension, since the NEPS data provide no German listening comprehension test.

The NEPS assesses receptive vocabulary using a German version of the Peabody Picture Vocabulary Test (Dunn and Dunn 2004) based on the US version of the PPVT-III (Dunn and Dunn 1997). The test consists of 89 multiple-choice items, which require the students to select the correct picture for each word that was spoken aloud by the interviewers from a set of four pictures. The sum of the correct answers can range from 0 to 89.

*L1 listening comprehension.* Since no standardized test instrument was available for measuring the Russian and Turkish language abilities, the NEPS developed a listening comprehension test. The decision to focus on listening comprehension was motivated twofold: first, the time limits during the data collection forbid multidimensional testing. Therefore a comprehensive measure had to be chosen; second, testing the more common reading competence was improper for children of immigrants who learn their first language more often as a spoken than a written language. Thus, students with lower levels of L1 proficiency would have been excluded from the testing. During the construction of the listening comprehension test, the NEPS team consulted with experts of the Russian and Turkish language and conducted an extensive pilot study. The following Russian and Turkish listening comprehension test comprised seven independent texts with varying difficulties that include 97 to 156 words. The texts consist of two dialogues, three expository texts, and two narrative texts that were audio-recorded from native speakers on CD. Consistent with the L2 test, the text design ensures that no prior knowledge influences the probability to answer the questions of the texts correctly. Each text is presented via CD player just once to the students before they must answer three to six multiple choice questions, each with four or five response options resulting in a total of 31 items. The Russian and the Turkish test are equivalent in the instructions, the text contents, the questions, and the response options. However, in the data analysis only configural, but no strict statistical equivalence could be reached. This limitation is one of the reasons for scaling the Russian and the Turkish test separately with one-parameter logistic models (Rasch models). The scaling procedure yield weighted likelihood estimates (WLE) that represent students' Russian or Turkish listening comprehension (Edele, Schotte, and Stanat 2015).

**Independent variables.** The NEPS measures the *age of children's first exposure* to German by a categorical variable with five response options. Due to the sample size, I distinguish three age ranges: null to two years old (i.e., simultaneous bilinguals), three to five years old (i.e., early successive bilinguals), and six years or older (i.e., late successive bilinguals). The first exposure to German for monolinguals is generally still before birth or at birth. Thus, I added a monolingual reference category to the analyses regarding the monolingual-bilingual comparison.

Three indicators of the educational and cultural *resources of the family* are included in the analyses. As the first indicator, I use the highest educational qualification of the father or the mother. I distinguish between a low, middle and high educational level of the parents. "Low-level" refers to no educational degree, primary education or lower secondary education with a maximum of nine years of schooling, "middle-level" means an upper secondary education with 10 to 11 years of schooling, and "high-level" relates to post-secondary and tertiary education with at least 12 years of schooling. For the students with missing information, I added a fourth "missing information" category. A second indicator is the number of books available at home. The 6-point scale ranges from 1 (= none to 10 books) to 6 (= more than 500 books). Cultural possessions are the third indicator for the family resources. It is assessed with three items that ask whether or not the students' have books of poems, classic literature, and works of art in their home. A mean value is computed for the three dichotomous items leading to a 4-point scale ranging from 0 (none of the cultural possessions at home) to 1 (all three of the cultural possessions at home).

As a measure of the *quality of language input*, I use a variable indicating whether one of the parents is a “German native speaker” (= 1) or “not” (= 0). Language use is probably the most important factor for the *amount of language input*. The students’ questionnaire provides three indicators of students’ language use patterns. A first indicator is the language spoken with mother, father, and siblings in the family. A second indicator is the language use with peers assessed by language patterns with the best friend and the classmates. The third indicator is the language of media consumption measured by seven items like reading newspapers, watch programs on TV or surf the Internet. Each of the language use questions had a 4-point response scale ranging from “only the other language” (= 1) to “only German” (= 4). Mean values were computed for the respective items of each of the three language use indicators. Since a high share of migrants at school usually enhances the opportunities to use the L1, while reduces the L2 use, I included the variable as a further indicator of input quantity. In the NEPS the students were asked how many of their classmates had an immigration background. The 7-point response scale ranges from “none of them” (= 1) to “all of them” (= 7).

**Control variables.** In the current study, all multivariate models include three control variables related to language learning efficiency: gender, school track, and general cognitive abilities. According to the current state of research, females, better educated, and individuals with higher cognitive abilities tend to be more efficient language learners (Andringa et al. 2012; Kristen, Mühlau, and Schacht 2016). *Gender* is coded 1 for females and 0 for males. *School track* distinguishes whether the students attended the highest track leading to a university entrance degree (“Gymnasium”), an intermediate track (“Realschule”), a comprehensive school track (“Gesamtschule”), a school with several educational tracks (“Schule mit mehreren Bildungsgängen”) or the lowest track of the German secondary school system (“Hauptschule”). The *general cognitive ability (reasoning)* was assessed with the NEPS-MAT (Lang et al. 2014), a 12-item nonverbal reasoning test that consists of matrices comparable to the RAVEN test (Standard Progressive Matrices SPM-C; Raven 1977). The correct answers are summed up and can range from 0 to 12. In multivariate models that only involve bilinguals from immigrant families, I also control for the *immigrant generation*, since being born in the country of origin considerably delays the first exposure to the second language and serves as a proxy for the integration process. In the current sample, I divide between students born abroad (i.e., first generation) and students born and raised in Germany (i.e., second or third generation).

## Analyses

To explore the assumptions of the current study, I employ mean comparisons and ordinary least square (OLS) regression analyses using Stata 14 (StataCorp 2014). All analyses are conducted separately for the Russian-German and the Turkish-German sample.

The first set of OLS regression models addresses the relation between age of onset of L2 acquisition and proficiency in L1 and L2 in the bilingual sample. Based on the raw model (Model 1), which only includes age of onset, the base model (Model 2) identifies the effect of age of onset on the L1 and L2 when gender, school track, general cognitive abilities, and immigrant generation is controlled. When an earlier L2 acquisition promotes high L2 skills but hinders high L1 skills, there should be opposing effects of age of onset on L1 and L2 proficiency. The input quantity model (Model 3) adds indicators of current amount of L2 input to the analysis. In case simultaneous bilinguals encounter more L2 dominant language environments, the effects of age of onset should decrease in the input quantity model. This indicates how much of the advantages of simultaneous bilingualism are due to the language input patterns in the social environment and how much is due to the age of onset.

The second set of OLS regression models addresses the monolingual-bilingual gap in L2 proficiency in the total sample. The base model (Model 1) examines the effect of the age of onset of bilinguals compared to monolinguals (as reference category) when gender, school track, and general cognitive abilities are controlled. Subsequently, indicators of family resources (Model 2), input quality (Model 3) and input quantity (Model 4) are added to the base model. The full model (Model 5) finally comprises all covariates of the Models 2 to 4. When these other relevant factors of language learning, in which monolinguals and bilinguals mostly differ, are taken into account in Model 2 to 5, the extent of the difference to monolinguals should decline in all age of onset groups. In case there is a benefit for simultaneous bilinguals to achieve L2 proficiency on a monolingual level due to a maximum efficiency at the start of L2 acquisition and a longer duration of exposure, the differences between simultaneous bilinguals and monolinguals in L2 proficiency should become insignificant or at least be considerably smaller than those between successive bilinguals and monolinguals.

To address the multilevel data structure with students clustered in schools and in classes, I estimated robust standard errors in the regression analyses (Huber 1967; White 1982). The OLS regression analyses are estimated without weights. The reported results are robust between weighted and unweighted datasets. The descriptive results are adjusted for information coming from different strata with design weights (Abmann et al. 2011). For a better interpretation of the mean comparison of the L1 and L2 tests in the first part of the analysis, the test scores were z-standardized separately for the Russian and the Turkish sample. For all other analyses, I z-standardized the L2 test scores over the total sample and the L1 test scores separately for the Russian and the Turkish sample. The mean of the z-transformed tests is 0. A student's score value indicates how many standard deviation units a student differs from the mean of the reference group (i.e., Russian/Turkish or total sample).

## RESULTS

### Descriptive sample statistics

All variables and their weighted distribution for the three language groups are summarized in Table 1. A comparison of parents' highest education, the number of books and cultural possessions reveals that monolinguals possess the most family resources followed by Russian-German bilinguals. However, the language use pattern is slightly different to the literature (Strobel and Seuring 2016; Gebhardt et al. 2013). In the current sample, Turkish-German bilinguals use German more frequently with family members and for media consumption and live more often in families with a German native speaker than Russian-German bilinguals. The higher share of first-generation immigrants in the Russian-German sample might be the reasons for this unexpected pattern.

**Table 1.** Descriptive statistics of model variables (means and percentages)

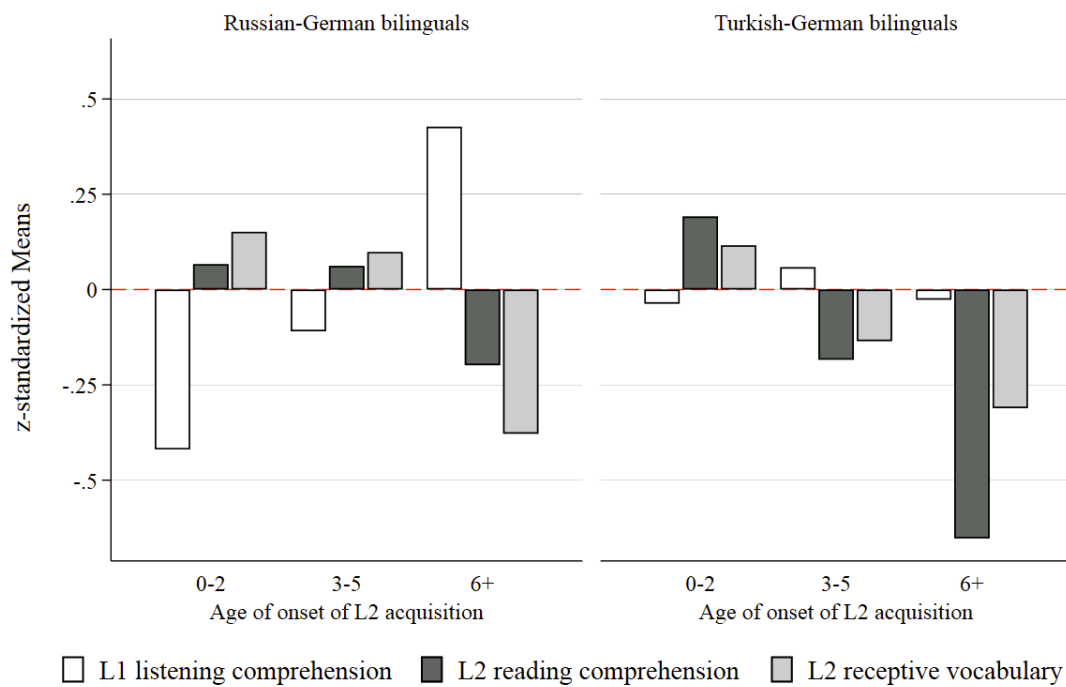
	Russian-German bilinguals			Turkish-German bilinguals			German monolinguals	
	MN/ %	SD	Range	MN/ %	SD	Range	MN/ %	SD
<i>Z-standardized on L1 sample</i>								
L1 listening comprehension	-0.07	1.0	-2.45–3.52	0.00	1.0	-3.50–2.90	—	—
L2 receptive vocabulary	-0.01	1.0	-2.82–3.36	-0.02	1.0	-2.32–3.83	—	—
L2 reading comprehension	-0.01	1.0	-2.57–2.78	-0.03	1.0	-2.73–2.87	—	—
<i>Z-standardized on total sample</i>								
L2 receptive vocabulary	-0.71	1.0	-3.06–2.60	-1.39	1.0	-3.00–2.60	0.12	0.9
L2 reading comprehension	-0.49	0.9	-3.22–2.03	-0.92	0.9	-4.21–1.63	0.06	1.0
Age of L2 onset (Ref. 0-2)	0.35	—	—	0.50	—	—	—	—
3-5	0.37	—	—	0.41	—	—	—	—
+6	0.28	—	—	0.08	—	—	—	—
Parents' education (Ref. No degree/low-level)	0.06	—	—	0.39	—	—	0.10	—
Middle-level	0.40	—	—	0.21	—	—	0.32	—
High-level	0.24	—	—	0.14	—	—	0.44	—
Missing information	0.29	—	—	0.26	—	—	0.14	—
Number of books	3.12	1.3	1–6	2.87	1.2	1–6	4.05	1.4
Cultural possession	0.49	0.3	0–1	0.45	0.3	0–1	0.58	0.4
L2 use in family	2.60	0.8	1–4	2.54	0.6	1–4	4.00	0.0
L2 use with peers	3.57	0.6	1–4	3.36	0.7	1–4	4.00	0.0
L2 use for media consumption	3.57	0.5	1–4	3.28	0.6	1–4	4.00	0.0
Migrants in school	3.78	1.0	1–7	4.15	1.2	1–7	3.07	1.0
Parent L2 native speaker (Ref. No)	0.23	—	—	0.34	—	—	1.00	—
Born in Germany (Ref. Born abroad)	0.48	—	—	0.89	—	—	1.00	—
General cognitive ability	8.38	2.3		7.36	2.5		9.07	2.2
School track (Ref. Lowest)	0.36	—	—	0.44	—	—	0.17	—
Several tracks	0.05	—	—	0.04	—	—	0.09	—
Intermediate	0.33	—	—	0.25	—	—	0.27	—
Comprehensive	0.05	—	—	0.11	—	—	0.07	—
Highest	0.21	—	—	0.17	—	—	0.41	—
Female	0.53	—	—	0.53	—	—	0.52	—
<i>N</i>	365			473			6057	

*Note:* Weighted percentages. Number of cases is reported regarding absolute observations. Due to rounding the total percentages might deviate from 100%. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post-secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium.

### Relation of age of onset to L1 and L2 proficiency

To answer the first question whether early exposure increases the likelihood for bilinguals to acquire not only a higher proficiency in L2 but also in L1, I focus on the age of onset in the bilingual sample. Figure 1 shows the means of L1 listening comprehension, L2 reading comprehension, and L2 receptive vocabulary for Russian-German and Turkish-German bilinguals by their age of L2 acquisition. The language proficiency measures are *z*-standardized on the Russian and the Turkish sample thus the data display no absolute but relative values for the three age groups.

**Figure 1.** Means of L1 and L2 proficiency for Russian-German and Turkish-German bilinguals by age of L2 acquisition



Note: Russian-German bilinguals: N = 365, Turkish-German bilinguals: N = 473, weighted means. The dashed red line represents the z-standardized means of the respective bilingual group.

Consistent with the assumptions, the data reveal that starting the L2 exposure between birth and the age of two promotes L2 acquisition, especially compared to late successive bilinguals (i.e., age of onset: 6+ years), but renders it difficult for the Russian-German bilinguals to develop a high L1 proficiency. Surprisingly, L1 listening comprehension seems to be unrelated to the age of L2 acquisition for the Turkish-German bilinguals, since it is around the mean in all age groups.

### Age of onset and current amount of input

To further investigate the observed differences in L1 and L2 proficiency by age of onset in both samples, I conduct regression analysis. The coefficient plots in Figure 2 are based on the results of a series of regression models, illustrating unstandardized regression coefficients and 95%-confidence intervals of the effect of age of onset on L1 listening comprehension, L2 reading comprehension, and L2 receptive vocabulary in the Russian- and Turkish-speaking group (see Appendix: Table 1 – 3 for more detailed results). I use simultaneous bilinguals who began to acquire the L2 between birth and the age of two as reference category in all analyses.

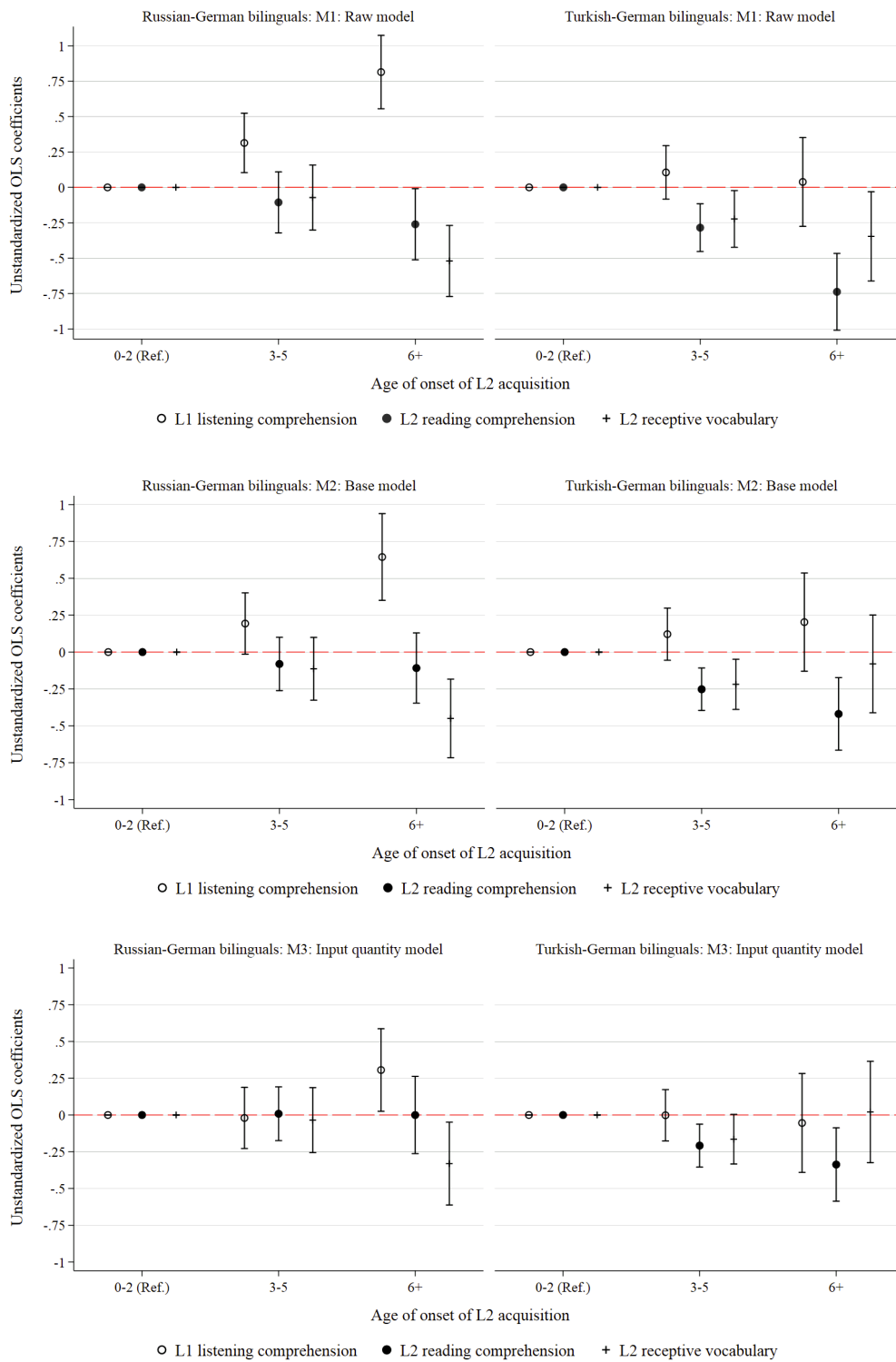
In a first step, I test whether the observed opposing effects of age of onset on L1 and L2 proficiency in Figure 2 are statistically significant by using bivariate regression models that include age of onset as sole predictor of L1 and L2 proficiency. The *raw models* confirm that age of onset of L2 acquisition is significantly related to L1 listening comprehension only in the Russian sample. This means that Russian-German bilinguals who are first exposed to L2 after the age of two tend to have a higher listening comprehension in Russian than simultaneous bilinguals (i.e., age of onset: 0-2 years). The age of first exposure is also significantly associated with L2 proficiency, however in the opposite direction. In the Turkish sample, simultaneous bilinguals score significantly higher than early and late

successive bilinguals in German reading comprehension and receptive vocabulary. In the Russian sample, simultaneous bilinguals outperform late successive bilinguals but not early successive bilinguals in both L2 tests. As expected, the differences are more pronounced for late (age of onset: 6+ years) than early (age of onset: 3-5 years) successive bilinguals in both language groups. Taken together, the raw models also support the assumption that an older age of onset has a positive effect on L1 proficiency and a negative effect on L2 proficiency.

In a second step, I examine how much of the age of onset effects are due to differences in the current amount of input between simultaneous and successive bilinguals. Therefore, I use the base models and quantity input models. The *base models* include control variables and age of onset as predictor of L1 and L2 proficiency. The control variables are significantly related to L1 and L2 proficiency. Females are more likely to score higher on the L1 listening comprehension test and the L2 reading comprehension tests, except in the Russian sample on L2 reading comprehension. However, in the receptive vocabulary tests the male students outperform the female students. In addition, students with higher general cognitive abilities, and students who attend higher school tracks are more proficient in L1 and L2 in both samples. These results support the assumption, that factors enhancing learning efficiency mostly promote an additive bilingualism. Moreover, students who are first-generation immigrants tend to have higher L1 listening comprehension only in the Russian sample. No significant effect of the immigrant generation is found for L2 proficiency. In comparison to the raw model, the effects of age of onset are reduced by the control variables, especially for the late successive bilinguals. Thus, some of the differences by age of onset are not statistically significant anymore. However, the Russian-speaking simultaneous bilinguals still score significantly lower on L1 listening comprehension and higher on L2 vocabulary than late successive bilinguals. Similarly, Turkish-speaking simultaneous bilinguals still outperform early and late successive bilinguals in both L2 tests, except of late successive bilinguals in the L2 vocabulary test. Hence, the age of onset of L2 acquisition further contributes to the prediction of L1 proficiency in the Russian sample, and L2 proficiency in both samples.

In the *input quantity models*, indicators for students' amount of current German input are included in the analysis. The effect of age of onset on L1 listening comprehension in the Russian sample remains significant but sharply declines, indicating that most of the difference in L1 proficiency between simultaneous and late successive bilinguals is related to varying language input. However, age of onset still contributes to the prediction of L1 listening comprehension. A similar pattern emerges for L2 reading comprehension. Including the amount of language input in the analysis reduces the effect of age of onset in the Turkish sample, especially for late successive bilinguals, although the age of L2 acquisition continues to significantly predict L2 reading comprehension. The results are slightly different for vocabulary knowledge in L2. As the data reveal, the only significant difference between simultaneous and early successive bilinguals in the Turkish sample can be fully explained by the varying amounts of language input the adolescents receive. In the Russian sample the differences between simultaneous and late successive bilinguals can be strongly reduced by taking into account the current amount of L2 input. Taken together, these results support the assumption that many of the differences, especially between simultaneous and late successive bilinguals, can be attributed to different language environments. However, an older age of onset still has a positive effect on L1 proficiency in the Russian sample, and negative effects on L2 proficiency in both samples, when the amount of language input is controlled.

**Figure 2.** Coefficient plots for the effects of age of onset on L1 and L2 proficiency of Russian-German and Turkish-German bilinguals



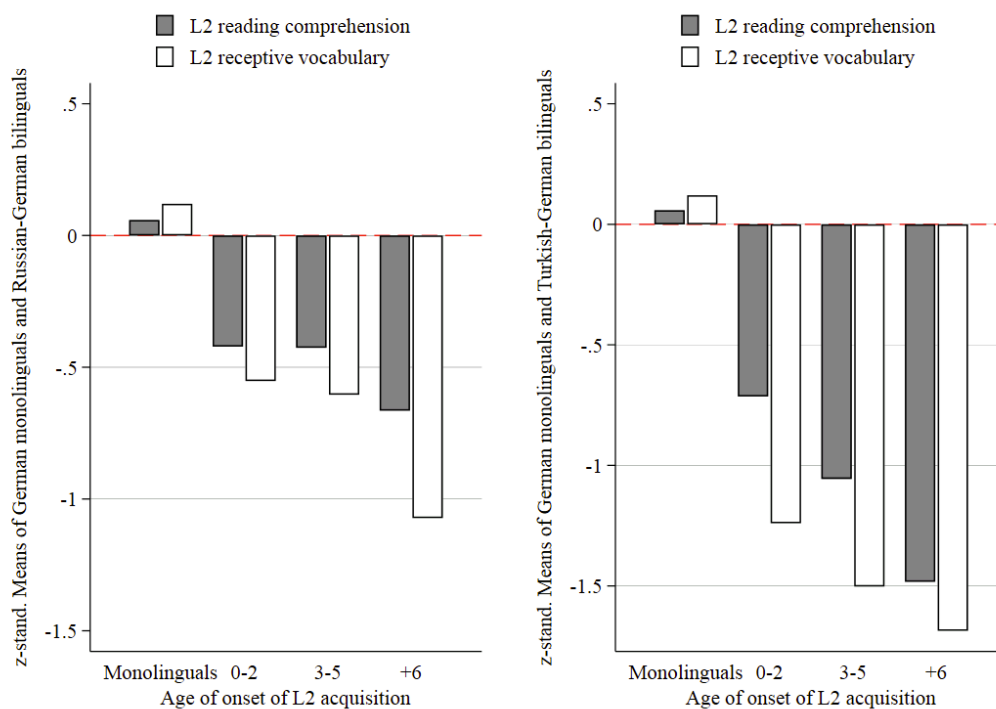
*Note:* Figure shows unstandardized coefficients and 95%-confidence intervals. Base models control for gender, school track, general cognitive abilities, and immigrant generation. Input quantity models additionally control for parents' education, number of books, cultural possession, share of migrants at school, language use in the family, with peers and for media consumption. Russian-German bilinguals: N = 365 (Adj. R<sup>2</sup>: Listening comprehension: M1 = .10, M2 = .28, M3 = .36; Reading comprehension: M1 = .01, M2 = .36, M3 = .37; Receptive vocabulary: M1 = .04, M2 = .31, M3 = .32), Turkish-German bilinguals: N = 473 (Adj. R<sup>2</sup>: Listening comprehension: M1 = .00, M2 = .12, M3 = .19; Reading Comprehension: M1 = .05, M2 = .34, M3 = .34; Receptive Vocabulary: M1 = .01, M2 = .29, M3 = .30). The dashed red line represents the reference category of simultaneous bilinguals with an age of onset between birth and two years.

The results of the control variables are equal to the base models. Regarding the variables on language input, most of the findings are as expected. The frequent use of L2 with family members and for media consumption is negatively associated with L1 listening comprehension in both bilingual samples. In the Russian sample, a lower share of migrants in the students' school is also negatively related to listening comprehension in L1. In contrast to L1 proficiency, L2 use is positively associated with L2 reading comprehension. In the Turkish sample it is the language use with peers, in the Russian sample it is the language use with family members that significantly contributes to higher reading comprehension in German. Unexpectedly, none of the L2 input variables are significantly correlated to L2 receptive vocabulary in both language groups. Consequently, the use of the majority language with family members in the Russian sample is the only subtractive pattern of language input for L1 and L2 proficiency I found.

### Monolingual-bilingual gap in L2 proficiency

To address the second question whether very early exposure helps to close the gap in L2 proficiency to native monolinguals, I compare the L2 proficiency of bilinguals with different ages of onset to monolinguals. I start with Figure 3 that compares the means of L2 reading comprehension and L2 receptive vocabulary of German monolinguals to Russian-German and Turkish-German bilinguals with different ages of onset. Consistent with previous research, there is a profound L2 proficiency gap between monolinguals and bilinguals in reading comprehension and vocabulary (Hoff and Ribot 2017; Hoff et al. 2012; Leseman et al. 2009; Pearson, Fernández, and Oller 1993). This gap is larger for the Turkish sample than for the Russian sample. However, the earlier the students were exposed to L2 the more the language gap decreases, indicating the expected age of onset effect.

**Figure 3.** Means of L2 proficiency of monolinguals compared to Russian-German and Turkish-German bilinguals with different ages of L2 acquisition

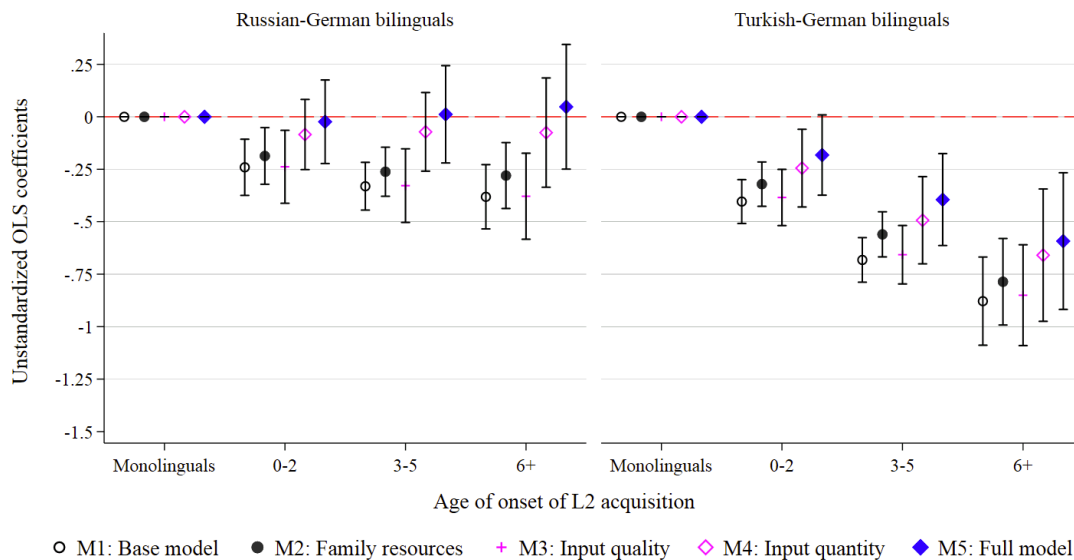


Note: German monolinguals: N = 6057, Russian-German bilinguals: N = 365, Turkish-German bilinguals: N = 473, weighted means. The dashed red line represents the z-standardized means for the total sample.

## Age of onset and differences between bilinguals and monolinguals

Figure 3 does not take into account that family resources, input quality, and input quantity might vary between monolinguals and bilinguals. Before concluding that a very early age of onset can narrow the gap to monolinguals' L2 proficiency, it is important to control for these factors. The coefficient plots in Figure 4 display the results of five OLS models, showing unstandardized regression coefficients and 95%-confidence intervals of the age of onset effect on L2 reading comprehension for both bilingual groups compared to German monolinguals as the reference category (see Appendix: Table 4 – 5 for more detailed results).

**Figure 4.** Coefficient plots for the effects of age of onset on L2 reading comprehension of Russian-German and Turkish-German bilinguals compared to monolinguals



*Note:* Figure shows unstandardized OLS coefficients and 95%-confidence intervals. German monolinguals: N = 6057, Russian-German bilinguals: N = 365 (Adj. R<sup>2</sup>: Model 1 = .30, Model 2 = .32, Model 3 = .30, Model 4 = .30, Model 5 = .32). Turkish-German bilinguals: N = 473 (Adj. R<sup>2</sup>: Model 1 = .33, Model 2 = .35, Model 3 = .33, Model 4 = .33, Model 5 = .35). The dashed red line represents the monolingual reference category.

The *base model* includes the age of onset and the control variables. The results resemble Figure 3. Bilingual students score significantly lower on the reading comprehension test than monolinguals. In line with the assumptions, however, the gap to monolinguals is smaller for simultaneous (i.e., age of onset: 0-2 years) than successive bilinguals in both language groups. The effects of age of onset on L2 reading comprehension are moderate (> 0.2 SD) in the Russian sample and moderate (> 0.3 SD) to large (> 0.8 SD) in the Turkish sample. The control variables gender, school track and general cognitive abilities are significantly related to L2 reading comprehension. Female students, students attending a higher school track and students with higher general cognitive abilities score higher on the L2 reading comprehension test in both samples. The *second model* additionally controls for the indicators of adolescents' family resources (i.e., parents' education, number of books and cultural possessions). Parents' highest education and the number of books at home show the expected positive correlation with German reading comprehension. The differences to monolinguals in all age of onset groups moderately decline compared to the base model but remain significant. The *third model* controls for the quality of input (i.e., one German native-speaking parent). As the coefficients in Figure 4 reveal, in both samples the

differences to monolinguals are not reduced compared to the base model, and having a German native speaker as parent has no significant relation to reading comprehension in L2.

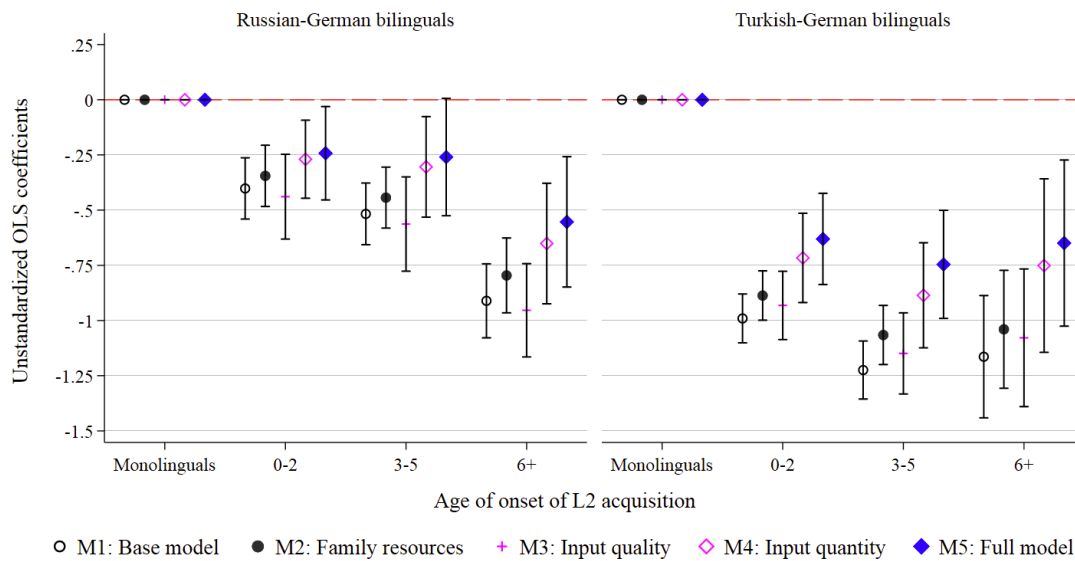
By including indicators for students' amount of current L2 input in the analysis in the *fourth model*, the differences to monolinguals sharply decline in all age of onset groups. Besides, in the Russian sample the gap to monolinguals even becomes insignificant, indicating that all of the difference in L2 reading comprehension between Russian-speaking bilinguals and German monolinguals is related to varying language input. Contrary to the assumptions, there seems to be no advantage of simultaneous bilinguals over successive bilinguals in the Russian sample due to starting L2 acquisition earlier and at a highly efficient learning period. With respect to the indicators of the amount of language input, the findings are as expected. In the Russian sample, students who frequently use German with family members and attend schools with a low share of migrants tend to have higher L2 reading comprehension. In the Turkish sample only a low share of migrants in the students' school is positively related to L2 reading comprehension.

Taking into account students' family resources as well as the quality and the quantity of input in the *full model*, additionally reduces the gap in L2 reading comprehension between simultaneous bilinguals and monolinguals to non-significance in the Turkish sample. The difference between successive bilinguals and monolinguals in the Turkish sample further decreases but remains significant, indicating in contrast to the Russian sample that the age of onset probably matters to close the monolingual-bilingual gap. The results for the predictors of L2 reading comprehension are equivalent to the former models, highlighting the relevance of family resources and language input in both samples. But most importantly the full model reaffirms that the family resources and the current amount of L2 input accounts for the differences between simultaneous bilinguals and monolinguals in both samples.

Next, I conduct the same OLS analysis for L2 receptive vocabulary. As Figure 5 displays, the results of the base models are similar to the data pattern in Figure 4 (see Appendix: Table 6 – 7 for more detailed results). Monolingual students score significantly higher on the receptive vocabulary test than simultaneous bilinguals. The difference to monolinguals is more pronounced for successive than for simultaneous bilinguals. While the effects of age of onsets are mostly moderate in the Russian sample ( $> .40 - .91$ ), they are large in the Turkish sample ( $> .98 - 1.22$  SD). Again, the control variables gender, school track and general cognitive abilities are significantly related to L2 receptive vocabulary. The only difference to the results on reading comprehension is, that males score higher on receptive vocabulary than females.

The *second model* controls for students' family resources. As might be expected, students with higher educated parents, more books and more cultural possessions at home have significantly higher receptive vocabulary. In this model the difference to monolinguals in receptive vocabulary declines in all age of onset groups but the remaining differences are still significant. The *third model* adds input quality, measured as having one German native-speaking parent, to the analysis. The differences to monolinguals decrease only slightly in the Turkish sample, in the Russian sample they even marginally increase. Contrary to the assumptions and consistent with the results on reading comprehension, German input from a native speaker in the family is not significantly associated with L2 receptive vocabulary in both language groups. When the amount of input is controlled in the *fourth model*, the differences to monolinguals considerably decline. Indicating that a substantial part of the difference between monolinguals and bilinguals, regardless of the age of onset, can be explained by varying language input.

**Figure 5.** Coefficient plots for the effects of age of onset on L2 receptive vocabulary of Russian-German and Turkish-German bilinguals compared to monolinguals



*Note:* Figure shows unstandardized OLS coefficients and 95%-confidence intervals. German monolinguals: N = 6057, Russian-German bilinguals: N = 365 (Adj. R<sup>2</sup>: Model 1 = .33, Model 2 = .36, Model 3 = .33, Model 4 = .33, Model 5 = .36), Turkish-German bilinguals: N = 473 (Adj. R<sup>2</sup>: Model 1 = .41, Model 2 = .44, Model 3 = .41, Model 4 = .41, Model 5 = .44). The dashed red line represents the monolingual reference category.

The findings to the indicators of input quantity are as expected. A low share of migrants in school positively predicts receptive vocabulary. In the Turkish sample, a frequent use of German with family members also promotes German vocabulary. Similar results are found in the *full model* when all covariates are included. Except the differences to monolinguals further decrease marginally compared to the input quantity model thus the gap between early successive bilinguals and monolinguals becomes insignificant in the Russian sample. The findings support the assumption that bilinguals and monolinguals vary in their family resources and in their amounts of German input. This partially explains the difference in receptive vocabulary. However, in contrast to reading comprehension, additional factors must be at play since simultaneous bilinguals cannot close the gap to monolinguals. In addition, the results show less advantages of an earlier L2 exposure for vocabulary knowledge. The differences to monolinguals are nearly of the same size for simultaneous and successive bilinguals after controlling for family resources and language input. Only in the Russian sample, the differences to monolinguals are considerably smaller for simultaneous than for late successive bilinguals.

## DISCUSSION

A prominent assumption in language acquisition research is that children who are exposed to two languages very early in life can acquire a monolingual proficiency level in both languages, whereas older L2 learners have considerably lower chances to become highly proficient (Esser 2008; Meisel 2013; Tracy 2014). I have addressed this expectation in the present study by examining, *first*, whether a very early age of onset facilitates high proficiency in both languages and, *second*, supports L2 proficiency on a monolingual level. Starting out from a L2 acquisition model, I identified factors due to which simultaneous bilinguals, who are exposed to both languages very early after birth, have advantages or

disadvantages in L1 and L2 development compared to successive bilinguals, who first acquire the basic structures of L1 before they are exposed to L2 at an older age.

I suggested that the simultaneous bilinguals could benefit in their L2 proficiency from the longer duration of L2 exposure, which starts in the period of highest learning efficiency during early childhood. These advantages, I hypothesized, could narrow the gap to monolinguals and lead to higher L2 proficiency than successive bilinguals. However, the earlier age of onset in L2 reduces the time in a L1-only environment what I assumed to be a hindrance for high L1 proficiency. In addition, I expected the age of onset to condition the amount of L2 input over the life span due to the formation of systematically different social environments. While an early exposure should promote contacts to the majority, a late exposure should support contacts to individuals of the same heritage language. Accordingly, I hypothesized that simultaneous bilinguals follow the pattern of a subtractive bilingualism and develop higher L2 but lower L1 proficiency than successive bilinguals.

While I expected simultaneous bilinguals to narrow the gap to monolinguals in L2 proficiency due the very early age of onset, I assumed additional learning-related factors as relevant for closing the gap. More specifically, the quality and the quantity of the language input the adolescents receive. Due to two reasons, I expected them to systematically differ between monolinguals and bilinguals. First, bilinguals generally have to divide their language input between two languages which reduces the average input in both languages. Second, bilinguals mostly live in immigrant families who tend to have lower learning-related family resources and mostly parents with less proficiency in the majority language as compared to monolinguals in native families. Therefore, I hypothesized, that simultaneous bilinguals could close the gap in L2 proficiency when these differences to monolinguals were taking into account.

Based on a ninth grade sample from the German NEPS data, I tested these assumptions on bilinguals from immigrant families whose L1 was Russian or Turkish and who started their L2 acquisition at three different periods in childhood. Overall, the analyses confirm most of these expectations.

To examine the *first research question*, I compared simultaneous and successive bilingual youth in their proficiency in L1 and L2, using language tests of receptive vocabulary and reading comprehension in the majority language, and listening comprehension in the heritage language. Most of the results exhibited the expected opposing effects of age of onset on L1 and L2 proficiency. For example, the simultaneous bilingual students in the Russian sample scored lower on the L1 listening comprehension test and higher on the L2 vocabulary test than late successive bilinguals (i.e., age of onset: 6+ years). The simultaneous bilingual students in the Turkish sample also outperformed late successive bilinguals in both L2 tests, and early successive bilinguals in the vocabulary test. However in contrast to the expectations, the L1 proficiency in the Turkish sample was not related to the age of onset, since listening comprehension in L1 was around the average in all age groups. Accordingly, Turkish-German bilingual youth who start L2 acquisition at an earlier age do not seem to be penalized in their L1 skills as compared to older L2 learners.

Taken together, these findings confirm that the age of onset of L2 acquisition contributes to the prediction of L1 proficiency in the Russian sample, and L2 proficiency in both samples. Contrary to the prominent assumption in language acquisition research there seems to be no efficiency benefit due to starting in a sensitive period of language learning which could guarantee simultaneous bilinguals high skills in both languages. Instead, most of the data show the expected typical time-on-task pattern of subtractive bilingualism that often occurs when the language input has to be divided between two languages at an earlier or a later stage in the learning process. From this perspective, there is less indication that the threshold argument holds.

The assumption that the age of onset conditions the amount of L1 and L2 input individuals receives over the life course, and thus contributes to lower L1 and higher L2 skills of simultaneous bilinguals, is also supported by the data. This conclusion is based on the observation that many of the differences in L1 and in L2 proficiency between simultaneous and successive bilinguals can be attributed to systematic variations in the amount of L2 input. Simultaneous bilinguals live more often in social environments where the L2 is the dominant language. These environments are beneficial for high proficiency in L2, however, detrimental for high proficiency in L1. Obviously, this long-term consequence of an early age of onset, contributes at least as much to high L2 skills as the fact that simultaneous bilinguals start in a highly efficient learning period and have a longer duration of exposure to L2. According to the explained variance and the strongly reduced age of onset effect, the amount of input seems to be more important for high L1 proficiency than for high L2 proficiency. This finding is in line with research on heritage language loss that has already highlighted how crucial the access to L1 in the social environment is for the survival of minority languages (Portes and Hao 1998; Alba et al. 2002). While for L2, as the majority language and the language of instruction in schools, many learning possibilities exist, the L1 depends on informal input through family, friends, classmates or the media.

The dilemma with respect to the social contacts of bilinguals is that they tend either to support L1 skills or L2 skills, and they cannot provide simultaneously input for both languages. Although I expected many opposing effects of language input on L1 and L2 proficiency, the analyses yielded only one subtractive pattern: Russian-German bilingual youth who used German with family members had significantly lower Russian listening comprehension, and at the same time, higher German reading comprehension. In contrast, I found clear evidence that most factors enhancing learning efficiency support an additive bilingualism. For instance, students with higher general cognitive abilities and students who attended a higher school track were more proficient in both L1 and L2. In addition, female students scored higher on L1 listening comprehension and L2 reading comprehension, although, on the L2 receptive vocabulary test females scored lower as male students.

Using language tests of receptive vocabulary and reading comprehension in the majority language to answer the *second research question*, I found the bilingual Russian-German and Turkish-German immigrant youth to be less proficient in L2 as compared to monolingual German youth. As expected, the monolingual-bilingual gap was less pronounced for simultaneous bilinguals than for successive bilinguals, but still existed. In line with previous research, however, the differences in L2 skills between bilinguals and monolinguals were strongly related to patterns of language use at home or with peers as well as to educational and cultural resources in the families. When these factors were taken into account in multivariate regression analyses, a more mixed picture emerged regarding the relevance of the age of onset.

On the one hand, controlling for these covariates reduced the monolingual-bilingual gap in L2 proficiency considerably. Thereby, the difference in L2 skills between simultaneous and successive bilinguals leveled out or disappeared, showing that an earlier age of L2 acquisition does not necessarily help to narrow the gap to monolinguals. This holds true for receptive vocabulary in the Turkish sample and reading comprehension in the Russian sample. On the other hand, there was still evidence that age of onset can promote L2 skills. For example, I found that starting the L2 acquisition before the age of two in a highly efficient learning period can close the gap of Turkish-German bilinguals to monolinguals in reading comprehension. Similarly, bilingual Russian-German youth who began their L2 acquisition before the age of 6 had higher receptive vocabulary, and therefore, could (nearly) close the gap to monolinguals. To sum up, these results suggest that there are benefits in the L2 development from being a simultaneous bilingual youth, even though

they vary depending on the linguistic phenomenon and the origin group. In addition, the data show how essential it is, to at least control for differences in family resources and input quantity between monolingual and bilingual youth when analyzing which role the age of onset plays for language proficiency in general and for the monolingual-bilingual gap in the majority language in specific.

In conclusion, the findings of this study partly reflect, that even if no limits exist in the cognitive capacities to learn two languages simultaneously in early childhood, there are certainly external factors, such as time limits for input and lower educational resources in immigrant families that reduce the chance to become highly proficient in two languages even for simultaneous bilinguals.

Due to restrictions in the NEPS data, the current study is limited in several respects. First, I used receptive vocabulary as indicator of listening comprehension in L2 because the NEPS data provide no listening comprehension test in German. Since vocabulary tests do not capture syntactic knowledge, the measure for German listening comprehension is less comprehensive than ordinary listening comprehension tests. However, vocabulary is a core component of the comprehension process, since without vocabulary individuals could not decode the meaning of spoken sentences (Rost 2011). In addition, vocabulary strongly predicts listening comprehension (Andringa et al. 2012). Although the operationalization could be improved in future studies, the L2 receptive vocabulary test is assumed to be a sufficient indicator for German listening comprehension.

Second, a measure for the length of exposure is missing in the current study. In general, the length of exposure is calculated by subtracting the child's age of onset from the age at the time the language testing takes place. In the NEPS data, age of onset was measured with a categorical variable, which rendered it impossible to compute a fine-grained variable for the length of exposure. Since the students were only 15 years old, a raw measure of length of exposure using the mean age of every age of onset group, was too imprecise and therefore not an option to include into the analysis. A measure of length of exposure would have made it possible to disentangle the two core mechanisms underlying the age of onset in the empirical analysis: first, the high level of learning efficiency, and second, the longer duration of L2 exposure.

Third, the L2 input quality was measured by having a German native-speaking parent. Surprisingly, no significant correlation with L2 proficiency was found. There are several possible reasons for this result. One reason is that a more proximate measure of parents' language proficiency, like a language test, would yield more precise results of the language input quality the youth receive from their parents. The NEPS provided information on the self-assessed language skills of the parents, however, unit- and item-nonresponse on these variables was large, and therefore would have also affected the results. This is why I decided to rely on the information about the native languages of the parents. Second, studies which found that the input of native speakers has a positive effect on language development, used a very detailed measure derived from a language diary including all native speaker contacts during the daily interactions with the child (Place and Hoff 2011, 2016). Perhaps, it is not one native speaking contact but the amount of native speaking contact that matters for high L2 proficiency. Moreover, the children in these studies were on average two to three years old. However, in early childhood the influence between input and language outcome should be more immediate than in adolescence, since at the age of 15 the most important processes of oral and literacy language acquisition are already completed (Weinert and Grimm 2008).

Fourth, this study addressed L1 skills only in terms of listening comprehension and L2 skills in terms of reading comprehension and receptive vocabulary. Hence, no conclusion can be drawn regarding other linguistic phenomena. To generalize these results, future

studies should also include more language components that vary in their dependency from a critical period of language learning. A more systematic variation of language components, an additional measurement of length of exposure, and a more detail assessment of parents' language skills could provide an even better understanding when and how the age of onset matters for high language proficiency.

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## APPENDIX

**Table 1.** OLS regression models of L1 listening comprehension for Russian-German and Turkish-German bilinguals

	Russian-German bilinguals						Turkish-German bilinguals					
	M1		M2		M3		M1		M2		M3	
	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Age of L2 onset (Ref. 0-2)												
3-5	0.31**	(0.11)	0.19	(0.11)	-0.02	(0.11)	0.11	(0.10)	0.12	(0.09)	-0.00	(0.09)
+6	0.81***	(0.13)	0.64***	(0.15)	0.31*	(0.14)	0.04	(0.16)	0.20	(0.17)	-0.05	(0.17)
L2 use in family					-0.25***	(0.07)					-0.22**	(0.08)
L2 use with peers					-0.00	(0.10)					0.07	(0.07)
L2 use for media consumption					-0.29*	(0.13)					-0.34***	(0.08)
Migrants in school					0.12**	(0.04)					-0.00	(0.03)
Born in Germany (Ref. Born abroad)			-0.33**	(0.11)	-0.32**	(0.11)			-0.16	(0.17)	-0.08	(0.16)
General cognitive ability			0.05**	(0.02)	0.06**	(0.02)			0.09***	(0.02)	0.08***	(0.02)
School track (Ref. Lowest)												
Several tracks			0.45*	(0.21)	0.59**	(0.19)			-0.14	(0.21)	0.00	(0.19)
Intermediate			0.12	(0.10)	0.22*	(0.10)			0.50***	(0.11)	0.52***	(0.11)
Comprehensive			0.18	(0.20)	0.24	(0.18)			0.18	(0.13)	0.23	(0.12)
Highest			0.90***	(0.14)	1.03***	(0.14)			0.48**	(0.15)	0.55***	(0.14)
Female			0.25**	(0.09)	0.23*	(0.09)			0.25**	(0.09)	0.20*	(0.09)
Adj. R <sup>2</sup>	0.10		0.28		0.36		0.00		0.12		0.19	
<i>N</i>	365		365		365		473		473		473	

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 2.** OLS regression models of L2 reading comprehension for Russian-German and Turkish-German bilinguals

	Russian-German bilinguals						Turkish-German bilinguals					
	M1		M2		M3		M1		M2		M3	
	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Age of L2 onset (Ref. 0-2)												
3-5	-0.11	(0.11)	-0.08	(0.09)	0.01	(0.09)	-0.28***	(0.09)	-0.25***	(0.07)	-0.21***	(0.07)
+6	-0.26*	(0.13)	-0.11	(0.12)	-0.00	(0.13)	-0.74***	(0.14)	-0.42***	(0.13)	-0.34**	(0.13)
L2 use in family					0.14*	(0.06)					0.10	(0.06)
L2 use with peers					0.08	(0.08)					0.12*	(0.06)
L2 use for media consumption					0.02	(0.09)					-0.03	(0.07)
Migrants in school					0.08	(0.04)					-0.01	(0.03)
Born in Germany (Ref. Born abroad)			0.02	(0.09)	-0.02	(0.09)			0.15	(0.11)	0.14	(0.11)
General cognitive ability			0.11***	(0.02)	0.11***	(0.02)			0.12***	(0.02)	0.12***	(0.02)
School track (Ref. Lowest)												
Several tracks			-0.01	(0.22)	0.05	(0.21)			-0.16	(0.22)	-0.18	(0.23)
Intermediate			0.41***	(0.10)	0.42***	(0.09)			0.54***	(0.09)	0.53***	(0.09)
Comprehensive			0.62***	(0.15)	0.61***	(0.15)			0.35**	(0.11)	0.33**	(0.11)
Highest			1.02***	(0.11)	1.07***	(0.12)			0.59***	(0.11)	0.54***	(0.11)
Female			0.15	(0.08)	0.11	(0.08)			0.27***	(0.07)	0.27***	(0.07)
Adj. R <sup>2</sup>	0.00		0.36		0.37		0.05		0.34		0.34	
<i>N</i>	365		365		365		473		473		473	

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 3.** OLS regression models of L2 receptive vocabulary for Russian-German and Turkish-German bilinguals

	Russian-German bilinguals						Turkish-German bilinguals					
	M1		M2		M3		M1		M2		M3	
	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Age of L2 onset (Ref. 0-2)												
3-5	-0.07	(0.12)	-0.11	(0.11)	-0.03	(0.11)	-0.22*	(0.10)	-0.22*	(0.09)	-0.16	(0.09)
+6	-0.52***	(0.13)	-0.45***	(0.14)	-0.33*	(0.14)	-0.35*	(0.16)	-0.08	(0.17)	0.02	(0.18)
L2 use in family					0.07	(0.07)					0.13	(0.08)
L2 use with peers					0.12	(0.10)					-0.00	(0.07)
L2 use for media consumption					0.07	(0.11)					0.08	(0.08)
Migrants in school					-0.02	(0.05)					-0.05	(0.03)
Born in Germany (Ref. Born abroad)					-0.03	(0.11)			0.25	(0.14)	0.21	(0.14)
General cognitive ability					0.04*	(0.02)			0.07***	(0.02)	0.07***	(0.02)
School track (Ref. Lowest)												
Several tracks					-0.13	(0.21)			0.49*	(0.20)	0.42*	(0.20)
Intermediate					0.55***	(0.10)			0.49***	(0.11)	0.49***	(0.11)
Comprehensive					0.34	(0.19)			0.53***	(0.12)	0.51***	(0.12)
Highest					1.19***	(0.13)			1.22***	(0.13)	1.17***	(0.13)
Female					-0.36***	(0.09)			-0.37***	(0.08)	-0.36**	(0.08)
Adj. R <sup>2</sup>	0.04		0.31		0.32		0.01		0.29		0.30	
N	365		365		365		473		473		473	

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 4.** OLS regression models of L2 reading comprehension for Russian-German bilinguals and German monolinguals

		Russian-German bilinguals									
		M1		M2		M3		M4		M5	
		<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Age of L2 onset (Ref. Monolinguals)											
0-2		-0.24***	(0.07)	-0.19**	(0.07)	-0.24**	(0.09)	-0.08	(0.09)	-0.02	(0.10)
3-5		-0.33***	(0.06)	-0.26***	(0.06)	-0.33***	(0.09)	-0.07	(0.10)	0.01	(0.12)
+6		-0.38***	(0.08)	-0.28***	(0.08)	-0.38***	(0.10)	-0.08	(0.13)	0.05	(0.15)
Parents' education (Ref. No degree/low-level)											
Middle-level				0.02	(0.04)					0.02	(0.04)
High-level				0.08*	(0.04)					0.08*	(0.04)
Missing information				-0.01	(0.04)					-0.00	(0.04)
Number of books				0.09***	(0.01)					0.09***	(0.01)
Cultural possession				0.06	(0.03)					0.06	(0.03)
L2 use in family								0.13*	(0.06)	0.14*	(0.06)
L2 use with peers								0.06	(0.08)	0.05	(0.08)
L2 use for media consumption								0.03	(0.09)	0.07	(0.09)
Migrants in school								-0.04**	(0.01)	-0.03*	(0.01)
Parent L2 native speaker (Ref. No)						0.00	(0.09)			-0.01	(0.09)
General cognitive ability		0.11***	(0.01)	0.10***	(0.00)	0.11***	(0.01)	0.11***	(0.01)	0.10***	(0.00)
School track (Ref. Lowest)											
Several tracks		0.20***	(0.04)	0.18***	(0.04)	0.20***	(0.04)	0.16***	(0.04)	0.16***	(0.04)
Intermediate		0.39***	(0.03)	0.32***	(0.03)	0.39***	(0.03)	0.38***	(0.03)	0.31***	(0.03)
Comprehensive		0.46***	(0.04)	0.38***	(0.04)	0.46***	(0.04)	0.45***	(0.04)	0.37***	(0.04)
Highest		0.95***	(0.03)	0.79***	(0.03)	0.95***	(0.03)	0.92***	(0.03)	0.77***	(0.04)
Female		0.16***	(0.02)	0.16***	(0.02)	0.16***	(0.02)	0.17***	(0.02)	0.16***	(0.02)
Adj. R <sup>2</sup>		0.30		0.32		0.30		0.30		0.32	
<i>N</i>		6422		6422		6422		6422		6422	

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 5.** OLS regression models of L2 reading comprehension for Turkish-German bilinguals and German monolinguals

Turkish-German bilinguals					
	M1	M2	M3	M4	M5
	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
	(SE)	(SE)	(SE)	(SE)	(SE)
Age of L2 onset (Ref. Monolinguals)					
0-2	-0.40***	-0.32***	-0.38***	-0.24**	-0.18
	(0.05)	(0.05)	(0.07)	(0.09)	(0.10)
3-5	-0.68***	-0.56***	-0.66***	-0.49***	-0.40***
	(0.05)	(0.05)	(0.07)	(0.11)	(0.11)
+6	-0.88***	-0.79***	-0.85***	-0.66***	-0.59***
	(0.11)	(0.11)	(0.12)	(0.16)	(0.17)
Parents' education (Ref. No degree/low-level)					
Middle-level		0.01			0.01
		(0.04)			(0.04)
High-level		0.10*			0.09*
		(0.04)			(0.04)
Missing information		0.00			0.00
		(0.04)			(0.04)
Number of books		0.09***			0.09***
		(0.01)			(0.01)
Cultural possession		0.05			0.05
		(0.03)			(0.03)
L2 use in family			0.07		0.04
			(0.06)		(0.07)
L2 use with peers			0.11		0.11
			(0.06)		(0.06)
L2 use for media consumption			-0.03		-0.01
			(0.06)		(0.06)
Migrants in school			-0.04***		-0.03**
			(0.01)		(0.01)
Parent L2 native speaker (Ref. No)			0.03		0.02
			(0.07)		(0.07)
General cognitive ability	0.11***	0.10***	0.11***	0.11***	0.10***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
School track (Ref. Lowest)					
Several tracks	0.19***	0.17***	0.19***	0.15***	0.14***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Intermediate	0.40***	0.33***	0.40***	0.38***	0.32***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Comprehensive	0.44***	0.36***	0.44***	0.43***	0.35***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Highest	0.93***	0.77***	0.93***	0.89***	0.74***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Female	0.17***	0.16***	0.17***	0.17***	0.17***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Adj. R <sup>2</sup>	0.33	0.35	0.33	0.33	0.35
<i>N</i>	6530	6530	6530	6530	6530

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 6.** OLS regression models of L2 receptive vocabulary for Russian-German bilinguals and German monolinguals

Russian-German bilinguals					
	M1	M2	M3	M4	M5
	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
	(SE)	(SE)	(SE)	(SE)	(SE)
Age of L2 onset (Ref. Monolinguals)					
0-2	-0.40***	-0.34***	-0.44***	-0.27***	-0.24***
	(0.07)	(0.07)	(0.10)	(0.09)	(0.11)
3-5	-0.52***	-0.44***	-0.56***	-0.30***	-0.26
	(0.07)	(0.07)	(0.11)	(0.12)	(0.14)
+6	-0.91***	-0.80***	-0.95***	-0.65***	-0.55***
	(0.09)	(0.09)	(0.11)	(0.14)	(0.15)
Parents' education (Ref. No degree/low-level)					
Middle-level		0.08*			0.08*
		(0.04)			(0.04)
High-level		0.12**			0.12**
		(0.04)			(0.04)
Missing information		0.06			0.06
		(0.04)			(0.04)
Number of books		0.11***			0.11***
		(0.01)			(0.01)
Cultural possession		0.09**			0.09**
		(0.03)			(0.03)
L2 use in family				0.07	0.08
				(0.07)	(0.07)
L2 use with peers				0.13	0.12
				(0.09)	(0.09)
L2 use for media consumption				0.06	0.11
				(0.11)	(0.11)
Migrants in school				-0.03**	-0.02
				(0.01)	(0.01)
Parent L2 native speaker (Ref. No)			-0.06		-0.06
			(0.10)		(0.10)
General cognitive ability	0.08***	0.08***	0.08***	0.08***	0.07***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
School track (Ref. Lowest)					
Several tracks	0.33***	0.30***	0.33***	0.30***	0.28***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Intermediate	0.36***	0.28***	0.36***	0.35***	0.27***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Comprehensive	0.39***	0.29***	0.39***	0.38***	0.29***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Highest	0.96***	0.77***	0.96***	0.92***	0.75***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Female	-0.34***	-0.35***	-0.34***	-0.34***	-0.34***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Adj. R <sup>2</sup>	0.33	0.36	0.33	0.33	0.36
<i>N</i>	6422	6422	6422	6422	6422

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 7.** OLS regression models of L2 receptive vocabulary for Turkish-German bilinguals and German monolinguals

Turkish-German bilinguals										
	M1		M2		M3		M4		M5	
	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Age of L2 onset (Ref. Monolinguals)										
0-2	-0.99***	(0.06)	-0.89***	(0.06)	-0.93***	(0.08)	-0.72***	(0.10)	-0.63***	(0.11)
3-5	-1.22***	(0.07)	-1.07***	(0.07)	-1.15***	(0.09)	-0.89***	(0.12)	-0.75***	(0.12)
+6	-1.16***	(0.14)	-1.04***	(0.14)	-1.08***	(0.16)	-0.75***	(0.20)	-0.65***	(0.19)
Parents' education (Ref. No degree/low-level)										
Middle-level			0.10**	(0.03)					0.10**	(0.03)
High-level			0.15***	(0.04)					0.14***	(0.04)
Missing information			0.06	(0.04)					0.06	(0.04)
Number of books			0.11***	(0.01)					0.10***	(0.01)
Cultural possession			0.08**	(0.03)					0.08**	(0.03)
L2 use in family							0.15*	(0.07)	0.10	(0.08)
L2 use with peers							0.01	(0.07)	0.01	(0.07)
L2 use for media consumption							0.10	(0.08)	0.12	(0.08)
Migrants in school							-0.04***	(0.01)	-0.02*	(0.01)
Parent L2 native speaker (Ref. No)					0.10	(0.09)			0.07	(0.09)
General cognitive ability			0.08***	(0.00)	0.08***	(0.00)	0.08***	(0.00)	0.08***	(0.00)
School track (Ref. Lowest)										
Several tracks			0.36***	(0.04)	0.33***	(0.04)	0.36***	(0.04)	0.32***	(0.04)
Intermediate			0.37***	(0.03)	0.29***	(0.03)	0.37***	(0.03)	0.36***	(0.03)
Comprehensive			0.41***	(0.04)	0.31***	(0.04)	0.41***	(0.04)	0.40***	(0.04)
Highest			0.97***	(0.03)	0.78***	(0.03)	0.97***	(0.03)	0.94***	(0.03)
Female			-0.34***	(0.02)	-0.35***	(0.02)	-0.34***	(0.02)	-0.34***	(0.02)
Adj. R <sup>2</sup>	0.41		0.44		0.41		0.41		0.44	
<i>N</i>	6530		6530		6530		6530		6530	

*Note:* Unstandardized OLS coefficients and robust standard errors in parentheses. Parents' education: low level = no, primary or lower secondary education (maximum of nine years of schooling), middle level = upper secondary education (10 to 11 years of schooling), high-level = post secondary or tertiary education (at least 12 years of schooling), missing information = students with missing data on this variable. School track: Lowest = Hauptschule, several tracks = Schule mit mehreren Bildungsgängen, intermediate = Realschule, comprehensive = Gesamtschule, highest = Gymnasium. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$