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Slavic Psycholinguistics in the 21st Century*

Irina A. Sekerina

Abstract: This article provides an update on research in Slavic psycholinguistics since 2000 following my first review (Sekerina 2006), published as a position paper for the workshop The Future of Slavic Linguistics in America (SLING2K). The focus remains on formal experimental psycholinguistics understood in the narrow sense, i.e., experimental studies conducted with monolingual healthy adults. I review five dimensions characteristic of Slavic psycholinguistics—populations, methods, domains, theoretical approaches, and specific languages—and summarize the experimental data from Slavic languages published in general non-Slavic psycholinguistic journals and proceedings from the leading two conferences on Slavic linguistics, FASL and FDSL, since 2000. I argue that the current research trends in Slavic psycholinguistics are (1) a shift from adult monolingual participants to special population groups, such as children, people with aphasia, and bilingual learners, (2) a continuing move in the direction of cognitive neuroscience, with more emphasis on online experimental techniques, such as eye-tracking and neuroimaging, and (3) a focus on Slavic-specific phenomena that contribute to the ongoing debates in general psycholinguistics. The current infrastructural trends are (1) development of psycholinguistic databases and resources for Slavic languages and (2) a rise of psycholinguistic research conducted in Eastern European countries and disseminated in Slavic languages.

1. Introduction

In 2000 I wrote a position paper based on my presentation at the workshop The Future of Slavic Linguistics (SLING2K) that was held at Indiana University (Sekerina 2006). In it I characterized the field of Slavic psycholinguistics as nascent and named the only conference venue where experimental studies of Slavic languages appeared, namely, the Annual Workshop on Formal Approaches to Slavic Linguistics (FASL); then it was the 8th FASL Workshop that took place in 1999. At that time I was also able to list all of the active laboratories in the U.S. and Europe and name most of the established and rising psycholinguists who worked on Slavic languages. The experiments

* I wish to thank two anonymous reviewers and Catherine Rudin for their helpful comments and especially suggestions regarding additional sources. All the mistakes are, of course, mine.

that I described encompassed psychophonology, agreement attraction errors in production, lexical production, and sentence processing, but their number was under 20. The overwhelming majority was on Russian, and only a few were on Bulgarian, Polish, and Serbian/Croatian. I finished the review with speculations on future directions that Slavic psycholinguistics may take, i.e., the significant contribution of Slavic data to the ongoing debates in theoretical linguistics, its increased integration into interdisciplinary cognitive science, and emergence of new, Slavic-specific topics.

As we know all too well, offering forecasts especially in science is a risky business. In the 20 years that have passed since the original review, some of my speculations have turned out to be spot-on (e.g., interdisciplinary integration) and some have fallen short (e.g., emergence of new, Slavic-specific topics). This update is necessarily brief, as it is a part of the special issue dedicated to the 25th anniversary of the *Journal of Slavic Linguistics* that covers many subfields of Slavic linguistics, and it follows in the footsteps of several recent review articles on Slavic languages that provide the backdrop for comparison of the field of Slavic psycholinguistics to Slavic theoretical linguistics (Franks 2009; Lauersdorf 2009; Nedashkivska 2011; Rappaport 2006). Three of those are dedicated to describing what Slavic theoretical linguistics looks like (Franks, Nedashkivska, and Rappaport), while Lauersdorf reviews Slavic sociolinguistics. What comes out loud and clear from them is that psycholinguistics remains on the periphery of Slavic linguistics. In the most recent review, Nedashkivska says that psycholinguistics, together with sociolinguistics and computational linguistics, only “becomes visible [sic]” (509). This conclusion is based on her search for relevant publications in four main Slavic journals, i.e., *Journal of Slavic Linguistics*, *International Journal of Slavic Linguistics and Poetics*, *Slavic and East European Journal*, and *Canadian Slavonic Papers* (Nedashkivska 2011: Tables 1–4). According to the author, not a single psycholinguistic article was published in them during the period of 1993–2010.

I argue here that although the number of psycholinguistic studies on Slavic languages that appeared from 2000 to the present day is modest, Slavic psycholinguistics is alive and doing well. For example, in 2016, the first edited volume on psycholinguistics of Slavic languages was published (Anstatt et al. 2016). For reasons that have to do with both career development and scientific impact, psycholinguists who work on Slavic languages (and I include myself in this category) prefer to present their work at general psycholinguistic conferences and workshops and publish in psycholinguistic field journals instead of the Slavic ones. Field journals are scholarly, peer-reviewed periodicals that publish research in a particular field of a particular discipline. In general psycholinguistics, such field journals include *Cognition*, *Journal of Memory and Language*, and *Language, Cognition, and Neuroscience* (entitled *Cognitive and Linguistic Processes* until 2014), just to name a few top ones. They are the most prestigious publication venues for all psycholinguists, regardless of

the language family, participant group, or choice of methodology. These publication venues, as well as the specialized psycholinguistic conferences such as the CUNY Conference on Sentence Processing (North America) and the Architecture and Mechanisms of Language Processing conference (AMLaP, Europe), are the ones in which Slavic psycholinguists prefer to showcase their experimental work on Slavic languages.

2. Dimensions of Slavic Psycholinguistics

Psycholinguistics in the broader sense, just by the mere nature of its interdisciplinary origin at the intersection of psychology and linguistics, is a complex field defined by five dimensions: populations, methods, domains, theoretical approaches, and specific languages. Formal experimental psycholinguistics that investigates language processing by healthy monolingual adults who are native speakers is the core subfield of psycholinguistics in the broader sense. The two-dimensional properties and linear restrictions imposed on this article by its physical format do not do justice to the relationships and interdependence among the dimensions and do not allow for full coverage of every branch and thread in psycholinguistics, even though its focus is on one language family, i.e., that of Slavic languages.

The first three dimensions depicted in Figure 1, i.e., populations, methods, and domains, are unique characteristics of modern general psycholinguistics that it shares with its first parent discipline, that of cognitive psychology, and they set it apart from its other parent discipline, theoretical linguistics. What unites psycholinguistics with the latter are the remaining two dimensions, i.e., theoretical approaches and specific languages. Slavic psycholinguistics in general and formal experimental Slavic psycholinguistics thus mirror that of general psycholinguistics, with the only difference in the fifth and last dimension, namely, its focus on Slavic languages.

2.1. Populations

The populations dimension is the most noticeable one; it represents a shift of focus from adult native speakers to special population groups, such as children, people with aphasia, and bilingual learners, both second language (L2) and heritage language (HL) speakers. In fact, since 2000, experimental studies of these three special population groups have outpaced those of monolingual adults and warranted separate articles in this special issue, namely, on first language (L1) acquisition (Ionin and Radeva-Bork this issue) and L2 acquisition of Slavic languages (Gor this issue). As a result, there have been fewer stand-alone experiments with monolingual adults who used to be the main focus of psycholinguistics in the past (e.g., Bott and Gattnar 2015; Levy, Fedo-

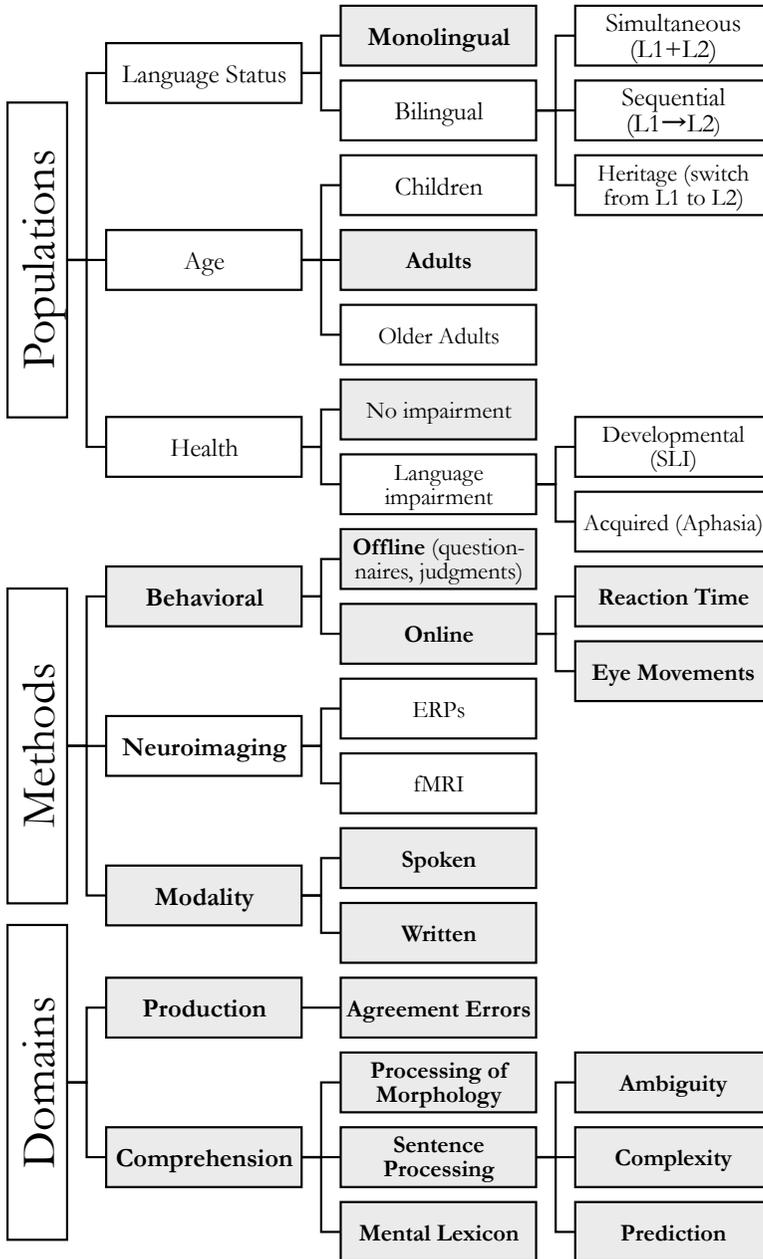


Figure 1. Slavic Psycholinguistics: populations, methods, and domains. Shaded boxes comprise the subfield of formal experimental psycholinguistics.

renko, and Gibson 2013; Slioussar and Malko 2016). These days, monolingual young adults tend to assume a subordinate status of a control group for the above-mentioned special populations.

Acquisition and processing of Slavic languages as heritage languages, represented mostly by Russian, is unfortunately missing from this special issue. This is despite the fact that HL Russian research occupies a very prominent position in the field of bilingualism thanks to the work of Maria Polinsky (University of Maryland) (see Polinsky 2006 for an overview) and some of my own (Sekerina and Sauermann 2015). Acquired (aphasia) and developmental (specific language impairment, SLI) language impairments in Slavic languages also known as neurolinguistics have made substantial gains as well. A steady stream of articles on Russian aphasia from the Laboratory of Neurolinguistics at the Higher School of Economics (HSE) in Moscow (head: Olga Dragoy; Dragoy et al. 2016; Laurinavichyute et al. 2014) and on Russian-speaking SLI children from the research group at Yale University (Rakhlin et al. 2013) deserve a special mention. There are also articles on aphasia and SLI for Bulgarian (Nikolova and Jarema 2004), Czech and Slovak (Marková and Cséfalvay 2010; Smolík and Vávrů 2014), Polish (Jodzio, Biechowska, and Leszniewska-Jodzio 2008), and Serbian (Vuković and Stojanović 2011; Vuković, Vuković, and Miller 2016). It is clear that Slavic neurolinguistics will continue to grow at a fast pace in the near future.

2.2. Methods

The current trend in the methods dimension in psycholinguistics logically follows from rapid growth in cognitive neuroscience. Its subfield, cognitive neuroscience of language, has become so prominent that nowadays experimental studies that use neuroimaging methods, e.g., event-related brain potentials (ERPs), functional magnetic resonance imaging (fMRI), and magnetoencephalography (MEG) supersede the traditional behavioral ones (Fedorenko and Kanwisher 2009). The offline behavioral methods (e.g., grammaticality, preference, and truth-value judgments, sentence-picture matching and verification, and picture selection, among others) that once used to be the staple of psycholinguistics have been relegated to pilot and normative stages of experimental design and play a subordinate role for both online time-sensitive behavioral (e.g., naming, priming, self-paced reading, and eye-tracking) and neuroimaging methods. While not long ago it was possible to write an entire Ph.D. dissertation in psycholinguistics based on mostly offline experiments (Avrutin 1994; Stojanović 1998), the pressure on doctoral students today is to master one or even two online behavioral or neuroimaging techniques (Stoops 2012; Wagner 2011).

The neuroscience push has also resulted in a stratification of psycholinguistic laboratories into those that have access to very expensive fMRI

equipment (very few), those that have less expensive eye-trackers and/or ERP systems (many), and those that have none (a few). Integration of Slavic psycholinguistics with cognitive neuroscience is gradually taking place in Eastern Europe as well. It has been made possible through the acquisition of external grants or securing institutional funds to buy the equipment necessary to conduct eye-tracking and ERP studies. There are several active eye-tracking laboratories in Russia including the above-mentioned Laboratory of Neurolinguistics (HSE, Moscow), Program in Higher Neurobiology at the Department of Biology (Moscow State University; head: Alexandr V. Latanov), the Laboratory for Cognitive Studies at the Faculty of Liberal Arts (Saint Petersburg State University; head: Tatiana V. Chernigovskaya), and the Program in Psychophysiology at the Department of Social Sciences (Nizhniy Novgorod State University; head: Sofia A. Polevaya). The Center for Experimental Research on Natural Language (University of Wrocław, Poland; head: Joanna Błaszczak) is the largest psycholinguistic laboratory outside of Russia that conducts both eye-tracking and ERP studies on Polish (Tomaszewicz 2013). In several recent articles, ERPs were used to investigate conjunct and object-clitic agreement in Slovenian (Marušič, Nevins, and Badecker 2015) and Croatian (Palmović and Willer-Gold 2016; Pavlinušić and Palmović 2016). Research with fMRI on Slavic languages is rare because it usually requires affiliation with a medical center that uses fMRI equipment for medical purposes, though there are several experiments on the role of morphology in lexical access in Polish from the team at the University of Cambridge (Bozic, Szlachta, and Marslen-Wilson 2013; Szlachta et al. 2012) and in Russian from the Laboratory for Cognitive Studies at the Saint Petersburg State University (Slioussar et al. 2014).

Another trend that is characteristic of general psycholinguistics is a shift from the written to the spoken language (Fig. 1) that can be attributed, for the most part, to the appearance of the visual world eye-tracking paradigm (VWP; Altmann and Kamide 2004). Written materials used to dominate psycholinguistics in general in the 1980–90s, when the most widely used online methods were self-paced reading, cross-modal priming, and eye-tracking in reading. The VWP that is based on the integration of visual context in the form of real objects, pictures, and video clips with spoken materials has made it possible for psycholinguistic research to focus on spoken language comprehension in naturalistic interaction of speakers with the visual world. The work conducted in my laboratory was the first to use the VWP to study language comprehension phenomena in Slavic. In particular, we investigated gender agreement (Sekerina 2012) and processing of universal quantifiers in Russian (Sekerina and Saueremann 2015). Myachykov and colleagues used the VWP in a production experiment that looked at the cost of producing noncanonical word orders in Russian (Myachykov et al. 2013).

2.3. Domains

The domains dimension is by far the most important one because it has to do with topics and themes that constitute the core subject matter of psycholinguistics. It is, of course, an impossible endeavor to survey in full all of the domains of formal experimental psycholinguistics, even if we focus just on Slavic languages. I have chosen several topics from sentence processing that allow me to illustrate noticeable contributions Slavic data have made to ongoing debates (e.g., ambiguity, complexity, and prediction) in formal experimental psycholinguistics. These topics include relative clause attachment ambiguity (Section 2.3.1.), syntactic complexity of object relative clauses (Section 2.3.2.), morphological decomposition in lexical access (Section 2.3.3.), predictive role of morphosyntax (Section 2.3.4.), and agreement attraction errors (Section 2.3.5.). I also list some of the experiments in Slavic psychophonology and psychosemantics. This list is far from complete, as the selection of the experiments reflects my expertise and therefore cannot be comprehensive.

The goal of formal experimental psycholinguistics is to understand the mental mechanisms supporting our remarkable abilities to produce and to understand language with little effort. Therefore it recognizes a number of specific subfields in theoretical linguistics as the most critical in achieving this goal, namely, phonology and phonetics, morphology and lexicon, syntax, semantics, pragmatics, discourse, and their interfaces. The psycholinguistic subfields exist in parallel in production and comprehension and often bear unique names that distinguish them from their theoretical-linguistic counterparts. For example, the core domains of language comprehension include psychophonology, processing of morphology, mental lexicon, experimental semantics, and sentence processing. In the remainder of this article, I focus on Slavic sentence processing leaving a review of other domains for the future.

Sentence processing constitutes perhaps the most well-studied domain in psycholinguistics. It concerns itself with how readers and listeners project structure onto the linear string of words of a sentence to arrive at its meaning. Two classical phenomena—structural ambiguity and syntactic complexity—lie at the core of sentence processing research. A string of words is structurally ambiguous if it can be assigned more than one syntactic analysis leading to different meanings. Structurally ambiguous sentences come in two varieties: globally ambiguous (e.g., *Visiting relatives could be difficult*), where two interpretations are possible, and temporarily ambiguous ones (e.g., *The horse raced past the barn fell*), where the correct interpretation wins only through reanalysis. Syntactic complexity characterizes some sentences that although perfectly grammatical and unambiguous are difficult to understand because of the unbounded dependencies they contain, e.g., center-embedded sentences (*The mouse the cat the dog saw chased ran away*) and object relative clauses (*The representative that the president denounced slammed the door after the meeting*).

2.3.1. Relative Clause Attachment Ambiguity

Slavic sentence processing follows in the footsteps of general sentence processing. It started with the investigation of one type of globally ambiguous sentences, namely, relative clause (RC) attachment ambiguity, in three Slavic languages: Russian (Fedorova, Yudina, and Yanovich 2007; Sekerina 2002), Croatian (Lovrić 2003), and Bulgarian (Sekerina, Fernández, and Petrova 2004). The examples in (1) contain a complex NP1-[of]-NP2-RC string (e.g., *syna polkovnika* ‘the son_{ACC} [of] the colonel_{GEN}’ in (1a)), in which RC (e.g., *kotoryj pogib v avtomobil’noj katastrofe* ‘who died in a car accident’) could structurally attach to either of the two NPs. When the RC modifies the NP1, the sentence means that the son died (high attachment); when it modifies the NP2, it is the colonel who died (low attachment) (Cuetos and Mitchell 1988).

- (1) a. Ja znal syna polkovnika, kotoryj pogib v
 I knew son_{ACC} colonel_{GEN} that_{NOM} died in
 avtomobil’noj katastrofe. (Russian)
 car accident
 ‘I knew the son of the colonel who died in a car accident.’
- b. Nazvali smo kćerku političarke koja
 phoned are daughter_{ACC} politician_{GEN} that
 voli pjevati. (Croatian)
 likes to sing
 ‘We phoned the daughter of the politician who likes to sing.’
- c. Včera Petâr naj-nakraja sreštna brata na učitelja,
 yesterday Peter finally met brother of teacher
 kogoto târseše. (Bulgarian)
 that looked for
 ‘Yesterday Peter finally met the brother of the teacher whom he was looking for.’

The RC attachment ambiguity received unprecedented attention in general psycholinguistics because it is the only phenomenon that allows for cross-linguistic variation in the otherwise universal principle of Late Closure (LC) of the Garden Path theory of sentence processing (Frazier and Fodor 1978). The LC principle states that new constituents should be attached into the clause or the phrase that is currently being processed. For sentences with the RC attachment ambiguity, the LC Principle favors low attachment preference regardless of the language. However, the experimental studies by Seker-

ina (2002), Fedorova et al. (2007), Sekerina et al. (2004), and Stoyneshka, Fodor, and Fernández (2010) established that all other things being equal Slavic languages—Russian, Croatian, and Bulgarian—seem to prefer high attachment. In a recent revival of interest in explaining cross-linguistic variation in attachment preferences, Grillo and Costa (2014) singled out the Russian and Bulgarian results as requiring additional attention. According to their theory, high attachment preference in languages is due to the availability of the so-called pseudorelative construction; however, neither Russian nor Bulgarian grammar has them. The explanation of why Russian and Bulgarian exhibit high attachment preference without having pseudorelative clauses remains open. Thus the data on RC attachment ambiguity and other structural ambiguities (e.g., Stoops, Luke, and Christianson 2013) from Slavic languages illustrate how Slavic psycholinguistics could contribute to one of the longest ongoing debates in general psycholinguistics.

2.3.2. Syntactic Complexity of Object Relative Clauses

Processing of syntactically complex sentences is yet another area where Slavic languages offer a great opportunity for testing theoretical accounts of why sentences with unbound syntactic dependencies present problems even for monolingual young adults. In such sentences known in psycholinguistics as filler-gap dependencies, a constituent (i.e., a filler) is moved from its original position in the sentence, leaving a trace (i.e., a gap) behind. The necessity to establish this filler-gap dependency in object relative clauses (RC) (e.g., *The reporter₁ that the senator attacked ___₁ hoped for a story*) is the cause of errors in comprehension and slower reading times when compared to subject RC (e.g., *The reporter that attacked the senator hoped for a story*) (Levy, Fedorenko, and Gibson 2013). Two classes of theories have been proposed to account for processing difficulty of the object RC. One is the memory limitations accounts (e.g., the dependency locality theory and cue-based retrieval theory) and the other, the prediction-based ones (e.g., word-order frequency theory and surprisal).

Levy and colleagues 2013 used Russian RCs to tease apart the predictions of the two classes of theories of syntactic complexity by relying on Russian grammar that allows for considerable word order flexibility in any clause, including the RC, and overtly marks cases on noun arguments. They manipulated word order in the subject RC (default SVO vs. scrambled SOV, 2a-b) and object RC (default OSV vs. scrambled OVS, 2c-d) in a self-paced reading study:

- (2) a. Slesar', kotoryj udaril èlektrika, ušel domoj.
 repairman_{NOM} that_{NOM} hit electrician_{ACC} went home

- (2) b. Slesar', kotoryj èlektrika udaril, ušel domoj.
 'The repairman who hit the electrician went home.'
- c. Slesar', kotorogo èlektrik udaril, ušel domoj.
 repairman_{NOM} that_{ACC} electrician_{NOM} hit went home
- d. Slesar', kotorogo udaril èlektrik, ušel domoj.
 'The repairmen who the electrician hit went home.'

The authors found that in contrast to English, object RCs in Russian were not more difficult to process than subject RCs. This absence of processing difference in RTs is due to the fact that it was possible to disassociate word order from RC type (i.e., subject vs. object) in Russian. However, it took the Russian participants significantly longer to read the embedded verb *udaril* 'hit' when it was preceded by the NP2 *èlektrik/èlektrika* 'electrician_{NOM/ACC}' (2b-c). This result supports the memory-limitations theories because the word *èlektrik/èlektrika* 'electrician_{NOM/ACC}' intervenes between the filler (e.g., *slesar'* 'repairman') and the gap at the verb and disrupts the filler-gap dependency. At the same time, the NP2 in the nominative case in the object RC (2c) was read faster than when it was in the accusative case in the subject RC (2b), a finding that is better explained by the expectation-based theories. Thus, Slavic data, once again, support a new approach in explaining syntactic complexity that relies on the integration of the previously competing psycholinguistic theories. It is clear that flexibility of word order of arguments and adjuncts in all types of sentences in Slavic languages (e.g., *wh*-questions, passives, topicalized sentences) holds the potential to account for many more complexity phenomena initially proposed for languages like English (Slioussar 2011; Stepanov and Stateva 2015).

2.3.3. Morphological Decomposition in the Mental Lexicon

In addition to flexible word order, Slavic languages are characterized by rich derivational and inflectional morphology. It is then not surprising that morphology serves as an exciting testing ground for studying the mental lexicon and lexical access in comprehension. Another long-standing debate in general psycholinguistics is about how inflected words are accessed in the mental lexicon. It started with a hypothesis that English verbs in the past tense are retrieved differently depending on whether they are derived via the productive rule of adding an *-ed* suffix (e.g., *walk-walked*) or are exceptions to this rule (e.g., *eat-ate*). Thus, the "words and rules" model by Pinker (1999) argues that the regular forms like *walked* are accessed via morphological decomposition, whereas the irregular ones like *ate* that are stored as whole words are accessed by direct sound-to-meaning mapping.

Experimental data from Slavic languages, with their intricate multilayered and multiaffixed derivational and inflectional morphology, have challenged the dual-mechanism theory of lexical access. Kazanina (2008, 2011) found that in Russian both suffixed (e.g., *gorka* 'a mountain_{DIMIN}') and prefixed (e.g., *privkus* 'aftertaste') inflected words are accessed through morphological decomposition even if they are irregular and semantically nontransparent (e.g., *lunka* 'hole' and *prikol* 'prank'). Gor and Jackson (2013) similarly showed that, regardless of their regularity and transparency, prime finite verb forms facilitate access to the target verb infinitive (e.g., regular *rabotaju-RABOTAT'* 'I work-to work', irregular *moju-MYT'* 'I wash-to wash') in native speakers of Russian. By manipulating the absence and presence of inflections in Russian nouns, Gor and colleagues (Gor, Chrabaszcz, and Cook 2017) showed that the processing costs in lexical access are not associated with initial decomposition viewed as affix stripping but rather with later recombination and checking of the whole inflected word. In addition, in a series of experiments in Serbian, Feldman, and colleagues (Feldman et al. 2012; Feldman, O'Connor, and Moscoso del Prado Martín 2009) argued that the target words (e.g., *RAT* and *RATAR*) were processed faster when the primes and targets were morphologically related (e.g., faster lexical decision times for *ratovati-RAT* 'to wage war-a war') but not when they were not (e.g., *ratovati-RATAR* 'to wage war-a peasant'). The explanation of what accounts for differences in lexical access of inflected words in Russian and Serbian compared to English remains on the agenda for future psycholinguistic research and perhaps will come from neuroimaging data (Bozic et al. 2013).

2.3.4. Predictive Role of Morphosyntax

Morphosyntactic characteristics of Slavic languages hold a very promising potential for testing a new direction in psycholinguistic research that is receiving a lot of attention these days, i.e., real-time prediction in processing. Prediction is crucial not only for processing of ambiguous (Section 2.3.1.) and syntactically complex (Section 2.3.2.) sentences, but also for 'normal' ones (e.g., expecting *won* upon hearing *The prize the athlete ...*), because it is well-established in psycholinguistics that readers and listeners actively anticipate upcoming material. This is what lies underneath the robustness and speed of language understanding (Phillips and Ehrenhofer 2015: 413). Investigation of prediction has become particularly fruitful with the rise of eye-tracking, first in reading and later in spoken language comprehension in the form of the visual world eye-tracking paradigm. For example, English listeners can rapidly use selectional restrictions of the verbs to predict the direct objects that are yet to appear in speech stream. Altmann and Kamide 2004 showed that when watching a computer screen with four pictures of a boy, a cake, a toy train,

and a toy car, the listeners launched eye movements to the cake while still listening to the verb in the spoken sentence *The boy will eat the cake*.

Note that testing the role of prediction critically relies on **early** placement of predictive information in the sentence. English with its fixed SVO word order is not best suited for these purposes; in contrast, the flexible word order and rich morphosyntactic paradigms of Slavic languages can be very revealing about which information is predictive in online processing. For example, adjectives that precede nouns in Slavic languages agree with them in gender, number, and case. I used this feature of the Russian grammar to demonstrate that Russian listeners can quickly use the gender agreement marker on the adjective to identify the upcoming target noun (Sekerina 2012). The participants heard the spoken instructions to move colored shapes, e.g., *Položite krasnuju ...* 'Put the red_{FEM-ACC} ...' while looking at the visual display of four shapes, two of which were red objects, a car_{FEM} and a flower_{MASC}, but of different grammatical gender. Upon hearing the adjective *krasnuju* 'red_{FEM-ACC}', the listeners were able to quickly launch eye movements to the red car even though they had not heard the word *mašinku* 'car_{FEM}' yet. Bott and Gattnar 2015 used eye movements in reading to show that Russian readers were able to predictively use the aspectual information encoded on the perfective verb *vyigrala* 'won_{PERF}' when it was preceded by either the matching or mismatching durative adverbial (e.g., *Celyx tri časa *vyigrala turnir...* 'Whole three hours *won the championship...' vs. *Tri časa nazad vyigrala turnir ...* 'Three hours ago won championship...'). In the mismatching condition, their eye movements reflected immediate detection of the mismatch between the adverbial and the verb, and this allowed them to reject the sentence as not making sense significantly faster than in the matching condition.

Finally, to round off the description of psycholinguistic topics in comprehension with Slavic languages, I should mention experiments in psychophysics and psychosemantics. Russian psycholinguists have studied the role of acoustic cues in the perception of word stress (Chrabaszc et al. 2014), the use of prosody in deciding whether a sentence is declarative or interrogative (Makarova 2007) and its role in noncanonical word orders (Luchkina and Cole 2014), consonant devoting (Kharlamov 2014), and phonotactic constraints in oral reading of monosyllabic words (Ulicheva et al. 2016). Wagner and colleagues (2013) investigated phonotactic constraints that regulate consonant clusters in Polish. In psychosemantics, Slavic data have been used to study animacy in Serbian (Radanović, Westbury, and Milin 2016), comparative properties of quantifiers in Bulgarian and Polish (Tomaszewicz 2013), and quantifier scope in Russian (Ionin and Luchkina 2015; Sekerina and Sauerermann 2015).

2.3.5. Agreement Attraction Errors in Production

I will finish Section 2 with production experiments that investigated Slavic languages. Production traditionally occupies a smaller portion of psycholinguistic research in comparison to language comprehension because it is much more difficult to conduct tightly controlled experiments when participants have to produce language. For production experiments to succeed, it is important to set up a study in such a way that it is possible to restrict participants' free responses to as few categories as possible, which in effect means turning open-ended questions into closed-ended ones. One such topic is agreement attraction errors. In many languages, the subject and the predicate have to agree in grammatical features, although the types of agreement vary among languages. In English, the subject-predicate agreement is reflected in number; when the subject is complex, e.g., *the key* (NP1) *to the cabinets* (NP2), people often erroneously produce a predicate that agrees in number with the attractor (NP2) instead of the head (NP1) resulting in an ungrammatical sentence **The key to the cabinets were rusty* (Bock et al. 2001). This error is caused by the intervening NP2 that becomes the controller of agreement, i.e., "attracts" it.

Slavic languages offer an advantage to studying agreement attraction errors because the subject and the predicate agree not only in number as in English but also in gender. Lorimor and colleagues (2008) investigated agreement attraction errors in number in Russian and found that the singular-plural condition (e.g., *bilet na koncerty* 'ticket_{SG} to concerts_{PL}') produced the most errors similar to English, but in contrast to English, the overall proportion of errors in Russian was much lower (0.18 vs. 0.05, respectively). Agreement attraction errors in gender when the head and the attractor are of different gender (e.g., *soseodka muzykanta* 'neighbor_{FEM-NOM} musician_{MASC-GEN}') in their experiment were almost non-existent (0.006) similar to another Slavic language, Slovak (0.03) (Badecker and Kuminiak 2007). Slioussar and Malko 2016 argued that the standard task must be revised to get participants to produce errors in gender agreement. Instead of using sentence fragment completion, they presented the predicate first (e.g., *bylla* 'was_{MASC/FEM/NEUT}' + participle) followed by the complex subject in which the two NPs were crossed for all possible gender combinations and asked the participants to use them to produce a sentence. Quite a few gender agreement errors were elicited (0.054), with the MASC-FEM condition (e.g., *recept na maz' *byla...* 'prescription_{MASC} for ointment_{FEM} *was_{FEM}...') being the worst. The authors argue that agreement attraction errors in gender are due to retrieval interference: speakers generate the nouns inside the complex subject with their grammatical features and then look for specific feature values while retrieving the subject at the verb when they have to produce the right agreement pattern. When this search for specific feature values goes awry, the attractor instead of the head noun becomes the agreement controller, resulting in gender agreement attraction errors.

Besides attraction errors, gender and number agreement in production has been the focus of experimental research in Bulgarian (Andonova et al. 2004), Czech (Bordag and Pechmann 2009), and Serbian (Mirković and MacDonald 2013). The *Journal of Slavic Linguistics* (2016, 24.1) has recently published a special issue on agreement in Slavic languages that contains six experimental articles on conjunct, object-clitic, and RC-internal agreement in Slovenian, Bosnian/Serbian/Croatian, and Polish (Arsenijević et al. 2016). Psychophonology and prosody were studied in production experiments of Bulgarian acoustic cues of narrow and wide focus (Andreeva, Koleman, and Barry 2014), Slovenian irregular verbs (Petrič and Stemberger, 2014), and Serbian pitch accents (Zsiga and Zec 2013). Patterns of compound-word production in Polish were examined by Haman and colleagues (Haman et al. 2009), while two sentence production studies focused on the role of animacy in relative clauses in Serbian (Gennari, Mirković, and MacDonald 2012) and the cost of producing noncanonical word orders in Russian (Myachykov et al. 2013), respectively.

2.4. Theoretical Approaches and Specific Languages

The two final dimensions of Slavic psycholinguistics—theoretical approaches and specific languages—are shared with Slavic theoretical linguistics. The two main theoretical approaches in Slavic linguistics are formal generative and cognitive. Accordingly, Slavic psycholinguistic research falls either into formal experimental or cognitive-linguistic varieties. It is unfortunate that there is a terminological ambiguity: formal experimental psycholinguistics is a happy marriage of generative linguistics and experimental cognitive psychology that started in the late 1950s. However, the adjective “cognitive” is also used in the name of the second theoretical approach, that of cognitive linguistics. The latter is a theoretical linguistic model that emphasizes meaning as opposed to structure and draws on other less formally oriented disciplines, such as semiotics (Evans and Green 2006). This sometimes leads to a confusion in the literature in which psycholinguistics is considered a subfield of cognitive linguistics (Nedashkivska 2011). This is not true of formal experimental psycholinguistics because it takes its roots in generative grammar and closely mirrors the development of Chomsky’s linguistic theory (Ferreira 2005). In this article, I have focused on formal experimental psycholinguistics; therefore, I am leaving the description of experimental approaches to Slavic within cognitive linguistics to cognitive linguists (Janda 2006; Janda and Dickey this volume).

The final dimension of Slavic psycholinguistics represents the focus on specific Slavic languages. Out of the three branches of Slavic—East, South, and West—East Slavic languages dominate in psycholinguistic research. This is not surprising because the overwhelming majority of experimental work in Slavic psycholinguistics is on Russian. Among West Slavic languages, the

dominant one is Polish, with only a few experiments on Czech (Bordag and Pechmann 2009), while the studies in South Slavic languages are mostly on Serbian/Croatian followed by a few on Bulgarian (Andonova et al. 2004; Andreeva et al. 2014; Nikolova and Jarema 2002; Stoynezhka et al. 2010) and Slovenian (Marušič et al. 2015; Petrič and Stemberger 2014). There are single experiments on Slovak (Badecker and Kuminiak 2007) and Ukrainian (Mykhaylyk, Rodina, and Anderssen 2013), and, to the best of my knowledge, no experimental research on Belarussian and Macedonian.

3. Slavic-specific Academic Infrastructure for Psycholinguistics

In this final section, I will briefly describe two current trends that drive academic infrastructure growth in Slavic psycholinguistics. The first one is the development of norming databases, sets of visual and spoken materials for conducting empirical studies, and tests and assessments (Section 3.1.). The second trend is an increase in psycholinguistic research that is being carried out in newly established laboratories in the Eastern European countries, with the findings presented at local conferences and often published in Slavic languages (Section 3.2.).

3.1. Resources for Slavic Psycholinguistics

Empirical work in psycholinguistics is resource- and labor-intensive. Designing experiments depends on availability of databases of behavioral measures, sets of visual and spoken materials, and tests and assessments. Such resources are readily available for English and many other major European languages. The most important database for any language is its corpus of written and spoken sentences that allow psycholinguists to control for various characteristics of words and naturally occurring syntactic constructions. Such Slavic national corpora are available for Russian (Lyashevskaya and Sharov 2009) and Czech (Český národní korpus). They often serve as the first step in designing materials for psycholinguistic experiments. For example, when we set up an experiment that uses written materials, it is necessary to pay attention to word frequency, their length, and how predictable they are in the sentence. These parameters are especially critical for eye-tracking experiments in reading.

The Neurolinguistics Laboratory at the HSE in Moscow in partnership with the Laboratory for Cognitive Studies at the Saint Petersburg University and my Eye-Tracking Laboratory at the College of Staten Island has used the cross-linguistic protocol for eye movements in reading designed by Reinhold Kliegl (University of Potsdam) (Kliegl et al. 2004) to create the Russian Sentence Corpus (RSC; Laurinavichyute et al. submitted). The RSC contains 144 sentences, and each sentence contains a target word differing according to

three parameters: length (short, medium, long), frequency (low and high), and part-of-speech (noun, verb, adjective). We collected predictability norms and plausibility ratings for these sentences and then had 100 monolingual skilled readers (ages 18–29) read the RSC sentences. This allowed us to establish basic characteristics of eye movements in Russian (fixation durations, landing positions, word skipping probabilities) as factors of frequency, length, part-of-speech, and predictability. The RSC and the database of eye movements will be available as a free repository on the web site of the Laboratory of Neuro-linguistics at HSE and will serve eye-movement norms for skilled readers for comparison with eye-movement patterns in adult learners, i.e., Russian heritage speakers and L2 learners of Russian (https://www.hse.ru/neuroling/eyetracking_materials).

Other newly developed psycholinguistic resources for Russian include a database of linguistic parameters of words SimulStat (http://stimul.cognitivestudies.ru/ru_stimul/) and a database of pictures of 375 action nouns and verbs (Akinina et al. 2015, <http://en.stimdb.ru/>). The norms for age of acquisition, name agreement, picture name agreement, imageability, familiarity, word frequency, and word length for the most widely used picture set in general psycholinguistics by Snodgrass and Vanderwart (1980) are also available for Russian (Bonin, Guillemard-Tsarapina, and Méot 2013; Grigoriev and Oshhepkov 2013) and Croatian (Rogić et al. 2013). Lists of pseudowords are very useful for cross-modal priming experiments that rely on a lexical decision task; one such list is available for Polish (Imbir, Spustek, and Żygierewicz 2015).

3.2. Slavic Psycholinguistics in the Eastern European Countries

So far I have reviewed the state-of-the-art of Slavic psycholinguistics as it can be gleaned from empirical peer-reviewed publications in the western journals that are indexed in Web of Science™ and Scopus™. Such articles are easily accessible in the academic electronic databases through university libraries and are written in English. However, much of psycholinguistic research on Slavic languages appears in the proceedings of Slavic conferences and country-specific academic journals. The proceedings are always in English, whereas country-specific journals are often published in a Slavic language which make them less accessible to the readers outside of the Slavic world.

In addition to the most important Slavic conference held in the U.S. annually, i.e., Formal Approaches to Slavic Linguistics Workshop (FASL, with the 26th meeting held in 2017), there is a biannual European partner conference Formal Description of Slavic Languages (FDSL, with the 12th meeting held in 2016). Each FDSL conference features several talks that present psycholinguistic experiments on Slavic languages. For example, between FDSL-4 (2001) and FDSL-11 (2015), there were talks on negation and aspect in Bulgarian (Kühnast 2003), superiority effects and *wh*-questions in Russian (Meyer 2002),

prosody and focus in Bulgarian (Oliver and Andreeva 2004), grammatical gender in Czech (Bordag 2008) and Russian (Sekerina 2008), relative clause attachment ambiguity in Russian (Fedorova et al. 2007), and *neg*-raising in Slovenian (Dočekal and Dotlačil 2015), just to name a few. Moreover, the three recent FDSL conferences hosted special psycholinguistic workshops on heritage Slavic languages (FDSL-10 in 2013 in Leipzig), first language acquisition of Slavic languages (FDSL-11 in 2015 in Potsdam), and on experimental semantics and pragmatics (FDSL-12 in 2016 in Berlin). The FDSL proceedings, a selection of the talks, are published in English by Peter Lang, a German publisher.

Publishing special issues dedicated to a particular topic relevant to Slavic linguistics in Slavic journals presents an excellent opportunity for bringing psycholinguists to the forefront. One such example is the 32nd volume of *Cahiers Linguistiques d'Ottawa* entitled *Psycholinguistics in Slavic* for which Danijela Stojanović served as a guest editor (Stojanović 2004). This volume contains seven articles that describe experiments in a variety of Slavic languages (e.g., Russian, Czech, Polish, and Ukrainian), range from psychophonology to agreement to sentence processing, and investigate a variety of special populations such as children and bilingual speakers. The Slavic professional organization, the Slavic Linguistics Society (SLS), founded in 2004, that convenes its own annual conference, has made the premier publication venue for Slavic linguistics, the *Journal of Slavic Linguistics*, its official journal, and more Slavic psycholinguistic articles now appear there. Psycholinguistic coverage in *JSL* is still modest, but a recent issue, 24(1), contains a collection of six articles dedicated to experimental investigations of agreement in South Slavic (Arsenijević et al. 2016).

Finally, several country-specific journals publish psycholinguistic articles in the Slavic language of the country. For example, *Voprosy jazykoznanija* 'Issues in Linguistics', a journal of the Russian Academy of Sciences, has published several such articles in Russian by the two leading Russian psycholinguists, Olga V. Fedorova and Olga V. Dragoy, who work in Moscow (Dragoy 2006; Fedorova 2013). The Polish Academy of Sciences has an official journal, *Polish Psychological Bulletin*, and the University of Ljubljana has a Slovenian journal *Linguistica*, where psycholinguistic articles appear (Dočekal and Dotlačil 2015; Hamam et al. 2009) both in English and in Slavic languages. New e-journals create new opportunities for Slavic psycholinguists to make their work accessible to a wider audience. One such example is the *Questions and Answers in Linguistics* journal published jointly by the University of Wrocław and Mouton de Gruyter. One particular open-access journal where several psycholinguistic articles on Slavic languages have recently appeared (Imbi et al. 2015; Slioussar and Malko 2016; Stepanov and Stateva 2015) is *Frontiers in Psychology: Language Sciences* (<http://journal.frontiersin.org/journal/psychology/section/language-sciences>). Despite the fact that it has expensive article processing

charges, this open-access peer-reviewed journal is rapidly gaining popularity. Since its foundation seven years ago, it has become the largest and the second most cited journal in psychology, with an impact factor of 2.463. The fact that psycholinguistic articles on Slavic languages have started to appear in *Frontiers in Psychology* is an encouraging testimony to the high quality, interdisciplinary nature, and bright future perspectives for Slavic psycholinguistics.

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