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Mental Lexicon Structure in L1 and L2 Acquisition:
Russian Evidence[*]

Background

This study explores the structure of the mental lexicon and the processing of Russian verbal morphology by three groups of speakers, adult American learners of Russian, Russian children aged 4-6 with normal linguistic development, and Russian children aged 4-7 with specific language impairment (SLI). It reports the results of three matching series of experiments conducted at the University of Maryland, USA and St. Petersburg State University, Russia. The theoretical framework for this study comes from research on the structure of the mental lexicon and modularity in morphological processing. So far, there are very few studies investigating the processing of complex verbal morphology, with most of the work done on Icelandic, Norwegian, Italian, German, and Russian (Chernigovskaya and Gor 2000, Clahsen 1999, Gor and Chernigovskaya 2001, 2003, Matcovich 1998, Orsolini and Marslen-Wilson 1997, Orsolini et al. 1998, Ragnasdóttir, Simonsen, and Plunkett 1997, Simonsen 2000). The current views are shaped predominantly by research on English regular and irregular past-tense inflection, which has been conducted within two competing approaches.

According to the dual-system approach, regular and irregular verbs are processed by two distinct mechanisms or modules. Regular verbs are computed in a rule-processing system, while irregular verbs are processed in associative memory. (Marcus et al. 1992, 1995, Pinker 1991, Pinker and Prince 1988, 1994, Prasada and Pinker 1993, Ullman 1999). This so-called dual-system view holds that since irregular verbs are retrieved from associative memory, they will be frequency-sensitive. Thus, high-frequency forms will be

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better remembered than low-frequency forms. Unlike irregular verbs, regular verbs will show no frequency effects. The opposite single-system approach in its two variations, the connectionist (Plunkett and Marchman 1991, 1993, Rumelhart and McClelland 1986, MacWhinney and Leinbach 1991) and the network (Bybee 1985, 1995, Langacker 1987, 1988) approaches, holds that both regular and irregular verbs are processed by one single mechanism in associative memory. In other words, the single-system approach claims that no symbolic rules are used in morphological processing, only memory-based associations. Consequently, it predicts that both regular and irregular verbs will show frequency effects.

Research on frequency effects in morphological processing deals with two kinds of frequency, the so-called token frequency and type frequency. Token frequency refers to the frequency of the individual verb, and is further subdivided into whole-word frequency (or frequency of the word-form) and stem-cluster frequency (or cumulative frequency of all the word forms which share one stem). It is believed that whole-word frequency effects reflect the fact that the word is stored in a morphologically undecomposed form, while stem-cluster frequency effects reflect exactly the opposite, namely, that the words in the cluster are stored decomposed, and thus all the occurrences of the stem regardless of the inflections are computed together. It should be noted that whole-word and stem-cluster frequencies for the individual stems often positively correlate, which makes it difficult to control for one parameter while manipulating the other[i]. Type frequency (or the size of the class of words), a much less explored parameter, is now attracting more attention in frequency-based accounts of linguistic processing than token frequency (Ellis 2002).

It is clear that the properties of English past-tense inflection with only one regular verb class and with no developed conjugational paradigm cannot be readily generalized to other languages with developed inflectional morphology. Two developmental studies of child first language (L1) acquisition of complex verbal morphology, one in Norwegian and Icelandic and the other in Italian, recorded the influence of both type and token frequencies on their subjects' responses. The results of these studies, which assessed the influence of input frequencies through the rates of overgeneralizations, are in conflict with the predictions made by the proponents of the dual-system approach (Matcovich

1998, Ragnasdóttir, Simonsen, and Plunkett 1997, Simonsen 2000). At least two studies on languages other than English which exhibit a more complex system of inflectional morphology claim to support the predictions of the dual-system approach. One is a small-scale experiment with three bilingual Norwegian-English-speaking children (Jensvoll 2003), and the other is a comprehensive study of adult and child L1 processing of the German noun plural and past participle inflection (Clahsen 1999)[ii]. It may be too early to reach any definitive conclusions based on a pilot study supporting the dual-system approach on the grounds that the bilingual children performed better on the strong (irregular) Norwegian verbs than on the smaller weak verbs. The type frequency of the smaller weak verbs in Norwegian is considerably higher than that of the strong verbs, which led the author to conclude that this result cannot be attributed to the role of input frequency predicted by the single-system approach[iii]. While indeed these data do not support the prediction of the single-system approach, this does not necessarily mean that the study did not find a frequency effect. One also needs to look at the number of uses parameter evoked in the argumentation of the position exemplified in the Rule Competition Model (Yang 2002).

The analysis of the experimental data on German inflection (Clahsen 1999) is the most comprehensive one for any language other than English. It uses a variety of experimental techniques—sentence matching, cross-modal morphological priming, lexical decision tasks, and an event-related potentials study. The results obtained using different research paradigms show a robust effect that Clahsen interprets as the difference in regular and irregular processing. In fact, this effect should probably be attributed to the differences between default and non-default processing. Moreover, if we believe that regular inflection in German indeed relies on different processing mechanisms than irregular inflection, we will have to admit that the overwhelming majority (93%) of German nouns belong to irregular inflectional types, the fact which allowed the opponents of the dual-system-based interpretation of his data to call Clahsen's claims "a Pyrrhic victory over connectionism" (Schreuder et al. 1999). Therefore, the data on languages with rich inflectional morphology do not fully support the dual-system approach.

Phonological similarity to other verbs was also shown to play an important role in the processing of English past-tense inflection. It influenced the processing of English irregular verbs, but not regular ones (Prasada and Pinker 1993, Ullman 1999), thus supporting the dual-system approach. However, the data from a language with complex verbal morphology challenged the results obtained for English. Both developmental and adult data on past-tense processing in Italian showed effects of phonological similarity even in the Conjugation 1 class, considered to be a regular and default class (Matcovich 1998).

Rationale for the Study

This study investigates the processing of verbal morphology in Russian, a language with numerous verb classes differing in type frequency (size) and the number and complexity of conjugation rules. It assumes that instead of a sharp opposition of regular and irregular verb processing, a gradual parameter of regularity may be more appropriate for Russian[iv]. Therefore, the issue of symbolic rule application versus associative patterning can take on a new meaning for Russian, possibly, with the distinction between default and non-default processing replacing the regular-irregular distinction.

We have seen from a brief overview of the predictions made by the proponents of the dual- and single-system approaches, and the experimental data in support of their claims that the main argument in the polemics concerns the role of frequencies in verbal processing: frequency effects in regular inflection are in conflict with the predictions of the dual-system approach. In other words, the existence of frequency effects in regular verb processing is an argument in favor of associative patterning endorsed by the single-system approach and against symbolic rule application. The present experiment focuses mainly on type frequency[v], or the size of the class using a particular conjugational pattern, for which the dual-system approach predicts no role in regular verb processing, since symbolic rules are applied regardless of the frequency of the rule. If such type frequency effects are found in regular verb processing, this either disproves the dual-system theory or else indicates that symbolic rule computation is in fact not immune to linguistic probabilities.

The study explores the possible similarities and differences between child L1 and adult L2 verbal processing and tests the hypothesis that adult second language (L2) morphological processing shaped by formal learning is different from child L1 morphological processing. It addresses the following issues:

1. Is there a developmental tendency in child L1 acquisition of complex verbal morphology?

2. Does morphological processing in beginning adult second language (L2) learners match the processing in any of the child age groups?

3. Which population, children or L2 learners, relies more on associative patterning?

Additionally, the study explores the role of the stimuli frequency in the testing material in the processing of complex verbal morphology. And indeed, if the structure of the testing material, the composition and sequencing of the stimuli in the experimental set can lead to priming effects in regular verbs, this would be an argument in favor of the role of frequency in the processing of inflectional morphology.

And finally, the study compares the processing of verbal morphology in normal and SLI children with the aim of establishing similarities and differences between these two groups of speakers.

Russian Verb System

According to the one-stem description developed by Jakobson and his followers (Davidson, Gor, and Lekic 1996, Jakobson 1948, Townsend 1972), Russian has 11 verb classes, each with its own suffix (verbal classifier). The eleventh class has a zero suffix, and is subdivided into smaller subclasses depending on the quality of the root-final consonant. This is a small class, especially given the variety of conjugational patterns it includes, and there are well under 100 basic stems in it (Townsend 1975). The conjugational patterns of some of the sub-classes of the non-suffixed stems have

idiosyncratic features, and thus form verb clusters, which can be compared to the neighborhoods of English irregular verbs, or alternatively, characterized by the minor rules. The remaining 10 suffixed classes are identified by the suffix: -aj-, -ej-, -a-, -e-, -i-, -o-, -ova-, -avaj-, -nu- (including the "disappearing –nu-"), and -zha-[vi]. The suffix determines all the parameters of the conjugational paradigm, which include: conjugationl type, consonant mutations, stress shifts, and suffix alternations.

The features of the Russian Verbal System include:

- Numerous verb classes;
- Developed conjugational paradigm;
- No sharp division between regular and irregular classes;
- Several regular classes in addition to default;
- Infinitives of many verb classes have unrecoverable stems due to the truncation of the stem-final consonant before consonantal endings. Thus, the default pattern(s) has unrecoverable stem in the infinitive.

Table 1 lists the morphological processes ("processing rules") shaping the conjugational patterns of the 4 stems chosen for the experiment[vii]. The -aj- stem has only one rule, that of automatic consonant deletion, in its paradigm. Our previous research has demonstrated that the -aj- pattern is the default pattern in Russian (Chernigovskaya, Gor 2000). The -a- and -i- stems have three rules. The -ova- stem has two rules. Thus, the overwhelming majority of verbs have regular inflection, but at the same time, conjugational patterns vary in morphological complexity, or the "degree of regularity." The first row in Table 2 provides the information on the type frequencies of the 4 verb stems based on *The Grammatical Dictionary of the Russian Language* (Zalizniak 1980). The largest classes -aj-, -i-, and -ova- are also productive in Russian. The second and third rows in Table 2 contain the two kinds of data on the input frequencies to the American learners taking part in the experiment—type frequency and the number of uses. The latter parameter includes all the occurrences of the verbs belonging to a particular class computed together.

Table 1. Automatic and Non-Automatic Morphological Processes in the Stems Included in the Experiments

Verb classes	**-aj-** High-frequency, productive, default	**-a-** Low-frequency, unproductive	**-i-** High-frequency, productive	**-ova-** High-frequency, productive
Conjugation type	1	1	2	1
Conson. deletion before conson. Endings (automatic)	√			
Vowel deletion before vowel endings (automatic)		√	√	√
Consonant mutation		√	√	
Stress shift		√	√	
Suffix alternation				√

Table 2. Type Frequency of the Verbal Classes Included in the Experiment: Native and Second Language Input

Verb classes	-aj- productive	-a-	-i- productive	-ova- productive
Russian language Type frequency	11814	940 Appr. 60 stems	7019	2816
Input to L2 learners Type frequency	55 (86[VIII])	14 (24)	52 (80)	13 (34)
Input to L2 learners Number of uses	4333	1298	4546	555

The -aj- and –a- stems included in the experimental material have similar infinitives and past tense, but have different conjugational patterns in the non-past tense. The stem is not recoverable in the infinitive and past tense because the "j" is truncated, therefore the speakers need to "guess" the underlying stem to conjugate the verb in the non-past tense. The experiment aims at establishing which conjugational patterns will be generalized.

Type and token frequencies (whole-word and stem-cluster) were shown to influence verbal processing in both adult and child native speakers. But while adult native speakers potentially have full access to type and token frequencies, formal L2 learners with lower proficiency in L2 have limited access to input frequencies in the target language. A beginning classroom typically exposes learners to most verb classes (types), but the relative size of these classes (type frequency) is not available to the learners, and the frequency of use of individual verb classes may differ substantially from that found in native Russian. Likewise, token frequencies of individual verbs used in a highly structured situation of learning and a controlled classroom setting do not reflect that found in native speech. As a result, L2 learners may develop an interlanguage (IL) system based on verb classes of a more uniform size than the classes in the native language and with non-native token frequencies of individual verbs. Therefore, one can hypothesize that native input frequencies will affect non-native verbal processing indirectly, only to the extent that they are reflected in the actual L2 input frequencies.

Accordingly, the study uses its own frequency counts, which were done with the assumption that the frequencies found in the instructional materials used in first-year Russian would be the best approximation available of the input frequencies to which our subjects were exposed[ix]. The type frequencies and the number of uses of all the verbs were computed for two volumes of the textbook and two volumes of the workbook, which are part of the instructional package *Live from Moscow!* (Davidson, Gor, and Lekic 1996) that was used in first-year Russian. The counts included not only all of the verbs present in the books, but also the verbs in exercises that the students had to generate themselves. For example, if the assignment was to say where the student eats his/her breakfast, lunch, and dinner, the verb "to eat" was counted 3 times in the 1st

person singular non-past tense. The type frequencies found in the input to the learners were compared with the data on the Russian language (Townsend 1975, Zalizniak 1980).

Experiment 1 with American Learners

The data for Experiment 1 were collected from 20 volunteer students at the University of Maryland at the end of their second semester of Russian. The experiment was conducted orally and individually with each subject, and recorded on audiotape. The subjects met with the experimenter and received the printed version of the test assignment, which included written instructions. The experiment with American learners (and Russian children as well) consisted of two parts, which were administered with a one-week interval. In the first part, the verbal stimuli were in the past tense plural form, while in the second, they were in the infinitive. The subjects were asked to generate the non-past 3rd person plural and 1st person singular forms of the verbal stimuli. All the verbs were embedded in simple carrying sentences, which together with follow-up questions formed a quasi-dialogue:

Past Tense

Experimenter: Yesterday they _____. And what are they doing today?

Subject: Today they _____.

Experimenter: And you?

Subject: Today I _____.

Infinitive

Experimenter: I want to _____.

Subject: Me too, I want to _____.

Experimenter: And what are you doing today?

Subject: Today I _____.

Experimenter: And Mary and Peter?

Subject: Today they _____.

The testing material consisted of 60 verbs belonging to 4 classes (based on the one-stem verb system, Jakobson, 1948). In each class there were 5 high-frequency real Russian verbs, 5 low-frequency real Russian verbs, and 5 nonce verbs created by manipulating the initial segment of the high-frequency real Russian verbs. The average frequencies were balanced across the verb classes. Appendix 1 shows the verbs included in the experimental material with their token frequencies. The verbs were presented in a quasi-random order with no two verbs belonging to the same stem following each other. The token frequencies, or more exactly, stem-cluster frequencies, which reflect the frequency of the stem in all the forms of a particular verb that occurred in the database, were obtained from *The Frequency Dictionary of Russian Language* by Zasorina (1977). This dictionary contains approximately 40,000 words and is based on a 1,000,000-word corpus of written Russian language including fiction, scientific texts,

**Response Rates for 20 American Learners
(Past-Tense Stimuli)**

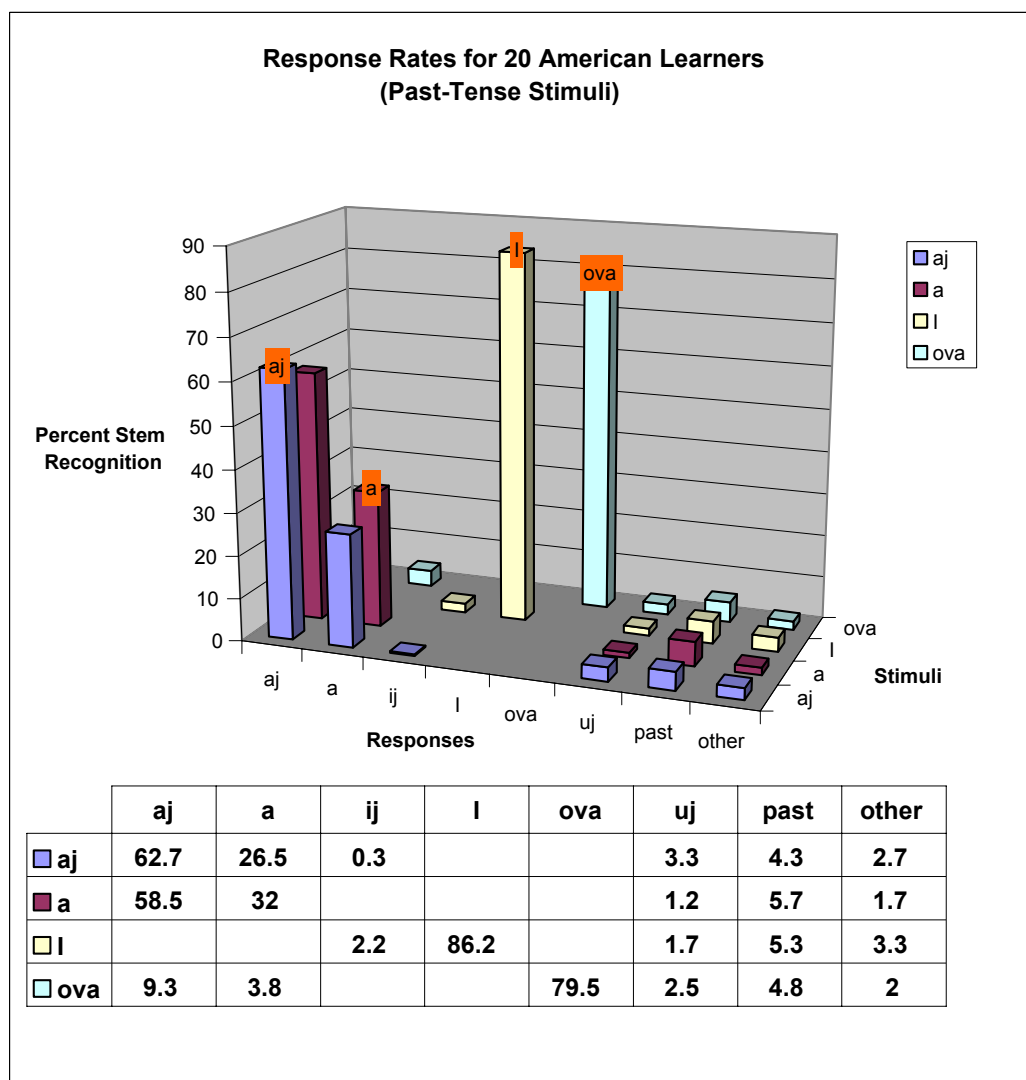|	aj	a	ij	l	ova	uj	past	other
aj	62.7	26.5	0.3			3.3	4.3	2.7
a	58.5	32				1.2	5.7	1.7
l			2.2	86.2		1.7	5.3	3.3
ova	9.3	3.8			79.5	2.5	4.8	2

Figure 1 Rates of Stem Recognition in American Learners (Past-Tense Stimuli)

and newspaper and journal articles. Figure 1 demonstrates that the American learners reliably identified the -i- and -ova- verbs. As for the "symmetrical" classes -aj- and -a-, which had unrecoverable stems, the subjects needed to guess the underlying stem, as most of the verbs were unknown to them. One can see from the chart that they did not make any distinction between the two stems and identified them as default (the -aj- pattern) twice as often as the unproductive -a- pattern.

Experiment 2 with Russian Children with Normal Linguistic Development

Experiment 2 was conducted at a kindergarten in St. Petersburg, Russia with 20 Russian children with normal language and cognitive development, and no hearing problems. There were 5 children aged 4, 9 children aged 5, and 6 children aged 6 in the group of subjects. The testing material and experimental procedure were exactly the same as in the experiment with American learners.

Figure 2 demonstrates that Russian children also showed high rates of stem recognition for the -i- and -ova- verbs, though they are somewhat lower than in American learners. Unlike American learners, children made a distinction between the -aj- and -a- verbs, which is understandable: they knew most if not all of the real verbs. However, one can see that the default -aj- pattern was more dominant in child L1 than in American learners' responses. One other type of response was much more prominent in children than in L2 learners: the use of the -uj- pattern, especially for the -aj- and -a- stems. The -uj- pattern does not exist in Russian by itself, but the allomorph with this suffix appears in the non-past tense as a result of suffix alternation -ova-/-uj-, as for example, in the stem *ris-ova-* "to draw, paint", which becomes *ris-uj-* in the non-past tense paradigm. The use of the –uj- suffix instead of the intended –aj- or –a- leads to the generation of the forms such as *chit-uj-u* instead of the expected *chit-aj-u* "I read" in child speech.
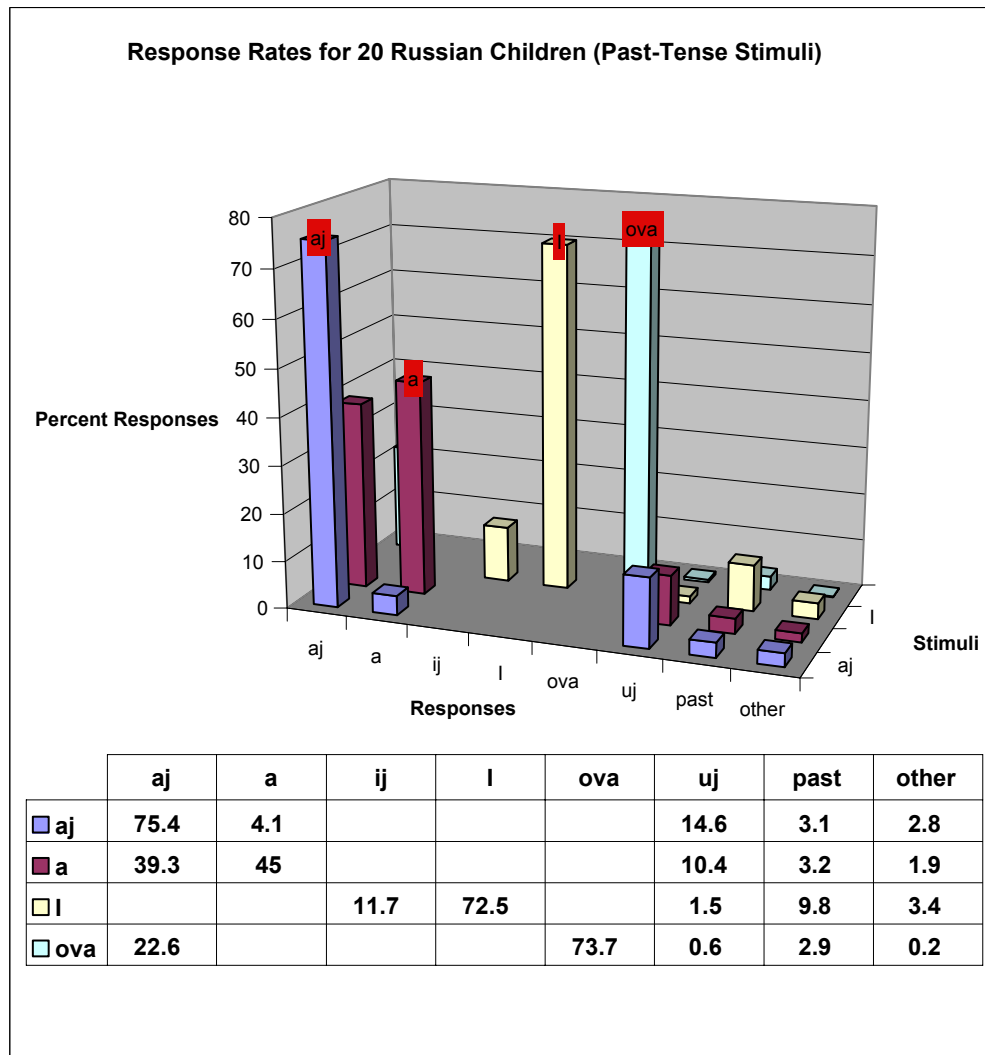
Response Rates for 20 Russian Children (Past-Tense Stimuli)

|	aj	a	ij	l	ova	uj	past	other
aj	75.4	4.1				14.6	3.1	2.8
a	39.3	45				10.4	3.2	1.9
l			11.7	72.5		1.5	9.8	3.4
ova	22.6				73.7	0.6	2.9	0.2

Figure 2 Rates of Stem Recognition in Russian Children (Past-Tense Stimuli)

1. Since we have tested the children of three age groups, averaging the child data could have masked certain developmental tendencies. And indeed, when at the next step we analyzed the child data grouped by age, several facts emerged: 5 and 6-year-olds use the default -aj- less than 4-year-olds. Apparently, at age 4 this is a predominant pattern, and other children depend on it less.

2. The rate of -a- and -i- responses increases with age. These non-default patterns are still developing in younger children.

3. There is an abrupt jump in the rates of stem recognition for the -ova- class between the ages of 4 and 5. It appears that this is the time when the –ova- pattern is acquired and used with more confidence.

Figure 3 Rates of Stem Recognition in Russian Children Grouped by Age
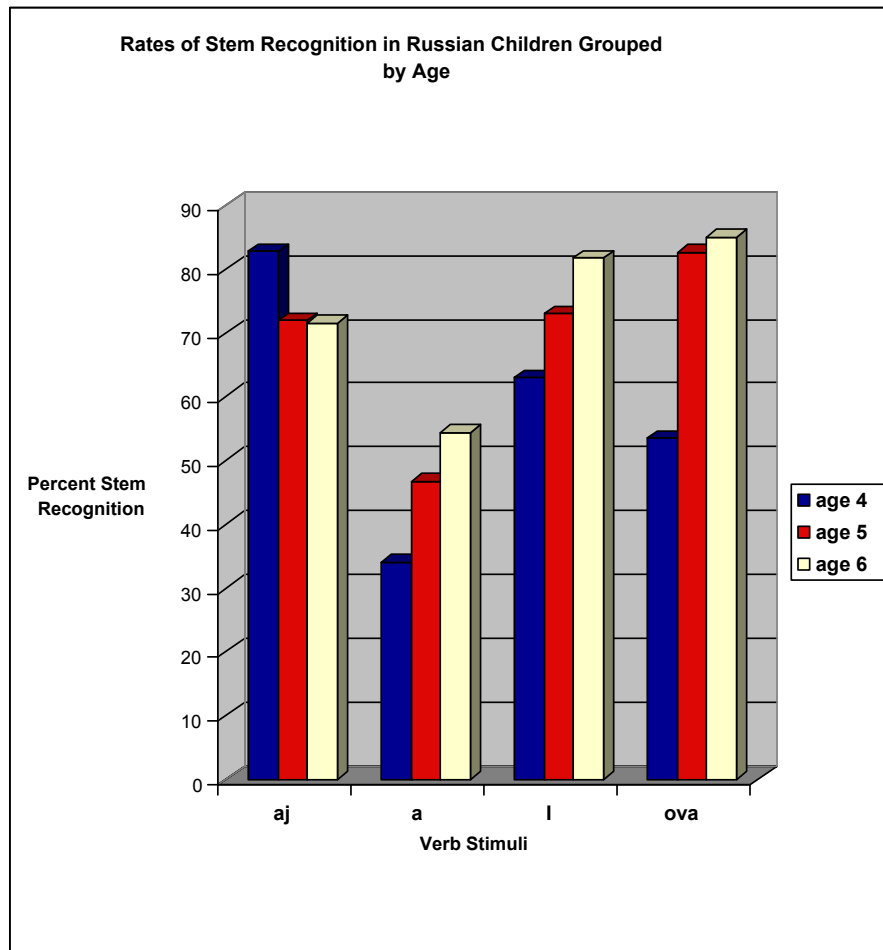
Therefore, one can observe certain developmental tendencies in the child responses. The older the children the less they use the default pattern and the more they rely on the non-default -a- and -i- patterns. The active use of the -ova- pattern at age 5 probably triggers the overgeneralization of the -uj- pattern to the -aj- and -a- stems that we have observed earlier.

Figure 4 compares the rates of stem recognition observed in L2 learners with the children of the three age groups. To control for the verb familiarity factor, it uses only the data on nonce verbs.
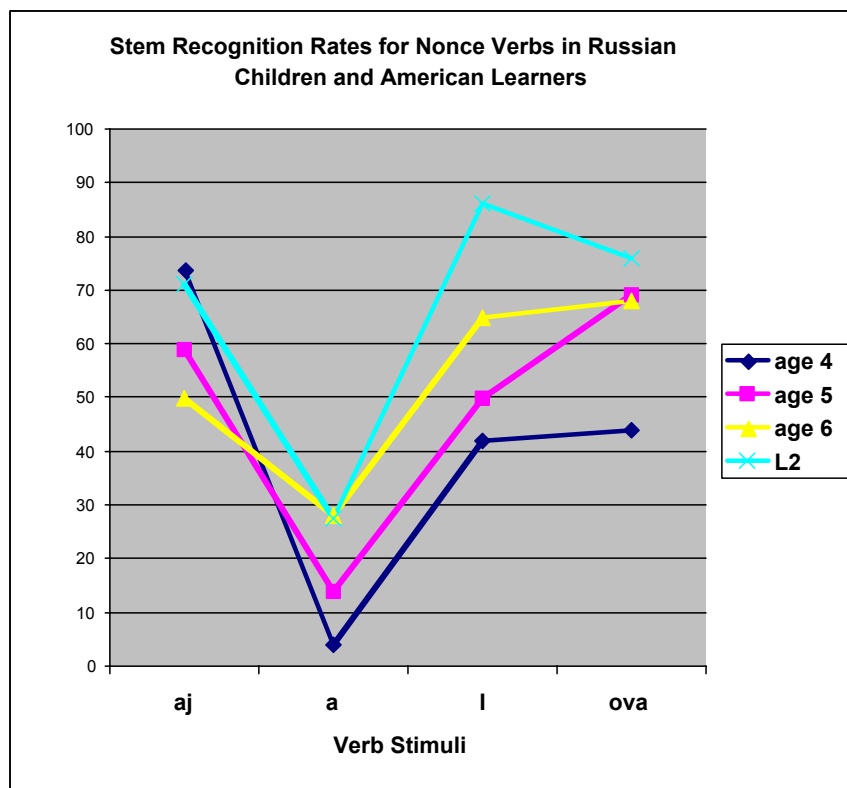
Figure 4 Rates of Stem Recognition in Russian Children and American Learners

(Nonce Verbs)

Figure 4 demonstrates that American learners did as 4-year-olds on the default -aj- verbs, as 6-year-olds on the -a- verbs, and better than any age group on the -i- and -ova- verbs. In other words, it is apparent that the Americans' responses do not match any of the child age groups. Thus, though we have not collected any longitudinal data on L2 learners, we can still see that their response pattern differs from children.

This same developmental tendency of moving away from the default to the non-default pattern can be observed if we compare the child responses to the nonce symmetrical stems -aj- and -a- broken down by age. Table 3 shows a gradual decrease in the use of the default -aj- pattern in response to both the -aj- and -a- stems. At the same time, the child results indicate that the children did not treat the nonce verbs derived from the -aj- and -a- stems in the same way. This means that they were to a certain extent

aware of the phonological similarity of the nonce verbs to their real verb prototypes. Apparently, this sensitivity to phonological similarity increases with age as a function of increased exposure to the input. For the Americans, the picture with nonce verbs was the same as for the

Table 3 Stem Recognition for Nonce Verbs, "Symmetrical" Stems -aj- and -a-

	L2 Learners		Children age 4		Children age 5		Children age 6	
	aj	a	aj	a	aj	a	aj	a
aj	**71**	22	**74**	8	**59**	5.6	**50**	13.3
a	65	**27.5**	68	**4**	38.9	**14**	30	**28**

whole sample. Their responses were practically not influenced by phonological similarity.

Comparison of L1 and L2 Responses: Conjugation Type and Consonant Mutation

We have seen that children clearly show a developmental tendency, and that the American learners' data do not match the response pattern for any of the age groups. Two additional data sets, error rates in conjugation type and consonant mutations, further demonstrate the differences between the child and L2 data.

1. Errors in Conjugation Type

In Russian, there are two conjugation types, 1st and 2nd, which differ by the thematic vowel in the inflections. The conjugation type is part of the overall conjugational pattern, and is therefore determined by the verbal suffix. Generally speaking, 1st conjugation is much more common, since out of the 11 stems, only 3 belong to 2nd conjugation, including the -i- stem and 2 other small unproductive classes. Given

such a distribution, one can put forward two opposite hypotheses concerning verbal processing.

a) If conjugation type is part of the conjugational pattern determined by the verb classifier, then once the speaker figures out the conjugational pattern, s/he will match the conjugation type with the overall pattern.

b) Since 2nd conjugation is much less common, speakers with incomplete proficiency (such as young children and L2 learners) will generalize 1st conjugation to 2nd conjugation -i- verbs.

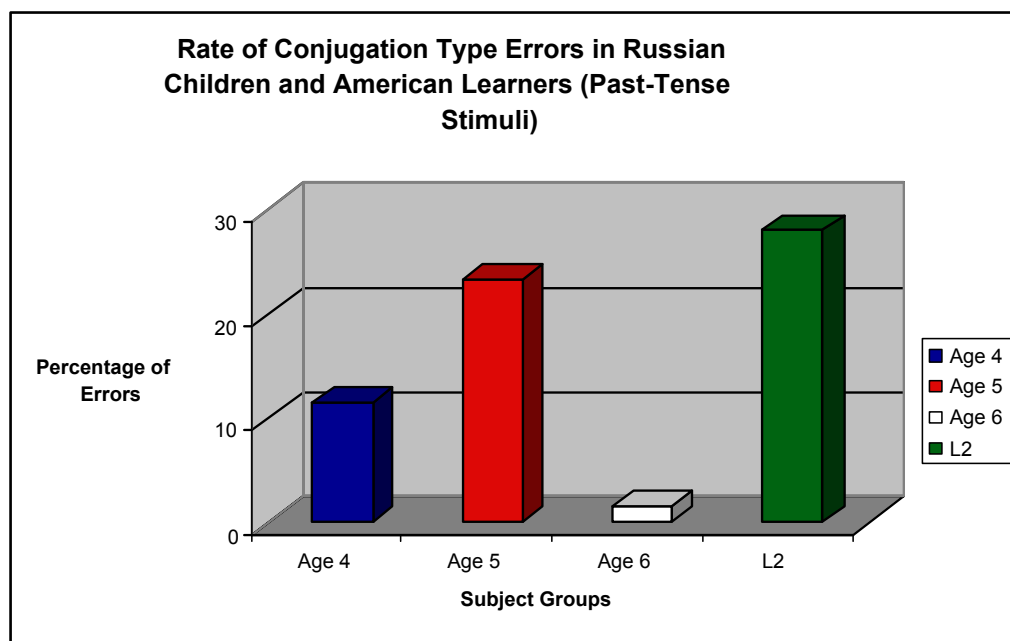**Rate of Conjugation Type Errors in Russian Children and American Learners (Past-Tense Stimuli)**

Figure 5 Conjugation Type Errors in Russian Children and American Learners

Figure 5 represents the rates of conjugation type errors in Russian children and American learners. It shows that younger children indeed made errors in assigning 2nd conjugation to the -i- verbs, however, this type of error became insignificant by age 6. At the same time, the errors in assigning 1st conjugation were virtually nonexistent. L2

speakers, however, produced a much higher rate of incorrect conjugation type errors than even the 5-year-olds. Thus, while L2 learners recognized the -i- stem better than any age group, they made more mistakes in conjugation type than children.

2. Errors in Consonant Mutation

We analyzed the rates of missed consonant mutations in the -i- verbs, where they are obligatory in the 1st person singular. As with conjugation type, consonant mutations are part of the overall conjugational pattern, and are fully predictable for the -i- verbs, since they occur automatically in certain consonants.

Rate of Missed Consonant Mutations in Russian Children and American Learners (Past-Tense Stimuli)
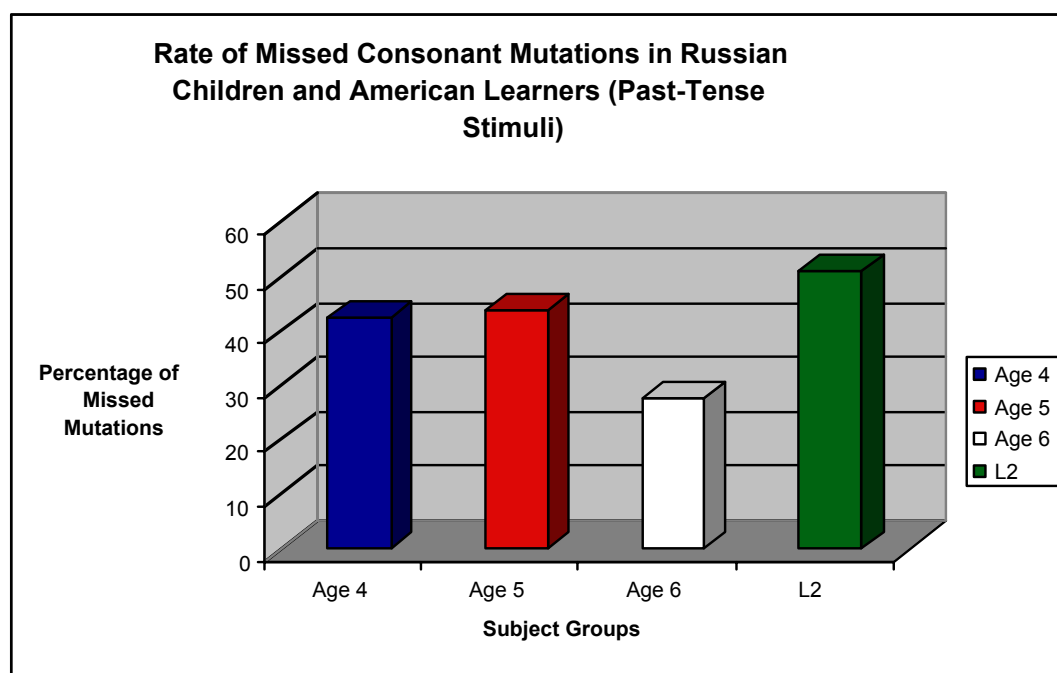
Figure 6 Errors in Consonant Mutations in Russian Children and American Learners

Figure 6 displays the same tendency for missed consonant mutations as for conjugation type errors, only it manifests itself to a lesser degree. Children show a drop in the rate of missed mutations at age 6, while L2 learners demonstrate the highest rate of missed mutations.

Role of the Testing Material: Past Tense Versus Infinitive Stimuli

Sometimes research on the processing of verbal morphology conducted by different teams produces conflicting results. One possible explanation for those discrepancies in the results has to do with the structure of the testing material. In order to evaluate the impact of this factor on our own results, we will compare the results obtained
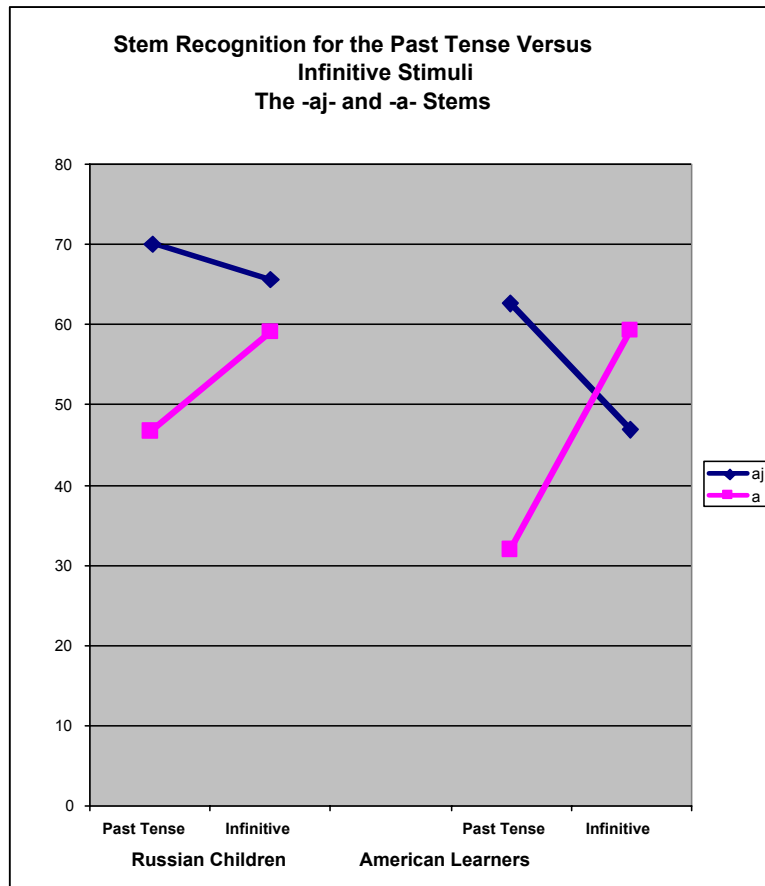
for children and L2 learners in two sets of experiments, with past tense and infinitive stimuli.

Figure 7 Stem Recognition for the Past Tense Versus Infinitive Stimuli: Russian Children and American Learners

First of all, it is important to note that the past tense and infinitive verb forms contain exactly the same information about the verb stem. If it is recoverable, than it will

be present in both types of verb forms, if it is unrecoverable, neither verb form will have it. This happens because the –j- of the –aj- suffix is truncated before consonantal endings.

To generate the non-past-tense forms of such stimuli one needs to apply exactly the same procedure:

- Drop the infinitive or past-tense plural inflections. In our experiments, the infinitive inflection is "-t'" (it is non-syllabic), and the past-tense inflection is "-li" (it is syllabic).

- Recover the stem based on morphological cues (if present) and/or statistical probabilities.

- Add the appropriate non-past inflections. This procedure includes several steps: choice of the conjugation type, application of the truncation rule and the consonant mutation rule (if needed).

All this means that one should not expect any significant differences between the results of the two experiments with past tense and infinitive stimuli. However, the responses of both groups of subjects do not support this prediction. Figure 7 represents the rates of stem recognition for two "symmetrical" stems, -aj- and -a-. For Russian children, the rate of the default -aj- responses is higher for the past-tense condition, while the rate of the -a- stem responses is higher for the infinitive condition. And this tendency is even much stronger for the American learners.

Experiment 3 with Russian-Speaking Children with Specific Language Impairment

This section will report the results of a preliminary study of 8 Russian-speaking children with specific language impairment (SLI). There was a total of: 1 child age 4, 3 children age 5, 2 children age 6, and 2 children age 7 in the experimental group. SLI children show no cognitive deficit, no sensory impairment potentially causing distorted input, no emotional pathology of autistic type, but have evident grammatical processing difficulties. All the children taking part in the experiment were diagnosed with Level 2 language impairment, which indicates a grammatical deficit. Each child was tested individually on both parts of the experiment, with the infinitives and past-tense verbs as the stimuli. Their responses were compared to those of the 20 children with normal

language and cognitive development discussed above with the aim of establishing similarities and differences in normal and SLI morphological processing.

Response Rates for 8 SLI Children (Past-

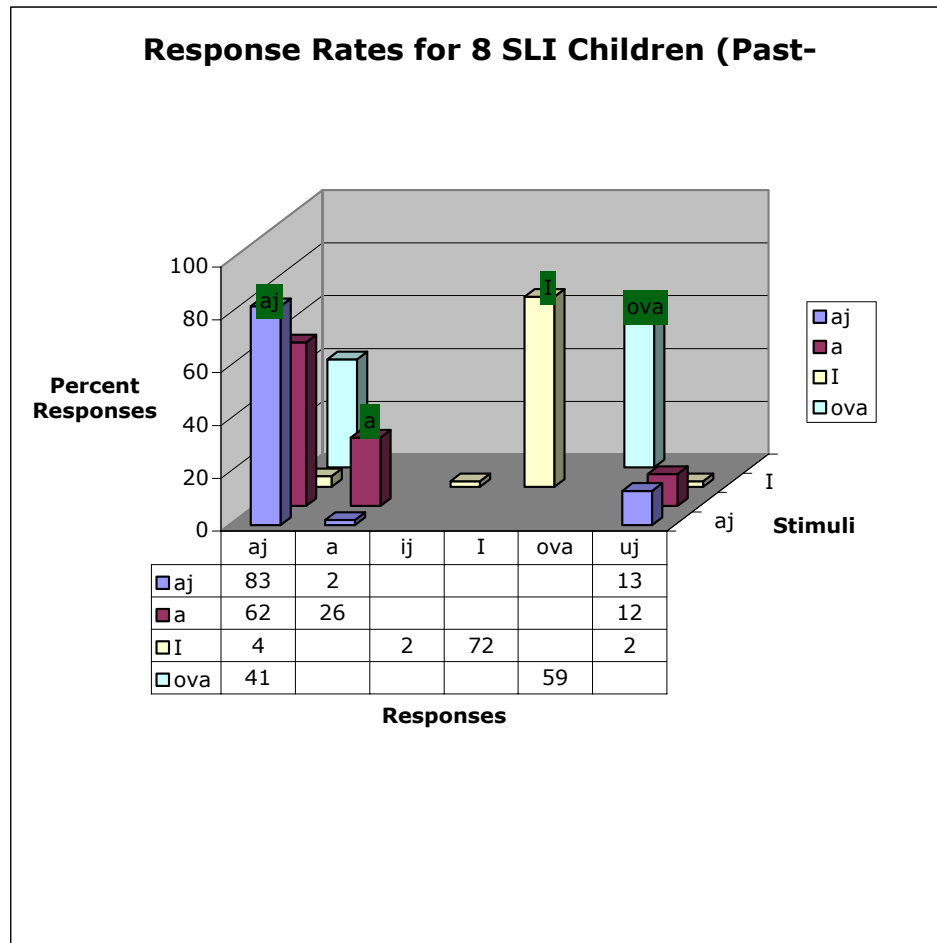|	aj	a	ij	I	ova	uj
aj	83	2				13
a	62	26				12
I	4		2	72		2
ova	41				59	

Responses

Figure 8 Rates of Stem Recognition in SLI Children (Past-Tense Stimuli)

This pilot study addressed the following issues:

- Do SLI children rely on the default pattern more or less than normal children?
- Is there a developmental sequence in SLI child acquisition of Russian verbal morphology similar to the one we found in normal children?
- Are there any unique features in SLI morphological processing?

The data obtained from the 8 SLI children in both parts of the experiment, with the past-tense and infinitive stimuli was analyzed in the same way as the data for normal children and L2 learners. Figure 8 represents the response rates for the group of SLI children to the past-tense stimuli. The SLI children as a group had a strong preference for the default –aj- pattern, which they consistently used in response not only to the –aj- verbs, but also to the –a- and –ova- verbs. The percent of stem recognition for the –a- stem was very low, two thirds of the responses to this class were overgeneralizations to the –aj- class. The percent of stem recognition the –i- stem was higher than for the –ova- stem. Figure 9 compares the percent of stem recognition for the SLI children with two other groups of subjects discussed above, the normal children and L2 learners of Russian.
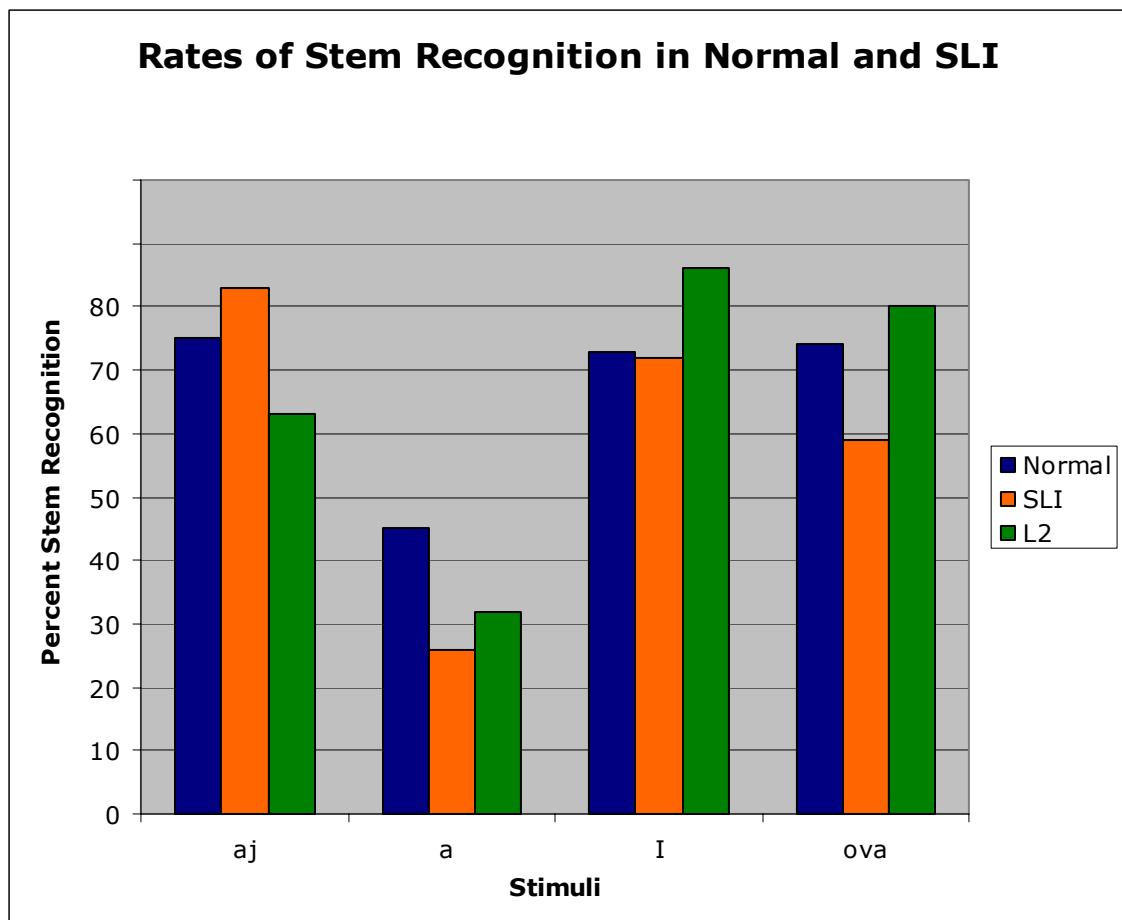

Figure 9 Rates of Stem Recognition in Normal and SLI Children, and L2 Learners (Past-Tense Stimuli)

The comparison of the responses of the SLI children with normal children, as well as the adult American learners of Russian leads to several observations. First, the SLI group has the highest rate of the use of the default –aj- pattern and the lowest rate of the –a- pattern of all the three groups of subjects. Second, while the SLI group performance on the –i- stem is comparable to that of the group of normal children, their rates of stem recognition for the –ova- stem are lower than in normal children and L2 learners. Let us compare these results to the developmental tendency observed in normal children described above. In normal children, the first class to be acquired around age 4 is the default –aj- class, and their subsequent development is characterized by the movement away from the default to the non-default –a- pattern, which stabilizes at age 6. Children gain control of the –ova- class only at age 5. The facts that the SLI children used the default pattern more, while the –a- and –ova- patterns less than normal children, indicate that developmentally the SLI children were behind the normal children. Such a claim needs to be confirmed by the analysis of age-based groups in both normal and SLI children. While the available data broken down by age are limited, it is possible to draw preliminary conclusions about the kind of development found in SLI children. First, they do not show the developmental tendency observed in normal children because 7-year-old SLI children still rely on the default –aj- pattern in a verb generation task as heavily as 4-year-olds do. Second, the SLI children taking part in the experiment made twice as many mistakes in conjugation type assignment (1st versus 2nd) as the group of normal child controls. Clearly, the SLI children had problems with the choice of the conjugation type up until age 7, whereas normal children develop a firm grasp on conjugation type at age 6 (see Figure 5). And finally, a detailed analysis of the individual performance of each of the 8 SLI children did not reveal a developmental tendency because the older SLI children were not closer to either younger or older normal children than the younger SLI children.

Discussion

The reported data on L1 verbal processing in normal Russian-speaking children documents the following developmental tendency: the first pattern to be acquired is the default "Vowel+j" pattern (as in the –aj- stem). This is the pattern that 4-year-old children generalize at higher rates than the older children. Gradually, the default pattern becomes less prominent, while the non-default "Vowel+ø" pattern becomes more active. This non-default pattern (as in the –a- stem) is acquired at age 6. The –ova- pattern shows a peak in the level of stem recognition at age 5; this is when it stabilizes in the child's linguistic system.

Taken together, the facts that L2 learners have the highest rates of stem recognition, but produce more errors in conjugation type and consonant mutations than children, indicate that L2 learners do not fit into the developmental tendency observed in children. These differences in child and L2 response rates seem to point to certain differences in the underlying processing mechanisms between children and L2 learners. Children have more problems with the identification of conjugational pattern and the use of morphological cues; they can get sidetracked to the use of an unpredictable pattern, such as -uj-. In nonce verb processing, children's response rates are influenced by phonological similarity to real verb prototypes. But once they opt for a certain pattern, they apply it more and more accurately as they become older. L2 learners, unlike children, seem to recognize the morphological cues better. In nonce verb processing they are not sensitive to phonological similarity to real verbs, since most of these verbs are not part of their lexicon. But for L2 learners the conjugational pattern is less fixed, they make more errors in its application. Also, generally speaking, L2 learners are better at nonce verb processing than children.

These differences in child L1 and adult L2 processing seem to be connected to the differences in the input received by these two populations of speakers, and to the processing strategies they use. Children receive more input, and this input is natural, also, they get more chances to use the verbs themselves, which means the statistical characteristics (input frequencies) should approximate those found in native colloquial speech. They certainly do not receive any explicit instruction in verb conjugation.

Beginning adult L2 learners, who study L2 in a formal classroom, receive very limited input with the differences between input frequencies for different classes much

weaker than in native Russian input (see Chernigovskaya and Gor 2000). However, unlike children, formal L2 learners typically receive massive explicit training in the application of conjugation rules for different verb classes. As a result, beginning L2 learners are better at some analytical procedures, such as deriving the basic stem from nonce verbs based on morphological cues. However, they do not apply all the rules shaping the conjugational pattern in a consistent way, which in turn leads to high rates of errors in conjugation type and consonant mutations. Thus, it appears that child L1 processing tends to rely more on the application of the whole conjugational pattern and is sensitive to phonological similarities. At the same time, adult L2 processing singles out discrete rules shaping the conjugational pattern, is not sensitive to phonological similarity, and relies less on associative patterning than on discrete rule application.

As to the differences in the rates of stem recognition for the two experimental conditions—with past tense and infinitive stimuli—there are at least two possible explanations for this effect. First, these differences may be caused by the phonological, or more exactly, syllable structure of the stimuli. The subjects tend to match the syllable structure of the stimuli in their responses. The past-tense plural stimuli have one extra syllable and thus trigger the responses with the same syllable structure, therefore, the preference here is for the default -aj- pattern. The infinitive, on the opposite, triggers shorter responses, and therefore favors the -a- pattern.

Another possible explanation is that the processing of past-tense stimuli is costlier than the processing of infinitives, as infinitive is the citation form, and it may be stored in a decomposed way, or more readily stripped of its inflection. If this logic is correct, then it makes sense that the subjects rely more on the default pattern with more complex past-tense stimuli.

Why were L2 learners more sensitive than children to this difference? While L2 learners were better than children at stem recognition, they were worse at rule application. If L2 learners were not very confident in the actual implementation of the rules shaping the conjugational pattern, then they could have opted for default when faced by the processing difficulties, or become influenced by the syllable structure of the stimuli. From a practical standpoint, this difference in the processing of past tense and

infinitive stimuli emphasizes the importance of taking into account the experimental design when interpreting any data on morphological processing.

The results obtained for the group of Russian-speaking SLI children indicate that their verb generation is more influenced by the default conjugational pattern that that of the normal children. Research on the processing of verbal morphology in English-speaking SLI children has shown that this population of speakers has more problems with the generation of past-tense forms of regular than irregular verbs (Ullman and Gopnik 1999). Given that SLI speakers have a grammatical deficit, this effect supports the claim of the dual-system approach that regular verbs are computed by a symbolic rule processor while irregular verbs are retrieved from associative memory. SLI speakers have problems with symbolic rule application, and rely on retrieval from memory, this is why irregular stored forms are easier for them to generate than the regular ones. Our data on the processing of Russian verbal morphology by SLI speakers has produced the results that are in conflict with the predictions of the dual-system approach. Our group of SLI children comparable in age compositon to the normal child controls showed a strong preference for the regular default –aj- pattern, which meets all the conditions to be considered symbolic rule-based.

Overall, the results of the reported experiments challenge the claims of the dual-system approach that regular verb processing is not affected by the input frequencies to the language speaker. At least when the speaker's linguistic system is not stabilized, as was the case for our three groups of subjects, native-speaking children with normal linguistic development, adult L2 learners, and children with specific language impairment, input frequencies as well as the type of the stimuli had an effect on stem recognition and generalization rates in a verb generation task. At the same time, the results of the study do not support the claims of the single-system approach that morphological processing is based entirely on phonological mappings with no abstract rules involved. The study demonstrated the role of morphological rules in the processing of Russian complex verbal morphology involving stem allomorphy. Additional analysis is needed to show whether the obtained results have a better fit to the Rules and Probabilities Model of complex morphological processing (Gor 2003).

Conclusions

1. This study has demonstrated that child L1 and adult L2 processing had several features in common:

   - Both children and L2 learners generalized the default -aj- pattern to the non-default irregular -a- class.

   - Both used the morphological cues and identified the -i- and -ova- stems.

   - Both made errors in conjugation type and consonant mutations.

2. However, a closer look at the data leads to the following observations:

   - There is a developmental tendency in child L1 processing of verbal morphology.

   - Morphological processing in beginning adult L2 learners does not match the processing in any of the child age groups.

3. Child L1 verbal processing depends more on associative patterning, while adult L2 processing depends more on the application of discrete rules.

4. The processing of inflectional morphology in children with specific language impairment was delayed in comparison to children with normal linguistic development. The SLI children relied on the default pattern more than the normal children.

5. The results of this study do not confirm the predictions of the dual-system approach:

   - Input frequencies influenced regular verb processing in all the three groups of subjects.

   - Children with SLI showed the highest rate of the use of the regular default conjugational pattern of all the three groups of speakers.

References

Alegre, M., and Gordon, P. 1999. Frequency effects and the representational status of regular inflections. *Journal of Memory and Language 40*, 41-61.

Bybee, J. L. 1985. *Morphology: A study of the relation between meaning and form.* Philadelphia: John Benjamins Publishers.

Bybee, J. L. 1995. Regular morphology and the lexicon. *Language and Cognitive Processes 10*, 425-455.

Chernigovskaya T., and Gor K. 2000. The complexity of paradigm and input frequencies in native and second language verbal processing: Evidence from Russian. *Language and Speech Behavior*, No 3, Part II, 20-37.

Clahsen, H. 1999. Lexical entries and rules of language: A multidisciplinary study of German inflection. *Behavioral and Brain Sciences 22*, 991–1060.

Davidson, D. E., Gor, K. S., and Lekic, M. D. 1996. *Russian: Stage One: Live from Moscow!* Kendall/Hunt Publishing Company: Dubuque, Iowa.

Gor, K. 2003. The Rules and Probabilities Model of Native and Second Language Morphological Processing. St. Petersburg: St. Petersburg University Press.

Gor, K., and Chernigovskaya, T. 2001. Rules in processing of Russian verbal morphology. In: Zybatow, G., Junghanns, U., Mehlhorn, G., and Szucsich, L. (eds.). *Current Issues in Formal Slavic Linguistics*. Frankfurt/Main: Peter Lang.

Gor, K., and Chernigovskaya, T. 2003. Formal Instruction and the Mental Lexicon: The Acquisition of Verbal Morphology. In: Housen, A., Pierrard, M. (eds.). *Current Issues in Instructed Second Language Learning*. Mouton De Gruyter.

Jakobson, R. O. 1948. Russian conjugation. *Word 4*, 155-167.

Jensvoll, M. H. 2003. The acquisition of past tense in English/Norwegian bilingual children. *Nordlyd*.

Joanisse, M. F., and Haskell, T. R. 1999. The dual-mechanism model of inflectional morphology: A connectionist critique. *Behavioral and Brain Sciences 22*, 1026-1027.

Langacker, R. 1987. *Foundations of cognitive grammar, vol. 1. Theoretical prerequisites*. Stanford, CA: Stanford University Press.

Langacker, R. 1988. A usage-based model. In: Rudzka-Ostyn, B. (eds.), *Topics in cognitive linguistics*, 127-161. Amsterdam: John Benjamins.

MacWhinney, B., and Leinbach, J. 1991. Implementations are not conceptualizations: Revisiting the verb learning model. *Cognition 40*, 121-157.

Markus, G. F., Pinker, S., Ullman, M., Hollander, M., Rosen, T. J., and Xu, F. 1992. *Overregularization in language acquisition*. Monographs of the Society for Research in Child Development 57 (4), Serial No. 228. Chicago: University of Chicago Press.

Markus, G. F., Brinkmann, U., Clahsen, H., Weise, R., and Pinker, S. 1995. German inflection: The exception that proves the rule. *Cognitive Psychology 29*, 189-256.

Matcovich O. 1998. Regular inflection in the mental lexicon: Evidence from Italian. *Proceedings from the conference "The Verb in Cognitive Grammar,"* Gran.

Orsolini, M., and Marslen-Wilson, W. 1997. Universals in morphological representation: Evidence from Italian. *Language and Cognitive Processes 12*, 1-47.

Orsolini, M., Fanari, R., and Bowles, H. 1998. Acquiring regular and irregular inflection in a language with verb classes. *Language and Cognitive Processes 13*, 425-464.

Pinker, S. 1991. Rules of language. *Science 253*, 530-535.

Pinker, S., and Prince, A. 1988. On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition 28*, 73-193.

Pinker, S., and Prince, A. 1994. Regular and irregular morphology and the psychological status of rules of grammar. In: Lima, S. D., Corrigan, R. L., and Iverson, G. K. (eds.). *The reality of linguistic rules*, 353-388. Amsterdam: John Benjamins.

Plunkett, K., and Marchman, V. 1991. U-shaped learning and frequency effects in a multi-layered perception: Implications for child language acquisition. *Cognition 38*, 43-102.

Plunkett, K., and Marchman, V. 1993. From rote learning to system building: Acquiring verb morphology in children and connectionist nets. *Cognition 48*, 21-69.

Prasada, S., and Pinker, S. 1993. Generalization of regular and irregular morphological patterns. *Language and Cognitive Processes 8*, 1-56.

Prasada, S., Pinker, S., and Snyder, W. 1990. Some evidence that irregular forms are retrieved from memory but regular forms are rule-generated. Paper presented at *The 31st Annual Meeting of the Psychonomics Society*, 16-18 November.

Ragnasdóttir H., Simonsen H.G., Plunkett K. 1997b. Acquisition of past tense inflection in Icelandic and Norwegian Children. In: Clark E.V. (ed.) *Proceedings of the 28th Annual Child Language Research Forum*, Stanford.

Rumelhart, D. E., and McClelland, J. L. 1986. On learning the past tenses of English verbs. In: McClelland, J. L., and Rumelhart, D. E. (eds.), *Parallel distributed processing: Explorations in the microstructures of cognition*, vol. 2, 216-271. Cambridge, MA: Bradford/MIT Press.

Schreuder, R., de Jong, N., Krott, A., and Baayen, H. 1999. Rules and rote: Beyond the linguistic either-or fallacy. *Behavioral and Brain Sciences 22*, 1038-1039.

Simonsen, H. G. 2000. Past tense acquisition and processing in Norwegian: Experimental evidence. *Language and Language Behavior 3/II*, 86-101.

Townsend, C. E. 1975. *Russian Word-Formation*. Slavica Publishers.

Ullman, M. T. 1999. Acceptability ratings of regular and irregular past-tense forms: Evidence for a dual-system model of language from word frequency and phonological neighborhood effects. *Language and Cognitive Processes 14*, 47-67.

Ullman, M.T., and Gopnik, M. 1999. Inflectional morphology in a family with inherited specific language impairment. *Applied Psycholinguistics 20*, 51-117.

Yang, C. D. 2002. *Knowledge and Learning in Natural Language*. Oxford University Press.

Zalizniak, A. A. 1980. *The Grammatical Dictionary of the Russian Language*. Moscow: Russian Language Publishers.

Zasorina, L. N. (ed.). 1977. *The Frequency Dictionary of Russian Language*. Moscow: Russian Language Publishers.

Appendix 1 The Verbs Included in the Experiments with their Token Frequencies[1]

		-aj-			
		Real Verbs		Nonce Verbs	
	High-Frequency		Low-Frequency	High-Frequency	Low-Frequency
	Verb	Fr	Verb	Fr		
	chitAt'	418	tOpat'	19	kitAt'	bOpat'
	meshAt'	166	obozhAt'	12	geshAt'	okozhAt'
	pAdat'	146	kusAt'	11	kAdat'	dusAt'
	guljAt'	77	kopAt'	10	tuljAt'	ropAt'
	plAvat'	59	chAvkat'	2	klAvat'	lAvkat'
Average		173.2		10.8		

		-a-			
		Real Verbs		Nonce Verbs	
	High-Frequency		Low-Frequency	High-Frequency	Low-Frequency
	Verb	Fr	Verb	Fr		
	pisAt'	578	skakAt'	24	kisAt'	snakAt'
	plAkat'	150	pljasAt'	19	glAkat'	gljasAt'
	prjAtat'	56	dremAt'	13	zrjAtat'	vremAt'
	xoxotAt'	51	vjazAt'	10	moxotAt'	tjazAt'
	rEzat'	37	shchipAt'	1	gEzat'	vremAt'
Average		174.4		13.4		

		-i-			
		Real Verbs		Nonce Verbs	
	High-Frequency		Low-Frequency	High-Frequency	Low-Frequency
	Verb	Fr	Verb	Fr		
	prosIt'	414	znakOmit'	17	trosIt'	glakOmit'
	stAvit'	185	travIt'	13	znAvit'	glavIt'
	nosIt'	112	krAsit'	10	losIt'	drAsit'
	gotOvit'	86	lAdit'	8	motOvit'	nAdit'
	platIt'	54	krepIt'	7	glatIt'	drepIt'
Average		170.2		11		

		-ova-			
		Real Verbs		Nonce Verbs	
	High-Frequency		Low-Frequency	High-Frequency	Low-Frequency
	Verb	Fr	Verb	Fr		
	trEbovat'	257	revnovAt'	20	klEbovat'	devnovAt'
	dEjstvovat'	172	riskovAt'	18	lEjstvovat'	viskovAt'
	chUvstvovat'	172	vorovAt'	12	kUvstvovat'	morovAt'
	celovAt'	91	zimovAt'	4	mylovAt'	limovAt'
	prObovat'	57	bintovAt'	1	drObovat'	tintovAt'
Average		149.8		11		

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[1] Word stress is marked with capitalized vowels. Low-frequency nonce verbs were used in some of the series, and are not included in the present analysis.

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[i] The study by Alegre and Gordon (1999) is an example of a successful solution to this methodological problem.

[ii] For a more detailed discussion of these studies, see Gor 2003.

[iii] Bybee supports the conclusions of a study, which demonstrated that it was the type frequency, and not the umber of uses that determined the accuracy rates on French verbs belonging to 1st, 2nd, and 3rd conjugation in French-speaking children (see Bybee 1995).

[iv] This view expressed in our earlier publications is shared by other researchers (Joanisse and Haskell 1999).

[v] In fact, the study was designed to investigate the effects of token frequency on morphological processing in addition to type frequency, these data will be discussed in a separate publication.

[vi] The consonant "zh" represents any palatal consonant—a hushing or "j"—and is not part of the suffix.

[vii] This study using a limited number of stems builds on the results of a previous study involving 11 stems which belonged to 9 suffixed classes and 2 subclasses of the zero-suffixed class (Chernigovskaya and Gor 2000).

[viii] The numbers in parentheses correspond to the total number of the verbs in the active and passive vocabulary of the learners taking part in the experiment, while the numbers without parentheses correspond to the active vocabulary.

[ix] The advantage of using the subjects who have completed only one year of instruction with a highly structured set of materials is that the experimenters can be confident that the frequencies computed based on the textbook and workbook truly reflect the input the learners have received. This approach becomes much more problematic with more advanced learners.