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Aspect and tense attrition in Russian-German bilingual speakers

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Abstract

Purpose: The impact of second language (L2) on first language (L1), known as L2 transfer, has been suggested as a fundamental driving force of L1 attrition. The goal of this study was to test the differential attrition of verb aspect and tense in L1 (Russian) under the influence of L2 (German) grammatical properties. We also investigated whether the age of bilingualism onset and the amount of exposure to L1 modulate this L2 transfer effect.

Methodology: We tested sentence processing in 30 adult Russian monolingual participants and 30 L1 attritors – Russian-German bilingual speakers – with early versus late bilingualism onset and with low versus high amounts of exposure to L1. Participants heard grammatically correct sentences, sentences with aspect violations and sentences with tense violations, and were asked to detect errors.

Data and Analysis: The accuracy of participants' responses was analysed using generalized linear mixed-effects modelling in R.

Findings: The L2 transfer effect was found, but was strongly modulated by the amount of L1 exposure: only bilinguals with little exposure to L1 showed greater attrition of L1 aspect compared to L1 tense. Moreover, the age of bilingualism onset proved to be more critical than the L2 transfer effect: an earlier bilingualism onset resulted in greater attrition of both aspect and tense in L1.

Originality: The study provided new evidence about the differential impact of the grammatical similarity between L1 and L2, the age of bilingualism onset and the amount of L1 exposure on aspect and tense processing in L1 attritors.

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Implications: Our findings suggest that greater L1 use after immigration helps bilingual speakers to be less susceptible to L2 transfer and prevents attrition of L1-specific grammatical categories. Also, a general decline in processing verbal morphology is more likely to occur in speakers with an early rather than a late onset of bilingualism.

Keywords

Verb aspect, tense, first language attrition, bilingualism, Russian

Introduction

A large body of literature has shown that the grammar of bilingual speakers has significant deviations from the baseline when it comes to processing verb morphology in general and the category of aspect and tense in particular (Bar-Shalom & Zaretsky, 2008; Montrul, 2002; Montrul & Bowles, 2009; Pereltsvaig, 2008; Polinsky, 1996, 2009; Silva-Corvalán, 1991, 1994, 1995). This is typically the case when one language is acquired under reduced input conditions or functions under the dominance of the other language (Benmamoun, Montrul, & Polinsky, 2013). The present paper focuses on aspect and tense processing in a specific group of such bilingual speakers, first language (L1) attritors.

L1 attrition

L1 attrition refers to the non-pathological erosion or restructuring of a previously acquired L1 in bilingual people (Köpke & Schmid, 2004; Schmid, 2011). L1 attrition typically occurs when a person relocates to another country or a region within the home country where this language is not spoken. This results in the total or partial reduction of L1 input and extensive and prolonged exposure to a second language (L2). Although the children of migrants are often broadly labelled as the heritage speakers (Montrul, 2012), in stricter terms there is a distinction between heritage speakers and genuine L1 attritors (Schmid, 2007). Heritage speakers acquire both languages from early childhood, and their L1 competence might not only be eroded but also incomplete due to restricted or distorted L1 input. In contrast, speakers qualified as attritors grow up as monolingual until they fully master their L1, and are exposed to a bilingual environment only after immigration. That is, an important prerequisite of a genuine L1 attrition is complete acquisition of L1 or its specific aspects under investigation, which later, under the dominance of L2, undergo changes. These changes might range from mild erosion (e.g., phonetic distortions, more effortful lexical retrieval) to those putting the person's native speaker status into question (De Leeuw, Schmid, & Mennen, 2010).

Both linguistic and extralinguistic factors can influence L1 attrition. From a linguistic point of view, the fundamental driving force of L1 attrition is the L2 transfer, or the influence of L2 on L1 (Andersen, 1983; Pavlenko, 2000; Sharwood Smith, 1983; see also Schmid (2013) for a more recent overview). The L2 transfer is a specific case of interference between several languages of a speaker addressed more comprehensively in the Language Transfer Hypothesis (Jarvis & Pavlenko, 2008; Odlin, 1989). It can occur when the two languages are structurally similar (Köpke, 2004), but it is particularly evident when the languages differ in a given grammatical property, especially for various morphosyntactic phenomena (Pavlenko, 1997; Pavlenko & Jarvis, 2002; Seliger & Vago, 1991; Skaden, 1999; Stoessel, 2000; Waas, 1996). If the L2 does not possess corresponding categories, L1 morphology (e.g., gender agreement) can be

simplified, adapted to the L2 processing strategies or lost (Andersen, 1982; Lestrade, 2002; Saville-Troike, Pan, & Dutkova-Cope, 1995; Schmid, 2002). The syntactic structures of the L1 may also change under the influence of the dominant L2 (Schmid, 2002; Sharwood Smith, 1983; Yagmur, De Bot, & Korzillus, 1999; Yukawa, 1998). For example, Larmouth (1974) demonstrated the shift from free to fixed word order in Finnish as a result of English domination. Jamshidiha and Marefat (2006) showed that early Persian-English bilinguals found acceptable syntactic constructions that were unlicensed in Persian but legal in English. Similarly, Beganović (2006) reported an increased production of postverbal subjects in Serbian/Croatian/Bosnian under the influence of L2 Dutch.

The typological similarity that drives L2 influence on L1 can be modulated by extralinguistic factors (Pavlenko, 2000). Among these, the age of bilingualism onset most strongly impacts the degree of L1 erosion (for a review, see Birdsong, 2014; Bylund, 2009; Montrul, 2008). Given that the L1 is fully acquired in earlier childhood by all attritors, a critical difference in various language domains (i.e., phonology, lexicon, grammar) was found between those speakers whose full exposure to L1 ends before versus after puberty. While late bilinguals perform similarly to monolinguals, speakers who experienced an onset of bilingualism prior to adolescence show significant deviations (Schmid, 2013). For example, the age of immigration was robustly associated with the number of case-marking errors both in Russian-German and German-English bilinguals (Schmid, 2002; Schmitt, 2010). Similarly, the findings of Montrul (2002) supported the influence of the onset age of bilingualism on the ultimate attainment/loss of verb morphology in Spanish-English bilingual speakers. In tasks of oral production, written completion and meaning-interpretation, Spanish-English speaking adults who learned their L2 English between ages 4 to 7 differed significantly from monolingual Spanish speakers regarding the use of tense/aspect morphology. In contrast, only a few late L2 learners (who acquired English between 8 and 12 years) showed erosion in this respect.

Another extralinguistic factor, the amount of L1 input or frequency of its use, does not have as much of an impact on L1 attrition as the age of bilingualism onset. It is an ingredient of the Activation Threshold Hypothesis (Paradis, 2004, 2007), which assumes that the more often certain linguistic elements of L1 are used, the lower their activation threshold is and the more resistant they are to attrition. According to De Bot, Gommans, and Rossing (1991) and Köpke (1999), very infrequent use of L1 causes more attrition. Similarly, Schmid (2002) demonstrated that the amount of L1 attrition depends on whether a language user's partner speaks the same or different L1: adult German migrants to anglophone countries whose partner had a different L1 made more production errors in their L1 German. However, other studies reported no association between the amount of L1 usage and the degree of its attrition (Schmid, 2007; Schmid & Dusseldorp, 2010): in German speakers residing in Canada and the Netherlands from at least 17 years of age, the amount of self-reported use of German in daily life did not have any predictive power for their L1 production profiles. In an earlier study, there was even a negative association reported by Jaspaert and Kroon (1989): Italian migrants to the Netherlands having a non-Italian partner showed better performance on their L1. Such contradictory findings may be associated with differences in the employed measures of the amount of L1 exposure (the distinction in terms "more" and "less" use of L1 made by De Bot et al. (1991) and Köpke (1999); self-reported use in daily life, as in Schmid (2007) and Schmid and Dusseldorp (2010); the presence of a partner not speaking the subject's L1, as in Jaspaert and Kroon (1989)), or with qualitative variation of such exposure in terms of code-switching, type of L1 environment, and so on. More experimental evidence is needed to establish the contribution of L1 exposure to L1 attrition.

The three outlined factors (L2 transfer, age of bilingualism onset and amount of L1 input) are relevant to the present study of tense and aspect attrition in L1, because each of them can

Table 1. Tense-aspect system of Russian.

	Past	Present	Future
Imperfective	pisal (“he was writing”)	pishet (“s/he is writing”)	budet pisat’ (“s/he will be writing”)
Perfective	napisal (“he wrote”)	–	napishet (“s/he will write”)

potentially highlight the existing asymmetry between these linguistic categories. This asymmetry is present both in theoretical models of tense and aspect and in empirical evidence about tense and aspect processing by bilingual speakers.

Linguistic categories of tense and aspect

Tense and aspect are common linguistic devices that express the temporal characteristics of a situation. Tense reflects the relation between the event and the reference point, whether the former precedes, coincides with or follows the latter, thus distinguishing between past, present and future time reference. In turn, aspect expresses the way of viewing the internal constituency of the event: the perfective highlights its boundaries without focusing on separate phases, while the imperfective relates to the internal structure of the situation. Tense is a typical grammatical category expressed through inflectional morphology, while aspect has more diverse representations across languages, from being an inherent lexical property of a verb (Aktionsart) to representing grammaticalized distinctions marked with inflectional devices, similar to tense (Bybee, 1985; Comrie, 1976; Smith, 1997).

For example, in Russian, the language tested in the present study, verbs are marked for both tense and aspect. Russian distinguishes inflections of past and non-past tenses that are used to refer to the past, present or future. Also, each Russian verb belongs to either a perfective or imperfective aspect,¹ expressed through various patterns of derivational morphology (e.g., imperfective *pisat’* – perfective *napisat’* (“to write”), imperfective *sprashivat’* – perfective *sprosit’* (“to ask”), imperfective *ukrashat’* – perfective *ukrasit’* (“to decorate”). Tense and aspect interact in Russian, as shown in Table 1. Both perfective and imperfective verbs can refer to the past and future, but only imperfective verbs can be used in the present. The suffix *-l-* and an inflection for gender and number (\emptyset for masculine singular) are added to the infinitive (imperfective or perfective) verb stem to form past tenses (past imperfective and past perfective). To form the present imperfective, an inflection for person and number is added to the present stem of an imperfective verb, while the future perfective is derived with the same morphology from the present stem of a perfective verb. For imperfective verbs, reference to the future is expressed through the analytical future imperfective by combining a present form of the verb *byt’* (“to be”) with an imperfective infinitive.

Unlike rule-based tense morphology, Russian aspect is not a typical grammatical category. It uses derivational morphology, and although some strategies of aspectual pair formation can be applied, there is no uniform way to form perfectives from imperfectives and vice versa. Also, aspectual derivation is often accompanied by an additional semantic shift (e.g., the imperfective *prygat’* (“to jump”) has an iterative meaning, while one of its perfective counterparts *prygnut’* gets a semelfactive interpretation, and another perfective *zaprygat’* has an ingressive interpretation). Aspectual counterparts are therefore considered different lexemes and represent different entries in the dictionary (Plungian, 2000; Zaliznyak & Shmelev, 2000). Thus, although expressed through morphological markers, Russian aspect has a highly lexical nature. This positions it between the purely grammatical and purely lexical aspects (Aktionsart).

Tense and aspect in heritage bilingual speakers and L1 attritors

Asymmetry in the crosslinguistic representation of tense and aspect is also reflected in the degree of erosion of these two categories in bilingual speakers. Tense marking is often found to be unaffected in heritage grammars (Benmamoun et al., 2013). Inuit receptive bilinguals showed preserved sensitivity to violations of tense, as opposed to other verbal categories (Sherkina-Lieber, Perez-Leroux, & Johns, 2011). Similarly, heritage Hungarian speakers produced no tense errors (Fenyvesi, 2000). English irregular past tense was also shown to be considerably retained in children who returned to Japan from the USA (Reetz-Kurashige, 1999; Tomiyama, 1999; Yoshitomi, 1999, but see Kang (2015) for contradictory data from Korean returnees).

In contrast to their performance on tense, bilingual speakers repeatedly display variable and reduced performance on the interpretation and production of aspect morphology (Montrul, 2002; Silva-Corvalán, 1994). Supporting evidence comes from both children and adult heritage speakers of several structurally different languages. For example, incomplete acquisition of Spanish aspect was found for simultaneous and early Spanish-American English adult bilinguals. Even when they were able to master basic aspectual oppositions, they failed to use them accurately in non-canonical, although pragmatically licensed, contexts (Montrul, 2002, 2009). Low-proficiency Inuit receptive bilinguals showed poor comprehension of aspectual morphology (Sherkina-Lieber, 2015). In the same vein, Polinsky (1997, 2006) reported that Russian-American English adult heritage speakers with low proficiency in Russian make no distinction between the two Russian aspects. Instead, they retain verbs in a single and invariable aspectual form, either perfective or imperfective, thus showing an essential loss of the perfective–imperfective opposition in Russian. Mikhailova (2012) also demonstrated that heritage adult speakers with early bilingualism onset interpreted Russian aspectual forms significantly poorer than monolinguals. Similarly, Gagarina, Armon-Lotem, and Gupol (2005) found that the number of aspectual errors increased significantly with age in the speech of successive Russian-Hebrew bilingual children; Ceytlin (2009) demonstrated considerable confusion in the Russian aspectual system in Azerbaijani-Russian bilingual children's production (but see Antonova-Ünlü and Li (2014) and Bar-Shalom and Zaretsky (2008), who reported a monolingual-like performance on Russian aspect for Russian-Turkish and Russian-American bilingual children).

In addition to the outlined studies of aspect in heritage speakers, a few works address performance on aspect in pure L1 attritors, but with mixed results. Laleko (2007) tested adult Russian-American English bilinguals who emigrated from Russia between the ages of 5 and 10, and reported multiple errors in their production of Russian aspectual counterparts following the aspect lexicalization track suggested by Polinsky (1996) for Russian heritage speakers. The same result was found in Russian-American English adult bilinguals tested by Polinsky (1997, 2006), who left their Russian communities at the age of 7 and later, and therefore can be classified as L1 attritors in strict terms, and not heritage speakers. However, Mikhailova (2012) demonstrated that adult bilingual speakers of Russian and American English with similar late bilingualism onsets (7–13 years), who also represent a sample of L1 attritors, show a monolingual-like behaviour on aspect interpretation. Similarly, Montrul (2002) tested a comparable group of Spanish-American English bilinguals (labelled as late child L2 learners) and reported that the majority did not differ from monolinguals, but a few individuals in this group still showed erosion of aspect. Thus, although examples of aspect erosion have been reported for L1 attritors, the status of aspect processing in this bilingual population has yet to be specified.

Notably, the dissociation between tense and aspect seen in heritage speakers and of potential relevance for L1 attritors (Laleko, 2007; Montrul, 2002; Polinsky, 1997, 2006) consistently occurred when L1 and L2 similarly represented the category of tense but were profoundly different

regarding aspect. Basic types of time reference (past, present and future) grammaticalized through tense morphology are present in all of the above-mentioned languages (Azerbaijani, English, Hebrew, Hungarian, Inuittitut, Japanese, Russian, Spanish and Turkish). In contrast, the aspectual systems of the tested L1s (Russian and Spanish) considerably differ from how aspect is represented in the L2s of their speakers. Unlike Russian and Spanish, English uses analytical verb forms and lexical devices to express aspect, while Hebrew, for example, merges aspect and tense so that perfective forms are used to refer to the past, and imperfective forms refer to the non-past. Montrul (2002) argued that such a divergence in grammatical resources available for the expression of aspectual oppositions in L1 and L2 is responsible for aspect attrition in L1 Spanish under the influence of the sociolinguistically dominant L2, English. The available evidence on Russian aspect erosion in Russian-American and Russian-Hebrew bilingual speakers, as well as on the general robustness of tense, can be similarly conceptualized in the framework of the L2 transfer hypothesis (Andersen, 1983), which laid the basis for the present study.

The study

The main goal of the study was to test, for the first time, the L2 transfer hypothesis in relation to tense and aspect attrition in the same sample of participants. The studies reviewed above focused on either tense or aspect; we tested the status of both categories in the L1 of bilingual speakers. For that, Russian and German were chosen as target languages. Similar to Russian, German distinguishes among past, present and future events with inflectional morphology and analytical verb forms. Although the realizations of each specific form differ in German (e.g., past – *hat geschrieben* (“s/he wrote”), present – *schreibt* (“s/he writes”), future – *wird schreiben* (“s/he will write”)) and Russian (see Table 1), the two languages have a comparable grammatical inventory to express tense. However, Russian and German considerably differ in how aspectual distinctions are expressed. In Russian, aspectual meaning is assigned to each verb by means of derivational morphology. In German, the internal constituency of an event can only be specified with lexical resources, if needed. For example, past forms of Russian verbs are explicit about aspect (e.g., imperfective *pisal* (“he was writing”) versus perfective *napisal* (“he wrote”)), while German present perfective (e.g., *hat geschrieben* (“s/he wrote”)), a default past form of a verb, only conveys information about the completeness of an event and is not informative about its internal structure without additional lexical specifications. In line with the L2 transfer hypothesis, Russian attritors whose L2 is German were expected to perform more poorly on Russian aspect than tense because the grammatical category of aspect is not represented in their dominant L2, while grammatical tense is expressed in both of their languages. In addition, Russian-German interaction represents a more predictable situation than the previously tested influence of L2 English on L1 Russian (Laleko, 2007; Mikhailova, 2012; Polinsky, 1997, 2006), because English also possesses a grammaticalized aspectual system, which, however, highlights different semantic distinctions as compared to Russian aspect.

Secondly, we aimed to test whether this L2 transfer effect is modulated by the two extralinguistic factors outlined above: the age of bilingualism onset and the amount of exposure to L1. In line with available evidence about the association of the age of immigration with the degree of L1 erosion in multiple linguistic domains (Bylund, 2009; Montrul, 2002, 2008; Schmid, 2002, 2013; Schmitt, 2010), we predicted that Russian-German bilinguals would show a graded decline in performance, and bilinguals with later bilingualism onset would outperform those who started acquiring L2 earlier. Regarding the second factor, we explored the role of the amount of L1 input in the attrition of Russian tense and aspect, in light of the contradictory findings provided by previous studies (De Bot et al., 1991; Köpke, 1999; Schmid, 2002 versus Jaspaert & Kroon, 1989; Schmid, 2007; Schmid & Dusseldorp, 2010).

Finally, the present study focused on a specific bilingual group, L1 attritors, to investigate the potential erosion of both tense and aspect. Most available evidence on tense and aspect processing in bilingual populations comes from heritage speakers who are commonly discussed from the point of view of incomplete acquisition (Montrul, 2002, 2006, 2008; Polinsky, 1997, 2006, 2007; Silva-Corvalán, 1994, 2003). When potential L1 attritors are involved, data from them and pure heritage speakers are often collapsed, thus making it difficult to explore the differences in the two populations. For example, Polinsky (1997, 2006) reported the performance of a bilingual group, which included speakers born in the country of their L2 and early/simultaneous bilinguals on the one hand, and potential L1 attritors with late bilingualism onset on the other hand. Mikhailova (2012) differentiated between early and late bilinguals, but similarly to Laleko (2007) did not provide information about the status of tense in L1 attritors. To our knowledge, our study is the first to investigate erosion of both tense and aspect in L1 attritors, that is, after these categories were fully acquired in a speaker's L1.

Method

Participants

A monolingual group and a bilingual group participated in the study. The monolingual group ($N = 30$; mean age (and range) – 30 (22–44) years; 14 females; mean years (and range) of education – 16 (11–19) years) included native speakers of Russian permanently residing in Russia, who were brought up in a monolingual environment. They learned other foreign languages as adolescents (from 10–13 years on) as a part of their standard formal education and never lived outside of Russia for longer than six months. No language professionals were included in this group.

The second group included Russian-German bilingual speakers ($N = 30$; mean age (and range) – 28 (22–36) years; 14 females; mean years (and range) of education – 16 (12–17) years) matched on the mentioned variables with the monolingual group ($p > 0.05$ on independent sample t -tests). Bilingual participants were born in Russia and spoke Russian in early childhood as their only language, thus obtaining knowledge of Russian in a setting without formal instruction. They immigrated to Germany and began learning German between the ages of 6 and 15, and by the time of testing had at least 12 years of German exposure. Although all members of the bilingual group had Russian as their L1, in multiple sections of the sociolinguistic questionnaire adapted to Russian from Keijzer (2007), they reported German or both German and Russian to be their current dominant languages.

To get more insight into the influence of the age of L2 onset and the proportion of L1 input on L1 attrition, the bilingual group was divided into three subgroups of 10 participants each: EBL1- participants were earlier bilinguals (age of bilingualism onset: 6–11 years) with very limited or no L1 input after immigration; EBL1+ participants were earlier bilinguals (age of bilingualism onset: 6–10 years) with substantial L1 input after immigration; and LB participants were late bilinguals (age of bilingualism onset: 12–15 years), all of whom had substantial L1 input after immigration. The bilingualism onset age and the amount of L1 input in the three subdivisions of the bilingual group were determined on the basis of relevant sections of the questionnaire adapted from Keijzer (2007), which is summarized in Table 2. The former measure was based on the reported age of first exposure to German; the latter took into account participants' responses about the amount of Russian spoken at home, in educational settings and in other social situations. Such a division in the bilingual group allowed us to differentially monitor the impact of the two extralinguistic factors under investigation: the groups of earlier bilinguals (EBL1- and EBL1+) differed in terms of amount of L1 exposure post immigration, while the critical distinction between the EBL1+ and LB groups was age of bilingualism onset.

Table 2. Biographical and sociolinguistic data about bilingual participants.

Characteristics	EBLI-	EBLI+	LB
Mean age at time of testing (min-max)	27 (22–35)	26 (22–32)	31 (25–36)
Mean age of first exposure to German (min-max)	9 (6–11)	8 (6–10)	13 (12–15)
Mean number of years of exposure to German (min-max)	18 (13–26)	19 (15–24)	18 (12–23)
Language spoken at home			
<i>Russian</i>	7%	80%	93%
<i>German</i>	93%	20%	7%
Primary language of education			
<i>Russian</i>	14%	7%	39%
<i>German</i>	86%	93%	61%
<i>Both</i>			
Language used in other social situations			
<i>Russian</i>	7%	50%	
<i>German</i>	93%	50%	30%
<i>Both</i>			70%
Dominant language			
<i>Russian</i>			50%
<i>German</i>	100%	88%	
<i>Both</i>		12%	50%
Speak better			
<i>Russian</i>			20%
<i>German</i>	100%	98%	
<i>Both</i>		2%	80%
Understand better			
<i>Russian</i>			14%
<i>German</i>	100%	60%	
<i>Both</i>		40%	86%

EBLI-: earlier bilinguals with little exposure to L1; EBLI+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

Materials

The materials were based on 42 aspectual pairs (see the Appendix) of Russian verbs representing a single actional class. All selected verbs were strong telic verbs denoting an activity of the agent that causes a change in the state of the theme and having endpoints. Imperfective verbs within this group express an activity that causes gradual change in the theme's state, such as *pilit' brevno* ("to be sawing a log"). Perfective verbs denote the result of this activity and the endpoint of the state change, such as *raspilit' brevno* ("to have sawed a log") (Tatevosov, 2005). This aspectual class was selected to ensure that bilingual participants acquired verb pairs used in the materials before immigration. Although fine-grained aspect processing may not be fully fledged even by the age of 7 (Kazanina & Phillips, 2003, 2007; Stoll, 1998, 2005), basic tense/aspect and perfective/imperfective distinctions in Russian are acquired by the age of 3 (Bar-Shalom, 2002; Brun, Avrutin, & Babyonyshev, 1999; Filiouchkina, 2004; Vinnitskaya & Wexler, 2001). Specifically, Stoll (1998) demonstrated that 6-year-old Russian children highly accurately differentiate between imperfective and perfective telic verbs. These findings suggest that the forms of telic verbs used in the present study were fully acquired by all participants when they emigrated from Russia.

Overall, verbs were matched on argument structure (all transitive) and lemma frequency (mean frequency in each subgroup was 13 occurrences per million words, as indexed in the New Frequency Dictionary of the Russian National Corpus; Lyashevskaya & Sharov, 2009). To control for morphological complexity, the aspectual pairs represented three groups: one third contained pairs with the imperfective verb being morphologically less complex than its perfective counterpart (I<P), such as *stroit'* – *postroit'* (“to build”); another third included pairs with the reverse pattern (I>P), for example, *zashivat'* – *zashit'* (“to sew”); and the last group comprised pairs of equal morphological complexity (I=P), such as *razrushat'* – *razrushit'* (“to destroy”). In the first group, the perfective verb is derived from the imperfective counterpart with a prefix; in the second group, the imperfective verb is derived from the perfective with a suffix; in the third group, the aspectual counterparts differ in one or two phonemes and often have different stress positions.

A sentence violation paradigm was used to investigate the recognition of two kinds of violations. Aspect violations and tense violations were presented to the participants in separate sentences, as well as their congruent counterparts. There were two sets of stimuli in the experiment. The first set included 21 experimental sentences with different perfective verbs. The second set included 21 sentences with different imperfective verbs. All verbs were in the past tense, since only these forms differ in aspect, and not time reference, in contrast to imperfective and perfective present tense forms. Both sets of verbs were presented in three conditions, as illustrated in Table 3: correct with perfective/imperfective verbs; incorrect with aspect violation; and incorrect with tense violation. Each sentence included a temporal setting phrase, either referring to the past (e.g., yesterday, last Friday) or future (e.g., tomorrow, next Saturday); an aspectual setting phrase, either imperfective (e.g., for entire ten minutes, all day long) or perfective (e.g., literally in a minute, in several hours); an animate subject; a verb; an inanimate object; and an extra word or phrase finalizing a sentence and irrelevant for the analysis. In the correct versions, verbs were preceded by a congruent aspectual and temporal context. In the aspect violation condition, the verbs were preceded by a congruent temporal context and an incongruent aspectual context; in the tense violation condition, they were preceded by an incongruent temporal context and a congruent aspectual context. This resulted in a 3 (correct/aspect violation/tense violation) × 2 (perfective/imperfective verb) design.

Preliminary plausibility ratings of the constructed sentences were collected from 60 monolingual Russian speakers using the online survey service www.lcs.ru. This was done for all experimental sentences to ensure that sentences in the correct condition are considered plausible, while those with violations are not. The sentences were presented to the participants as yes/no-questions, with the *yes*-answers marked with “1” and the *no*-answers marked with “2”. Paired-sample *t*-tests showed that there was a significant difference between the mean ratings of sentences in the correct condition ($M = 1.1$, $SD = 0.11$) and those with the tense violation ($M = 1.96$, $SD = 0.07$; $t = -43.1$, $p < 0.001$) and aspect violation ($M = 1.93$, $SD = 0.06$; $t = -42.3$, $p < 0.001$). There was no difference found between the mean ratings of the tense violation and the aspect violation conditions ($t = 1.82$, $p = 0.07$). In summary, the correct sentences obtained significantly higher plausibility ratings than the sentences with the two types of violations. Participants' ratings of the sentences with the two types of violations, meanwhile, did not differ significantly from one another.

To avoid any repetition effect, the experimental sentences from both sets were assigned to three lists in such a way that each list contained only one version of each experimental item (correct version, with aspect violation or with tense violation), resulting in 42 experimental sentences per list (21 per set). The lists were complemented with 42 filler sentences (the same for all three lists), a third of which included violations of different kinds (subject–verb agreement in terms of number or gender, and incorrect verb prefixes). In total, each list contained 84 sentences, half of them correct. The order was pseudo-randomized to avoid the effects of learning or attention loss. All sentences were read aloud by a female native speaker of Russian and audio-recorded in a professional

Table 3. Examples of experimental stimuli: three experimental conditions with the imperfective verb *krasit'* ("to paint") and the perfective verb *pochistit'* ("to clean").

Condition	Set 1. Imperfective verbs	Set 2. Perfective verbs
Correct	Na proshloj nedele tselyje vyhodnyje malyar krasil zabor svoej tjoschi. <i>Last week, for the whole weekend, the decorator was painting the fence of his mother-in-law.</i>	Vchera za paru sekund devushka pochistila tufli prijatelja. <i>Yesterday, in a couple of seconds, the girl cleaned the shoes of a friend.</i>
Aspect violation	*Na proshloj nedele <u>za neskolkko chasov</u> malyar krasil zabor svoej tjoschi. <i>*Last week, in several hours, the decorator was painting the fence of his mother-in-law.</i>	*Vchera <u>tselyh desjat' minut</u> devushka pochistila tufli prijatelja. <i>*Yesterday, for the whole ten minutes, the girl cleaned the shoes of a friend.</i>
Tense violation	* <u>V grjaduschem mesjatse</u> tselyje vyhodnyje malyar krasil zabor svoej tjoschi. <i>*In the coming month, for the whole weekend, the decorator was painting the fence of his mother-in-law.</i>	* <u>Zavtra vecherom</u> za paru sekund devushka pochistila tufli prijatelja. <i>*Tomorrow evening, in a couple of seconds, the girl cleaned the shoes of a friend.</i>

studio in Moscow. The obtained recordings were then cut in such a way that each sentence comprised a separate file, saved in Waveform Audio File Format (.wav). To optimize further data analysis, all experimental sentences were processed in Sound Forge Pro 10 (Sony Creative Software), so that the verb onset was positioned at 6000 milliseconds after the audio file onset by manipulation of a pause before the onset of the sentence.

Procedure

Programming and presentation of the experimental stimuli was done using E-prime software (Psychology Software Tools Inc., 2001). In order to avoid fatigue effects and loss of attention, the 84 sentences of each list were presented to the participants in two sessions consisting of 42 sentences each. There was a short break between the sessions; the participant pressed a button when they were ready to proceed. Each participant was exposed to one list of materials only, which resulted in 10 monolinguals and 10 bilinguals per list.

The participants sat in front of a computer with a white screen. They were informed that they would hear sentences in Russian, some of which would entail an error (the type of error was not specified). The modality was auditory, because reading in Cyrillic could be independently compromised in the tested cohort of bilinguals. Participants were asked to press the space bar as soon as they detected an error in a sentence. The response speed was emphasized, since the focus of the measure was on a primary reaction, and not on the ultimate interpretation of a sentence. Participants completed five practice items before the experiment (two items in the correct condition and three items with violations of different kinds) and were given feedback on their accuracy. No feedback was given during the experimental sessions. Each trial began with a 500 millisecond-long beep sound, directing the participants' attention to the sentence. Following this sound, the sentence was presented, followed by a 2500 millisecond-long pause. Participants responded to errors by pressing the space bar during or after sentence presentation.

Data processing

Accuracy results were extracted automatically from individual participants' output files generated by E-prime software. In the correct condition trials, a response was scored as accurate if the

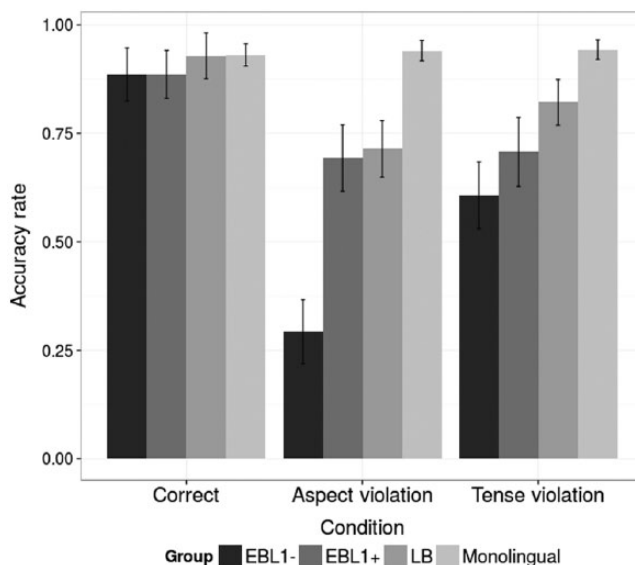


Figure 1. Mean accuracy scores and confidence intervals across conditions and groups. EBL1-: earlier bilinguals with little exposure to L1; EBL1+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

participant did not press the space bar, signalling no identified mismatch in the sentence. In trials with violations, a response was taken as correct if the bar was pressed. An additional check confirmed that, in the experimental trials, participants never pressed the bar before 6000 milliseconds, before the onset of the verb violating the previous context. Statistical analysis was carried out in R (R Development Core Team, 2013).

We fit a generalized linear mixed-effects model with a logit link function. As fixed effects, we entered group (monolingual/LB/EBL1+/EBL1-) and condition (correct/aspect violation/tense violation) as well as the interaction between them. As random effects, we had intercepts for subjects and items, as well as a by-subject random slope for condition only (as group is a between-subjects variable), and by-item random slopes for group and condition (but not the interaction between them, due to non-convergence issues). We employed sum contrast coding, and used the correct (no violation) condition and the monolingual group as reference levels.

To examine the effect of the specific aspectual characteristic of a verb on violation identification accuracy, the data were restricted to the aspect violation condition and a second model was built. As fixed effects, we entered group and aspect (perfective/imperfective) with the interaction between them. As random effects, we had intercepts for subjects and items, as well as a by-subject random slope for aspect (as group is a between-subjects variable) and a by-item random slope for group (as aspect is a between-items variable). We employed sum contrast coding, and used the perfective aspect condition and the monolingual group as reference levels.

Results

The results of the overall analysis are presented in Figure 1 and in Table 4; the coefficients and significance levels resulting from statistical analysis can be found in Table 5.

A main effect of condition was found: aspect violations elicited significantly fewer accurate responses in comparison to the correct (no violation) condition. There was no significant difference

Table 4. Mean accuracy scores across conditions in the four experimental groups.

Condition	Group			
	Monolingual	EBLI-	EBLI+	LB
Correct	0.93	0.89	0.89	0.93
Aspect violation	0.94	0.29	0.69	0.71
Tense violation	0.94	0.61	0.71	0.82

EBLI-: earlier bilinguals with little exposure to L1; EBLI+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

Table 5. Statistical analysis: model parameters and significance values.

	Coefficient estimate	Standard error	Z value	P value
Intercept	1.917	0.150	12.753	<0.001***
Aspect violation	-0.675	0.188	-3.589	<0.001***
Tense violation	-0.024	0.172	-0.138	0.891
EBLI-	-1.316	0.252	-5.218	<0.001***
EBLI+	-0.463	0.235	-1.972	0.049*
LB	0.265	0.254	1.041	0.298
Aspect violation × EBLI-	-1.171	0.289	-4.059	<0.001***
Tense violation × EBLI-	0.089	0.260	0.343	0.732
Aspect violation × EBLI+	0.270	0.272	0.993	0.321
Tense violation × EBLI+	-0.415	0.252	-1.647	0.100
Aspect violation × LB	0.060	0.292	0.205	0.838
Tense violation × LB	0.049	0.279	0.175	0.861

Note: significant results are marked with asterisks (* = $p < 0.05$; *** = $p < 0.001$).

EBLI-: earlier bilinguals with little exposure to L1; EBLI+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

between the scores on correct sentences and those with tense violations, nor between the scores on sentences with tense and aspect violations. A main effect of group was also found: the EBLI- and EBLI+ groups performed significantly worse than the monolingual group, and the EBLI- and EBLI+ groups differed from one another ($z = -1.97$, $p = 0.048$), with the latter producing more accurate responses. There was no reliable difference between the performance of the LB and monolingual groups. In addition, a significant interaction between the factors of condition and group was revealed: in the aspect violation condition, the EBLI- group performed significantly worse than the monolingual group. The statistical analysis yielded no other significant results.

As main effects should be interpreted with caution in the presence of an interaction, we performed an additional test specifically in the correct condition and found no reliable difference among the groups of participants. This suggests that the main effect of group and lower scores of the EBLI+ and EBLI- participants were driven by their performance in the violation conditions.

To test whether the two Russian aspects are vulnerable to different rates of attrition in the bilingual groups, we compared the performance of participants on sentences with aspectual violations made with perfective and imperfective verbs (see Figure 2; the coefficients and significance levels can be found in Table 6).

Similar to the overall analysis, a main effect of group was found. The EBLI- group produced fewer accurate responses than the monolingual group; no other group differed from the monolingual participants. A significant interaction between aspect and group was also found: EBLI+

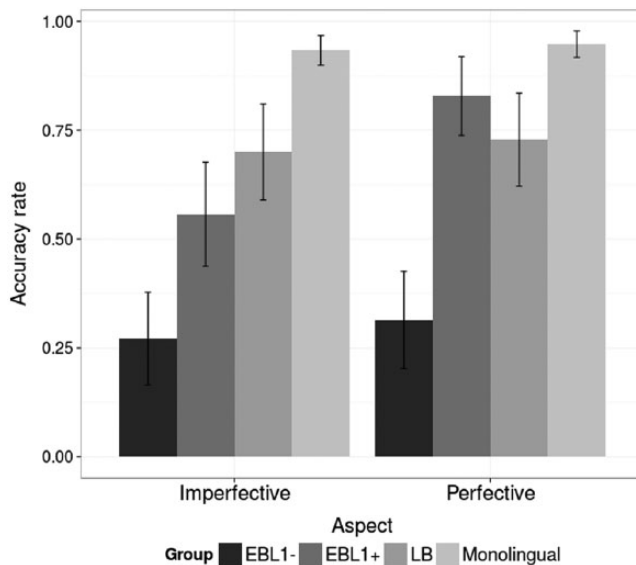


Figure 2. Effect of aspectual characteristics on the accuracy of violation identification. EBL1-: earlier bilinguals with little exposure to L1; EBL1+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

Table 6. Analysis of the effect of aspect on violation identification: model parameters and significance values.

	Coefficient estimate	Standard error	Z value	P value
<i>Intercept</i>	1.344	0.282	4.770	<0.001***
<i>Imperfective</i>	-0.293	0.170	-1.715	0.086
<i>EBL1-</i>	-2.701	0.498	-5.426	<0.001***
<i>EBL1+</i>	-0.218	0.449	-0.485	0.628
<i>LB</i>	0.286	0.475	0.602	0.547
<i>Imperfective × EBL1-</i>	0.044	0.299	0.147	0.883
<i>Imperfective × EBL1+</i>	-0.535	0.222	-2.410	0.016*
<i>Imperfective × LB</i>	0.275	0.243	1.132	0.258

Note: significant results are marked with asterisks (* = $p < 0.05$; *** = $p < 0.001$).

EBL1-: earlier bilinguals with little exposure to L1; EBL1+: earlier bilinguals with large exposure to L1; LB: late bilinguals.

participants performed more poorly in the imperfective condition than in the perfective condition. The analysis yielded no other significant results.

In summary, although the performance of the three bilingual groups on the correct condition was comparable to that of the monolingual speakers, they showed different degrees of accuracy in identifying both tense and aspectual violations. The LB group did not differ from the monolingual participants on any measure. The EBL1+ and EBL1- groups demonstrated poorer performance in the violation conditions, compared to the monolingual group; the EBL1- group showed a further decrease in the ability to identify violations, with worse performance on sentences with aspectual mismatches. Additional analysis of the potential differential processing of aspectual violations with perfective and imperfective verbs revealed better performance when identifying violations of perfective verbs in the EBL1+ group only.

Discussion

The current study investigated aspect and tense processing in a specific group of bilingual speakers: L1 attritors, who were asked to detect aspect and tense violations within a single paradigm. Driven by the L2 transfer hypothesis (Andersen, 1983; Pavlenko, 2000; Sharwood Smith, 1983), we predicted that since aspect is expressed differently in Russian and German, it would be more prone to attrition than tense, which is purely grammatical, and is similarly represented in the two languages. Under the L2 transfer account alone, all bilingual speakers who participated in the current study and were qualified as L1 attritors should have shown a difference in performance on aspect and tense, with lower scores on processing aspect violations than tense violations. However, we also tested the modulation of the L2 transfer effect by the two extralinguistic factors – age of bilingualism onset and the amount of exposure to L1 after immigration – predicting enhancement of the L2 transfer due to earlier bilingualism onset and less exposure to L1.

The performance of the EBL1- speakers in the aspect and tense violation conditions supported the L2 transfer hypothesis. Compared to the monolingual group, the EBL1- group identified aspectual violations significantly worse than tense violations. No such difference was found in the monolingual speakers of Russian, who performed equally well on correct sentences and those with any type of violation. However, in the other two bilingual groups, EBL1+ and LB, scores on aspect and tense violations did not differ either. This suggests a strong modulation of the L2 transfer effect by the amount of L1 input. In contrast to the EBL1- speakers, the EBL1+ and LB groups, both of which reported substantial Russian input after immigration (speaking Russian most of the time at home and using it extensively in other social contexts, see Table 2), were able to retain Russian aspect and tense to the same extent even in the overall dominance of German. This finding is in line with previous suggestions (De Bot et al., 1991; Köpke, 1999; Schmid, 2002) about the positive impact of the amount of exposure to L1 and frequency of its use on attrition. Also, our results support the Activation Threshold Hypothesis (Paradis, 2004, 2007), since the speakers in the EBL1+ and LB groups used Russian aspect more often than the EBL1- individuals did, thus lowering this category activation threshold and making it less susceptible to attrition. Although the role of L1 exposure remains contradictory in the literature (Jaspaert & Kroon, 1989; Schmid, 2007; Schmid & Dusseldorp, 2010), our data suggest its significant contribution at least to processing Slavic aspect in the context of the dominance of a language with no comparable category.

Preserved sensitivity to aspectual oppositions in the EBL1+ and LB participants was found irrespective of the age of bilingualism onset, the factor that differentiated these two groups. That is, according to our findings, the consistently reported effect of the age of bilingualism onset (Birdsong, 2014; Bylund, 2009; Montrul, 2008; Schmid, 2002, 2013; Schmitt, 2010) is irrelevant for a potential dissociation between aspect and tense processing in L1 attritors. However, the age of bilingualism onset had another effect. While overall the LB participants performed similarly to the monolingual ones, the EBL1+ and EBL1- groups, compared to the monolingual speakers, showed decreased performance on both aspect and tense. Notably, this equal decrease in both violation conditions cannot be attributed to the typical preference of bilingual speakers to rate ungrammatical linguistic expressions as more acceptable than monolingual controls (Scontras, Fuchs, & Polinsky, 2015), since LB speakers did not show it. That is, irrespective of the amount of L1 exposure, L1 categories of tense and aspect are vulnerable in bilinguals with earlier ages of immigration. This confirms the significant impact of the age of bilingualism onset on general L1 verbal morphology attrition and its non-interactive nature with L2 transfer. Consequently, the finding supports the idea about the critical role of the puberty landmark in L2 attrition (Schmid, 2013). In contrast to most representatives of the two earlier bilingual groups, the age of first exposure to German of the LB participants varied from 12 to 15 years, meaning that their full exposure to

Russian ceased only after puberty, which apparently played a general protective role for their competence in verbal morphology.

In addition, both the amount of L1 exposure and the age of bilingualism onset contributed to yet another revealed effect. Members of the EBL1+ group, who had earlier ages of immigration but greater amounts of subsequent exposure to Russian, were the only ones who demonstrated a reliable advantage when processing aspectual violations with perfective verbs compared with imperfective verbs, both of which are marked with past tense morphology. This finding is in line with the Aspect Hypothesis (Andersen & Shirai, 1994; Shirai, 2016), which proposes a universal preference to mark telic verbs (such as those used in our study) with past/perfective morphology in particular. Similarly, Pereltsvaig (2002) proposed that telic verb forms with inherent endpoints, such as accomplishments and achievements, are prototypically associated with the perfective aspect, whereas atelic verb forms without an inherent endpoint, such as activities and states, are more often associated with the imperfective aspect. This advantage of telic perfective verbs over their imperfective counterparts in the past tense has been previously shown for Russian individuals with aphasia (Dragoy & Bastiaanse, 2013), and is also explained in terms of prototypical matches of past time reference, perfective aspect and telic semantics. Characteristically, the effect was revealed in the EBL1+ group exclusively, possibly because the performance of the EBL1- group was too low in the aspectual violation condition to reveal any detailed effects. Meanwhile, the LB group's competence of Russian was too close to that of the monolingual group, so that they did not have to rely on specific heuristics in aspect processing. By contrast, EBL1+ participants represent the most probable target group for the effect of the prototypical verb class-aspect-time reference match, because they have been exposed to enough L1 input to acquire Russian aspect, but they have also experienced sufficient interference with German from early childhood to make this acquisition vulnerable. These circumstances may therefore result in a mechanism of aspect processing that is different from the norm. This mechanism may be similar to that seen in individuals with aphasia, resorting to the heuristics of the prototypicality match.

The present study has several limitations. Firstly, larger groups of EBL1-, EBL1+ and LB participants are desirable to confirm the generalizations suggested by our data of 10 people in each group. In addition, many interesting research questions, for example, about other factors affecting attrition of L1 tense and aspect or about differential erosion of various aspectual classes, were beyond the scope of our relatively restricted study. These remain subject to further research.

Conclusion

Our findings first showed that the L2 transfer effect was strongly modulated by the amount of L1 exposure. This means that L2 transfer is not ubiquitous, but takes place under specific conditions. Russian aspect undergoes erosion that is influenced by a more dominant German with no comparable grammatical category only when supplemented with limited or no exposure to Russian after immigration. Consequently, bilinguals with low exposure to L1 became prone to the L2 transfer effect. In contrast, those who reported considerable L1 exposure showed resistance to the L2 transfer, suggesting that the large amount of L1 input significantly contributes to such resistance. Secondly, the factor of bilingualism onset age per se explained a great portion of our data without interacting with the L2 transfer effect. Irrespective of the specific representations of tense and aspect in L1 and L2, both categories were vulnerable to attrition in individuals with an earlier bilingualism onset. This confirms the importance of the puberty landmark for L1 erosion, with no serious deviations from monolingual performance in late bilinguals. Finally, an additive value of the amount of L1 exposure and the age of bilingualism onset was revealed in respect to the sensitivity to aspect-tense matching: bilinguals with earlier ages of immigration and large subsequent L1

input, but not those with either late bilingualism onset or little L1 input, showed better performance on the prototypical match of past tense with perfective verbs than on its non-prototypical match with imperfective verbs.

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Note

1. There is also a limited class of biaspectual verbs, which can act both as perfective and imperfective (Anderson, 2002; Zaliznyak, 1977).

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Appendix. Verbs used in the test.

N	English translation	Morpho-logical complexity	Imperfective verb (frequency)	Perfective verb (frequency)	Object noun
1	To iron the laundry	I<P	гладить (19.1)	погладить (17.3)	бельё
2	To fry meat	I<P	жарить (8.8)	пожарить (1)	мясо
3	To weed beds	I<P	полоть (3.8)	прополоть (0.5)	грядки
4	To cut a sausage	I<P	резать (23)	порезать (5.6)	колбасу
5	To paint a fence	I<P	красить (10.9)	покрасить (5.9)	забор
6	To draw a portrait	I<P	рисовать (37.5)	нарисовать (33.9)	портрет
7	To chop wood	I<P	рубить (15.4)	порубить (1.8)	дрова
8	To build a pavilion	I<P	строить (82.2)	построить (114.9)	беседку
9	To sharpen a knife	I<P	точить (4.9)	наточить (0.9)	нож
10	To draw a square	I<P	чертить (4.2)	начертить (2.2)	квадрат
11	To polish shoes	I<P	чистить (17)	почистить (5.1)	туфли
12	To forge a sword	I<P	ковать (2.8)	выковать (1.2)	меч
13	To model a sculpture	I<P	лепить (8.2)	вылепить (2.6)	скульптуру
14	To saw a log	I<P	пилить (6.3)	распилить (1.6)	бревно
15	To grind pepper	I=P	измельчать (1.3)	измельчить (3.6)	перец
16	To change a testament	I=P	изменять (22.1)	изменить (79.9)	завещание
17	To decorate a Christmas tree	I=P	наряжать (1.5)	нарядить (2.4)	ёлку
18	To charge a gun	I=P	заряжать (3.6)	зарядить (9.6)	ружьё
19	To fill a barrel	I=P	наполнять (11.5)	наполнить (27.9)	бочку
20	To banish wolves	I=P	отгонять (4.8)	отогнать (4.7)	волков
21	To clean a pipe	I=P	прочищать (0.9)	почистить (1.6)	трубу
22	To remove wallpaper	I=P	отрывать (11.6)	оторвать (27.5)	обои
23	To move a fridge	I=P	передвигать (3.9)	передвинуть (3.3)	холодильник
24	To unknit a sweater	I=P	распускать (4)	распустить (9.4)	свитер
25	To decorate a room	I=P	украшать (17.2)	украсить (23.6)	комнату
26	To disassemble a motorcycle	I=P	разбирать (18.5)	разобрать (26.8)	мотоцикл
27	To unload a boat	I=P	разгружать (2.6)	разгрузить (1.9)	лодку
28	To destroy headstones	I=P	разрушать (15.3)	разрушить (33.2)	надгробия
29	To beat a carpet	I>P	выбивать (7)	выбить (19.6)	ковёр
30	To eat up a cake	I>P	доедать (2.3)	доесть (2.8)	пирог
31	To sew up pants	I>P	зашивать (1.5)	зашить (3.9)	брюки
32	To sew buttons	I>P	пришивать (1.8)	пришить (5.9)	пуговицы
33	To kick in a door	I>P	взламывать (1.2)	взломать (3)	дверь
34	To bury treasures	I>P	закапывать (2.7)	закопать (1.5)	сокровища
35	To sweep a street	I>P	подметать (3.1)	подмести (1.8)	улицу
36	To stick ads	I>P	расклеивать (0.5)	расклеить (1.1)	объявления
37	To comb hair	I>P	расчёсывать (2.3)	расчесать (2.1)	волосы
38	To fold clothes	I>P	складывать (13.4)	сложить (40.1)	одежду
39	To water flowers	I>P	поливать (11.1)	полить (5.7)	цветы
40	To nail a shelf	I>P	прибивать (1.5)	прибить (7.2)	полку
41	To deliver all letters	I>P	разносить (5.7)	разнести (6.6)	все письма
42	To wind wire	I>P	сматывать (0.8)	смотать (0.7)	проволоку

Note: I<P: imperfectives less complex than perfectives; I=P: equal complexity; I>P: imperfectives more complex than perfectives.