What Do Event-Related Potentials Reveal about Processing Grammatical Aspect in Bosnian/Croatian/Serbian? – A Comparison with English Aspect

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Abstract

Grammatical aspect expresses information about the temporal contours of an event. Such essentially semantic information is encoded via aspectual affixes in Bosnian/Croatian/Serbian (BCS) and periphrastically in English. As a South Slavic language, BCS grammaticalizes the binary opposition between imperfective and perfective aspect, while English distinguishes between the progressive and the perfect. Generally, grammatical aspect is obligatorily expressed on the verb in BCS but not in English. In an event-related potentials (ERP) experiment, we study the electrophysiological responses to aspectual violations in BCS. The robust P600 suggests that aspectual violations in BCS trigger repair processes as the parser detects the aspectually incongruous form and repairs it so that it can fit a wider sentential context. We then compare our ERP study on BCS aspect violations with an ERP study on English aspect violations by Flecken, Wallbert and Dijkstra (2015), and discuss the cross-linguistic differences between two inherently different grammatical aspect systems, BCS and English.

Keywords: aspect, event-related potentials, P600, English-Bosnian/Croatian/Serbian analysis

1   Introduction

Tense and aspect express the time frame of an event (Smith 1991; 1997; 2013; Bastiaanse 2013). Tense locates the event in time by relating the event time to the speech time (Comrie 1976; 1985). Grammatical aspect expresses the speaker's perspective of the internal temporal constituency of the event (Comrie 1976; 1985). Slavic aspectual oppositions 'imperfective' and 'perfective' are typically treated as prototypical exemplars of aspectual oppositions (Binnick 1991). The choice of perfective aspect for a particular utterance gives a holistic view of the event without recognizing different stages that make up the event, whereas the choice of imperfective aspect provides an internal view of the event, making semantically visible the stages of the event (Comrie 1976; Gasparov 1990; Smith 1991; 1997; 2013; Filip 1999; Madden and Zwaan 2003).

1.1   *Aspect in Bosnian/Croatian/Serbian*

Novak-Milić and Čilaš-Mikulić (2013) define BCS aspect as a lexical-grammatical category that differentiates between the imperfective and perfective. Very few aspectually ambiguous exceptions aside, in BCS the imperfective and perfective aspects are always expressed on the verb, which entails that each verb is either imperfective or perfective (Riđanović 1976; 2012; Stevanović 1989; Jahić, Halilović and Palić 2000; Klajn 2001; Silić and Pranjković 2007; Čirgić, Pranjković and Silić 2010; Novak-Milić and Čilaš-Mikulić 2013). Since finite verbs as well as the non-finite forms are generally marked for aspect, aspect in BCS, hence Slavic, is intrinsic to time reference (De Swart 2012; Riđanović 2012).

1.1.1   *Formal realization*

In standard BCS textbooks (as well as traditional Slavic aspectology in general) it is postulated that imperfective and perfective forms are morphologically related because aspectual meanings are conveyed by aspectual affixes (Stevanović 1989; Jahić, Halilović and Palić 2000; Klajn 2001; Silić and Pranjković 2007; Čirgić, Pranjković and Silić 2010). Jahić, Halilović and Palić (2000) describe two opposite processes in BCS: perfectivization – the derivation of perfective verbs from the imperfective ones as in (1), and imperfectivization – the derivation of imperfective verbs from the perfective ones as in (2).

(1)

šaptati$_{IPFV}$ – *šapnuti*$_{PFV}$: 'to be whispering' – 'to have whispered'

(2)

zaraziti$_{PFV}$ – *zaražavati*$_{IPFV}$: 'to have infected' – 'to be infecting'

Traditional BCS and Slavic linguistics also assumes that a minority of verbs are inherently perfective (e.g., Novak-Milić and Čilaš-Mikulić 2013), while most verbs are inherently imperfective, deriving the perfective form by pre-fixation, as can be seen in (3) (Riđanović 1976; 2012). A verb can also be per-fectivized by changing the suffix in the imperfective stem, as in (4) (Silić and Pranjković 2007; Čirgić, Pranjković and Silić 2010).

(3)

pisati$_{IPFV}$ – ***na**pisati*$_{PFV}$: 'to be writing' – 'to have written'

(4)

bacati$_{IPFV}$ – *bac**iti***$_{PFV}$: 'to be throwing' – 'to have thrown'

Klajn (2001) and Riđanović (2012) point out that it is not uncommon that aspectual affixes (prefixes in particular) introduce a new meaning component to the semantics of the verb, as in (5).

(5)

ići$_{IPFV}$ (*to go*) – *otići*$_{PFV}$ ('to go way')

                 doći$_{PFV}$ ('to come')

                 ući$_{PFV}$ ('to enter')

                 izaći$_{PFV}$ ('to leave')

                 preći$_{PFV}$ ('to cross')

Perfectivizing prefixes such as the ones in (5) are typically referred to as 'lexical prefixes' (Ramchand 2004; Gehrke 2007; Altshuler 2014 among many oth-ers), as they modify the lexical meaning of the verb: the derived perfective verbs in (5) do not have the same semantics as the root imperfective form. In such examples, aspectual morphology derives verbs with semantics different from the unprefixed imperfective verb form. This implies that some aspectual affixes resemble a derivational morphology that derives new lexemes rather than different word forms of the same lexeme (Bybee 1985).

This is precisely the most curious feature of BCS, and Slavic aspectual systems more generally – their morphology. Such a lexical nature of some of its morphology has inspired linguists to describe the nature of Slavic aspect as lexical-grammatical (e.g., Novak-Milić and Čilaš-Mikulić 2013). Nevertheless, BCS and Slavic aspect is a grammatical category because it does not relate to the inherent features of the verb (as lexical aspect) but rather expresses a speaker's viewpoint and it is grammaticalized. Slavic aspectology, however, shows a lack of agreement when it comes to the exact grammaticalization means. The traditional literature that treats aspectual partners as pairs of the same lexeme (the views outlined above) predicts that grammaticalization unfolds via affixes. That aspectual partners are forms of one lexeme is also supported by some psycholinguistic evidence (e.g., Anstatt and Clasmeier 2012).

However, it was shown in (5) that some affixes not only alter the semantics of the verb but consequently affect its argument structure ($ići_{IPFV}$ ['to go' – intransitive] – $preći_{PFV}$ ['to cross' – transitive]; Stevanović 1989). For this reason, some studies on aspect assume that grammaticalization is achieved via affixes but that not all affixes morphologically express grammatical aspect and that some actually mark lexical aspect (Gehrke 2004; 2007; Ramchand 2004; Slabakova 2005; Sussex and Cubberley 2006).

Some also claim that affixes do not mark grammatical aspect, but that the stems of what are traditionally considered aspectual partners (e.g., *lomi-* and *slomi-* 'to break', see 8 above) are stored in the lexicon (e.g., Willim 2006; Filip 2003; 2017; Klimek-Jankowska et al. 2018). Another instance of disagreement arises here: some studies assume that stems are already specified for aspect in the lexicon (e.g., Klimek-Jankowska et al. 2018), while others that stems are aspectless in the lexicon and that the aspect feature is acquired in the course of derivation (Tatevosov 2011).

Our goal is not to defend the basis of the above-presented theoretical approaches, as our experimental study does not probe into aspectual morphology and derivation *per se*. However, we aim to very briefly touch upon the complexity of the Slavic aspect analysis before focusing on the assumption relevant for the current work, one that is actually common to all the divergent views above, that Slavic and BCS grammaticalizes aspect.

More precisely, for our study that only contains perfectivizing affixes and not lexical affixes that introduce new semantics to the verb, we assume that verbs originate in the lexicon as imperfective or perfective and that aspectual morphology supplies the aspectual value. Moreover, following the theoretical

accounts of time reference proposed by Mezhevich (2008; for Russian) and the feature-checking mechanism as described by Pesetsky and Torrego (2004), we assume that in BCS the functional category for grammatical aspect (Aspect Phrase) is projected. We also postulate that aspect is grammaticalized via affixes. At some point in the derivation, affixes have to be associated with the functional head *Aspect*, where the semantic (formally dubbed as 'interpretable') feature [±perfective] needs to be checked. According to Pesetsky and Torrego, feature-checking means that the functional head *Aspect* carries the initially unvalued feature [±perfective] that is valued (i.e., checked) as, say, perfective only when the lexical item such as *napisati*$_{PERF}$ ('to have written') carrying the perfectivizing prefix enters the derivation of the sentence. For BCS, this means the following.

First, the verb enters the derivation with a valued aspect feature. The concrete value of the aspect feature depends on the morphological form of the verb. For example, the verb *napisati* ('to write') is perfective due to its perfectivizing prefix *na-*. Then, in BCS, the functional category for grammatical aspect (Aspect Phrase) is projected. The functional head *Aspect* contains the yet unvalued feature [±perfective]. The feature gets valued by agreement with the [±perfective] feature of the verb. In the case of *napisati* ('to write'), the feature [±perfective] of the functional head *Aspect* gets valued as [+perfective] via agreement with the verb that carries the [+perfective] feature as illustrated in (6). Therefore, it is verb morphology that determines the aspect feature.

(6)

Derivation of Aspect Phrase
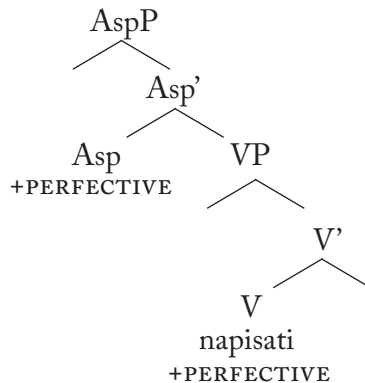
However, there are constraints in the context when the aspect feature is marked [+ perfective] that are important for experimental studies. Therefore, another relevant phenomenon concerning BCS aspect is its syntactic distribution.

1.1.2 Function

According to Riđanović (1976; 2012), there are three broad aspectual meanings in BCS: punctual (action took place at some point in time), durative (action ongoing), iterative (action repetitive). Perfective aspect expresses what Riđanović calls the punctual meaning as in (7), while imperfective aspect conveys the durative as in (8) and iterative meanings as in (9). All standard textbooks in all variants of BCS rely on these common descriptions (Jahić, Halilović and Palić 2000; Klajn 2001; Silić and Pranjković 2007; Čirgić, Pranjković and Silić 2010).

(7)

Učenici	su	napisali	esej.
Students	AUX	wrote$_{PFV}$	essay

'Students wrote an essay.'

(8)

Učenici	sada	pišu	esej.
Students	now	write$_{IPFV}$	essay

'Students are now writing an essay.'

(9)

Učenici	često	pišu	eseje.
Students	often	write$_{IPFV}$	essays

'Students often write essays.'

However, perfective verb forms cannot be used to express the present unfolding at the time of speech as (10) and (11) show (Riđanović 1976; 2012, Klajn 2001; Novak-Milić and Čilaš-Mikulić 2013).

(10)

*Sada napišem   esej.

Now write$_{1SG.PRS.PFV}$ essay

'I write an essay now.'

(11)

*Učiteljice trenutno   upišu   ocjene   u   dnevnik.

Teachers currently   write$_{PRS.PFV}$ grades   in   gradebook

'Teachers currently write grades in the gradebook.'

It is aspectual violations that arise when the perfective verb form is used in the real present contexts as in (10) and (11) that we investigate in our ERP study. We assume that in sentences such as (10) and (11), the temporal frame of the sentence is determined by the semantics of the adverbial *trenutno* ('currently') and *sada* ('now') and set as the real present. Upon encountering the perfective verb *upišu*$_{PFV}$ ('to have written') or *napišem*$_{PFV}$ ('to have written'), the perfective meaning of completion expressed by the verb violates the real present temporal frame. Essentially, this is a semantic violation because the verb *upišu*$_{PFV}$ ('to have written') and the verb *napišem*$_{PFV}$ ('to have written') are morphosyntactically well-formed (the forms are a legal combination of a prefix and a stem). What is in conflict here is the semantics of the temporal lexical adverb and the perfective verb. The question we ask in the ERP study is whether this violation is perceived by native speakers as a semantic violation or a morphosyntactic one despite its semantic origin.

To provide a contrastive analysis of our ERP findings and the first ERP study on this type of aspectual violations, the work of Flecken, Wallbert and Dijkstra (2015) on aspectual violations in English, a theoretical description of English aspect and its comparison to BCS aspect are all discussed below.

1.2   *Grammatical aspect systems: English versus BCS aspect*

English and BCS aspect differ structurally and functionally. The aspectual systems of these two languages show different aspectual realizations. The descriptive grammars in English specify aspectual distinctions between the progressive and the perfect (Comrie 1976; Greenbaum and Quirk 1990; Jacobs 1995; Biber et al. 1999; Greenbaum and Nelson 2009; Hasselgård, Lysvåg

and Johansson 2011). The status of English perfect aspect has been a matter of debate. While some authors treat it as aspectual distinction that expresses anteriority (e.g., Filip 2011), others consider the perfect a compound tense (e.g., Reichenbach 1947; Verkuyl 1999; Huddleston and Pullum 2002; Leech 2004). Bhatt and Pancheva (2005) suggest that the perfect should not be treated as a type of grammatical aspect because it can combine with another aspectual distinction, the progressive.

Unlike the BCS aspectual system that uses complex aspectual morphology (prefixes and suffixes) on the verb, the English progressive aspect (as well as perfect aspect, if considered an aspectual distinction) is expressed periphrastically in an auxiliary + participle construction (Quirk et al. 1985; Jacobs 1995; Aarts 2001; Greenbaum and Nelson 2009; Filip 2011; Hasselgård, Lysvåg and Johansson 2011) as (12–13) show, and where tense is marked on the operator as either past or present.

(12)

John was smiling. (Progressive)

(13)

Ben has fallen asleep. (Perfect)

Another characteristic of the English aspectual system is that simple forms that are not marked for aspect can also express aspect in combination with arguments and adjuncts (*He wrote a letter* – perfective; *It rained all day* – imperfective). With the exception of a few verbs that are aspectually ambiguous this is not possible in BCS, as BCS verbs are generally marked for aspect (Jahić, Halilović and Palić 2000; Klajn 2001; Čirgić, Pranjković and Silić 2010; Riđanović 2012) and do not depend on arguments and adjuncts for aspectual interpretation. Therefore, in terms of aspect realization, English expresses aspect periphrastically in combination with inflection and does not grammaticalize the perfective. BCS expresses aspect synthetically by aspectual morphology. Moreover, BCS grammaticalizes both imperfective and perfective aspect.

In addition to different formal realizations of aspect, the relationship between the aspectual form and its aspectual meaning is not identical in both languages. Portner (1998) adopts an 'event semantics' approach to the progressive and describes it in terms of the properties of particular events. He thus posits that progressive verbs express that a certain state continues and non-progressive ones that a certain event culminates. Ter Meulen (1985), Link (1987) and

Krifka (1992) base their analyses on the idea that the progressive describes a segment of the event. Similarly, Vlach (1981) and Lascarides (1991) argue that the progressive entails a process that is ongoing at the time expressed by tense information.

Therefore, the English progressive aspect corresponds to the BCS imperfective aspect for the most part. However, the BCS imperfective aspect shows a wider range of meanings, including the general-factual meaning (a past completed event presented in the imperfective to state the existence of the event) that English progressive aspect cannot convey. In (14), the imperfective aspect presents a complete and bounded situation in the past and not an internal interval or an unbounded situation that is a typical imperfective interpretation. Gasparov (1990) argues that such general-factual uses of the imperfective imply an existential interpretation (that a certain event occurred). However, the English progressive equivalent of the sentence below *Have you been reading* War and Peace*?* cannot have a perfective interpretation.

(14)

Jesi	li	ikad	čitao	Rat	i	mir?
AUX$_{\text{2SG.PRS}}$	PRT	ever	read$_{\text{PTCP.IPFV}}$	War	and	Peace?

'Have you ever read *War and Peace*?'

Therefore, the English progressive and the BCS imperfective should not be treated as identical aspectual distinctions, but rather the progressive is a type of the imperfective, whereas the imperfective can express meanings other than the progressive meaning.

The habitual meaning conveyed by the imperfective in BCS is generally expressed by simple forms in English. If the progressive (roughly speaking, the English equivalent of the BCS imperfective) is used in the habitual context, a very specific interpretation is achieved – disapproval and irritation with someone's habit, as in (15) (Alexander 1988).

(15)

She writes letters every day vs. She is writing letters every day.

English does not possess a grammaticalized perfective aspect but perfective meanings can be expressed by the perfect aspect, as in (13) above or by formally aspectless simple forms as in (16).

(16)

The boy walked to the store.

Quirk et al. (1985) and Aarts (2001) refer to the English perfect aspect as 'perfective'. Nevertheless, perfect aspect can also express a type of imperfective meaning – an interval that started in the past and spills into the present (*John has been sick*, Filip 2011).

In sum, the English progressive and the BCS imperfective are not identical aspectual oppositions. In English, the perfective meaning is expressed by simple forms that are not formally marked for aspect or by perfect forms that can also express imperfective meaning. The BCS perfective has a specific meaning, while the imperfective is underspecified as it can express more than one meaning. In English, it is the opposite. The progressive is specific, while non-progressive forms show a wider range of meanings. Therefore, English shows more flexibility and more options for an overlap – one aspectual meaning expressed by two different forms. In contrast, BCS aspect has a straightforward distribution with hardly any options for an overlap – the general-factual imperfective aside, imperfective and perfective verbs forms cannot be used in the same context with one and the same meaning. This is one of the unique features of the so-called Slavic-style/type aspect (Dahl 1985; Bybee and Dahl 1989). How different aspectual systems are processed has been investigated by using event-related potentials (ERPs).

1.3   *Event-related potentials*

Unlike behavioural data that can reveal quantitative differences between conditions, ERP data can reveal the nature of the processes underlying certain processing difficulties (Kaan 2007). The most well-studied ERP components related to word and sentence processing are the N400, the (early) Left Anterior Negativity (E)LAN and the P600.

The N400 effect is a negative deflection typically found 300-500 ms with a centro-parietal maximum and widely reported (but not exclusively) after the onset of a semantically/pragmatically incongruent item (*He spread the warm bread with socks*) (Kutas and Hillyard 1980). The N400 then reflects the inability to integrate lexical and semantic information (Tanner, Grey and Van Hell 2017).

Morpho-syntactic category and phrase structure violations typically elicit an early left anterior negativity (ELAN) with the latency of 100-200 ms after the onset of the critical stimulus (Kutas, Van Petten and Kluender 2005; Kaan 2007). The LAN, which peaks 300-500ms after the onset of the critical stimulus, is typically associated with morpho-syntactic and word form violations (Neville et al. 1991).

Another component often reported in morphosyntactic studies is the P600. This is a positive deflection that peaks 500-900 ms after the onset of the critical stimulus and with a posterior scalp distribution. There have been considerable debates on the nature of cognitive processes that underlie the P600. Some studies found the P600 for (morpho-)syntactically anomalous words (e.g., Friederici, Hahne and Mecklinger 1996) so that the P600 was initially believed to reflect syntactic integration difficulties (Osterhout and Nicol 1999; Kaan et al. 2000; Allen, Badecker and Osterhout 2003 among many others). However, the P600 was also found for non-syntactic violations, such as semantic violations, animacy violations or thematic role violations (e.g., Chow and Phillips 2013). Later accounts thus do not interpret the P600 as an index of syntactic processing alone.

More generally, Hagoort (2003) argues that the P600 reflects the time that is needed to unify all the relevant information that pertains to the interpretation of the sentence and select the appropriate analysis for the sentence. Van Herten, Chwilla and Kolk (2006) suggest that the P600 is indicative of general error monitoring processes that are triggered upon encountering syntax-semantics discrepancies. Similarly, Kolk and Chwilla (2007) argue that the P600 reflects engagement of the conflict-monitoring mechanisms. Friederici (2002) argues that the P600 reflects thematic integration and revision and repair processes. Bornkessel-Schlesewsky and Schlesewsky (2008) also assume the failure to correctly map thematic roles is reflected in the P600. Brouwer, Fitz and Hoeks (2012) argue that the P600 is evoked by continuous efforts to integrate semantic information following anomalous input. Tanner, Grey and Van Hell (2017) explain that all these later accounts of the P600 regard it as an index of late-stage processing where all information (syntactic, semantic, thematic, etc.) is integrated and that they postulate that the P600 is triggered when mismatching representations are attempted to be reconciled and integrated which sets in motion reanalysis processes. Previous studies on aspect have shown that aspectual violations elicit the P600 component, albeit not consistently.

1.4   *Previous studies on aspect processing*

The neuro- and psycholinguistic nature of aspect (violation) processing is rather understudied. However, two types of studies exist: those that investigate local aspectual violations (Zhang and Zhang 2008; Hao, Xun and Lu 2021) and others that investigate the mismatch between aspectual meaning of the verb and a wider sentential context (Bott and Gattnar 2015; Flecken, Wallbert and Dijkstra 2015; Zeller and Clasmeier 2020).

Zhang and Zhang (2008) present a study on the electrophysiological correlates of aspectual violations in Chinese caused by the co-occurrence of progressive and perfective markers on the verb. Their results show a 200–400 ms negativity with a posterior and left central distribution followed by a P600 in the 450–800 ms time window. Zhang and Zhang (2008) argue that the P600 effect reflected syntactic repair and resolution of conflict at the encounter of aspectual violations. They also explain that the negativity effect could not be interpreted as a left anterior negativity (LAN), which is usually associated with the detection of a morphosyntactic violation (Friederici 2002), due to a different distribution.

Hao, Xun and Lu (2021) performed another ERP study on aspectual violations in Chinese. In this work, aspectual violations were caused by the incongruity between the lexical aspect of the verb (achievement verbs that are +punctual -durative) and the grammatical aspect encoded by the progressive marker *zhe*. Aspectual violations elicited a negativity in the 300-500 ms time-window that had a centro-right distribution that the authors refer to as the N400-like component, which is usually related to semantic and lexical processing (Kutas and Federmeier 2011). That effect was followed by the P600 component as well as a late anterior negativity on the word immediately adjacent to the aspectual marker. Hao, Xun and Lu (2021) suggest that the mismatch between lexical aspect of the verb and grammatical aspect expressed by aspectual markers involved both semantic and syntactic processing, as reflected in the N400-like and the P600 components. The authors interpreted the late anterior negativity on the post-critical word as a secondary repair process that followed the repair process on the critical word indicated by the P600.

Only a few studies have investigated the morpho-semantic violations which arise due to mismatch between grammatical aspect and some other element in the sentence, such as the adverbial phrase. In an eye-tracking study, Bott and Gattnar (2015) show that the mismatch between the durative meaning of

the adverbial phrase and the perfective interpretation of the verb in Russian was processed directly at the violation, as Russian grammaticalizes aspect. In German, however, violations were detected only after the verb had acquired all its arguments. Bott and Gattnar (2015) argue that in German the detection of violations depends on the whole verb-argument structure, since German does not morphologically express aspect.

Zeller and Clasmeier (2020) investigated aspectual violations in Russian, another Slavic language that has the same perfective/imperfective opposition as BCS. They created violations by establishing habitual temporal context via topicalized temporal lexical adverbs or adverbial phrases and using the infelicitous perfective verb forms. The results show a robust P600 for aspectual violations in the late P600 window (800–1000 ms). The authors argue that the P600 should be interpreted as an index of the processing difficulty that arose in sentences with aspectual violations when the parser attempted to integrate the aspectual information on the verb in the sentence context.

Flecken, Wallbert and Dijkstra (2015) used an ERP experiment to study English aspect violations that arose due to a mismatch of aspectual information on the verb phrase with the previous temporal context (*Every day, Sophie is swimming in the pool*; *Right now, Sophie swims in the pool*). In their experiment the participants read questions that set up the progressive (*What is Sophie doing now in the pool?*) or habitual context (*What does Sophie do in the pool every Monday?*). After an introduction such as *Right now Sophie*, Flecken, Wallbert and Dijkstra measured ERPs time-locked to the verb phrase in the following four conditions: 1) *is swimming* (control, aspect match); 2) *swims* (violation, aspect mismatch); 3) *are swimming* (morphosyntactic violation); and 4) *is cooking in a pool* (semantically inappropriate verb form).

Semantic violations elicited a clear N400 effect, while violations of morphosyntax triggered a P600 modulation, as expected. Aspectual violations, however, showed a short early negativity (250-350 ms) which was not followed by either an N400 or P600. Flecken, Wallbert and Dijkstra (2015) explain that the early negativity they found did not resemble the LAN due to its more central distribution on the scalp, and argue that the absence of the P600 for aspectual violations suggests that aspectually incongruous sentences in English do not trigger reintegration and reanalysis, or additional processing costs. A follow-up offline grammaticality judgment task also showed the relative acceptance of aspectually incongruous forms in English. More precisely,

sentences with aspect mismatch were judged as more ungrammatical compared control sentences that were aspectually congruous. However, they were judged as more grammatical than sentences with morphosyntactic violations. Flecken, Wallbert and Dijkstra (2015) thus concluded that aspect mismatch sentences were not judged as highly ungrammatical in the grammaticality judgment task.

Čordalija (2021) performed a cross-modal lexical priming study that did not involve a violation paradigm but that tracked (re-)activation patterns of the subject in sentences with imperfective and perfective unergative and unaccusative verbs in BCS to investigate the interplay between unaccusativity and verbal aspect. The findings show that the subject of perfective unaccusative verbs was (re-)activated post-verbally, at the gap position, while this was not the case for unergative verbs and imperfective unaccusative verbs. This suggests an inextricable link between the perfective aspect and unaccusativity in BCS. The following sections describe how aspect was investigated in the present study.

1.5   Present study

We performed an ERP experiment to investigate the electrophysiological responses to aspectual violations in BCS. The following research question guided this research: Is the violation of grammatical aspect processed in the same way in BCS and English? And if not, what is the difference in processing as shown by ERPs?

In the experiment, aspectual violations were created by introducing the perfective verb form in a real present temporal frame. The critical word was the perfective verb that occurred in a context that requires an imperfective form. The semantics of temporal lexical adverbs sets the time frame of the sentence as the real present unfolding at the moment of speaking. This time frame is violated by the semantics of the perfective verb form indicating completion, which is a semantic paradox given the time frame of the sentence. Therefore, the semantics of the perfective verb form is incongruous with the time frame of the overall sentence and hence the possibility of the N400. Nonetheless, the semantics of the perfective verb form is encoded grammatically in BCS. Despite its semantic basis, since BCS aspect is coded grammatically, following Popov et al. (2020) we expect the P600 that will reflect structural repair processes at the feature level.

2   Method

2.1   Participants

We tested 17 participants (mean age 26.8; 9 females). All participants were L1 speakers of the BCS language, with representatives of all three variants: Bosnian, Croatian, and Serbian. One participant was excluded from the analysis due to strong artefacts in the EEG signal. Participants were right-handed, had normal or corrected-to-normal vision and hearing with no history of previous language or reading disorders or neurological injury. In the consent form the participants were informed of the duration of the experiment and procedure. They were told that they could stop and withdraw from the experiment at any time. Participants received 15 euros for participation in the experiment. The study was approved by the Research Ethics Committee (CETO) at the University of Groningen.

2.2   Materials and design

The ERP experiment comprised 40 grammatical and 40 ungrammatical sentences in the violation paradigm. We used 20 BCS verbs: 15 transitive and five intransitive verbs. Out of those 20 verbs, 13 verbs derived the perfective form by prefixation, two verbs required suffixation to derive the perfective aspectual partner and five verbs were unprefixed perfectives.[1]

Each verb was used to create two different sentences. All the sentences occurred in the grammatical condition (40 sentences) and the ungrammatical condition (40 sentences) in the violation paradigm, and thus served as their own control in case of variations caused by different perfectivization means and transitive/intransitive differences.

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1   In our ERP study, we investigated whether native speakers process aspectual violations as semantic or morpho-syntactic violations. Aspectual affixes were not investigated *per se*. Hence, the different means of perfectivization in the stimuli and a few unprefixed (inherently) perfective verbs. Following Mezhevich (2008), we assume that aspectual morphology conveys aspectual meanings. In the case of unprefixed perfective verbs, we assume that just as with any prefixed perfective, they also enter the derivation of the sentence with a [+perfective] feature. Whether that feature is conveyed by a null morpheme or unprefixed perfectives are stored in the lexicon as inherently perfective is beyond the scope of this paper. This study focused only on those verbs where the perfective and the imperfective variants differ in the aspectual value and where the perfectivizing prefix does not introduce additional semantics. Perfective verbs with lexical affixes are outside the scope of this study and a topic for future research.

(17)

Asistenti	*trenutno/često	pročitaju	članak o	umjetnoj inteligenciji.
Assistants	currently/often	read$_{PRS.PFV}$	article about	artificial intelligence

'Assistants *now/often read an article about artificial intelligence.'

As (17) shows, the experimental sentences had the following structure: occupation nouns in plural in the subject position + the temporal lexical adverb/adverbial phrase (*now* and *at the moment* in the ungrammatical condition and *often* and *always* in the grammatical condition) + the perfective verb form + the direct object + either a postmodifier of the direct object or an adverbial phrase both consisting of three to five words. Since the regions of interest comprised the verb position and the immediately adjacent position, the subsequent positions in the sentence were not totally identical and contained the above-mentioned variations in structure. We used *now* and *at the moment* in the ungrammatical condition and *often* and *always* in the grammatical condition to prevent participants from developing expectations with regard to temporal expressions and verbs form following them.

Sentences with intransitive verbs had the same structure as transitive sentences except for the object. For these items, we added sentence-final adverbial phrases, hence all sentences had approximately the same length. Sentences were distributed across two presentation lists using a Latin square design so that each list comprised 20 grammatical and 20 ungrammatical sentences.

The ERP experiment had two types of control sentences. The first type were sentences with and without time reference violations (60 sentences) from Tokmačić and Popov (2019). In the grammatical control sentences, the past time reference of the perfect periphrastic verb form was congruent with the temporal lexical adverb. In the ungrammatical control sentences, the perfect periphrastic form expressing past time reference violated the future time frame of the sentence that was set by a topicalized temporal lexical adverb. All verbs occurred in the imperfective aspect, as the imperfective is considered to be the unmarked form and can occur in all three time frames.

(18)

*Sutra/Jučer	je	pedagog	pozivao	roditelje na razgovor.
Tomorrow/Yesterday	AUX$_{PRS}$	counsellor	invite$_{PTCP.IPFV}$	parents on talk

'*Tomorrow/Yesterday the counsellor was inviting parents to a meeting.'

Control sentences had a structure as illustrated in (18): the topicalized temporal lexical adverb (*yesterday* and *the day before yesterday* in the grammatical condition; *tomorrow* and *the day after tomorrow* in the ungrammatical condition) + the present tense auxiliary that is part of the perfect periphrastic verb form + the subject realized as a singular occupation noun + the non-finite verb (the second element of the perfect periphrastic verb form) + the object + adverbial phrase. *Yesterday* and *the day before yesterday* were used in the grammatical condition, *tomorrow* and *the day after tomorrow* in the ungrammatical condition to prevent participants from developing expectations with regards to temporal expressions and verbs forms following them.

We also added the second type of control sentences (20 items) that contained only grammatical sentences with the temporal lexical adverb *currently* or the adverbial phrase *at the moment* and the imperfective verb form. We included control sentences with imperfective verb forms after temporal expressions *currently* and *at the moment* to prevent participants from developing expectations that such temporal expressions are always followed by infelicitous perfective verb forms as is the case in experimental sentences. The 12 imperfective verbs that occurred in the control sentences in our study were not imperfective counterparts of the verbs used in the experimental sentences, but were different lexical items. However, the sentence structure was similar, as (19) shows.

(19)

Cvjećari	trenutno	sade	novo cvijeće u kraljevskoj	bašti.
Florists	currently	plant$_{PRS.IPFV}$	new flowers in royal	garden

'The florists are currently planting new flowers in the royal garden.'

After the experimental and control sentences were created, they were distributed to 39 native speakers of BCS (mean age 19.8 years, with five males and 34 females) in a verification task. The participants were students at the English and psychology departments at the University of Sarajevo. They were instructed to judge the sentences as acceptable or unacceptable. All the sentences in the experiment were correctly deemed as grammatical or ungrammatical by 80%–100% of native speakers. Eighty filler sentences were added to each presentation list, yielding 120 sentences per list. The experiment started with six practice sentences.

The ERP experiment was performed at the University of Groningen, and due to the different language backgrounds of BCS speakers the stimuli were

adapted to different variants of BCS, although these adaptations never re-lated to the verb (form). All the variants are mutually intelligible, but to avoid any potential confounds, and in addition to a few minor lexical differences between the Bosnian, Croatian and Serbian varieties, the sentences that included the modern replacement of the old Slavonic vowel *jat* were accordingly adapted for the three variants.

2.3   *Procedure*

The sentences were presented via the software E-prime 2.0. Participants were seated in front of a computer screen and instructed to read the sentences that were shown in a word-by-word presentation in the centre of the screen. The words were presented in white letters against a black background. Each stimulus was preceded by a 500 ms fixation cross and followed by a 300 ms blank screen. Words were presented for 300 ms. Each sentence was followed by a grammaticality question and the participants were instructed to attend to the sentences carefully and answer the question by pressing a button. The experiment consisted of four blocks and each block lasted between five to seven minutes. The total time for the experiment was approximately one hour and 30 minutes.

2.4   *EEG recordings and data processing*

The continuous electroencephalogram was recorded from 32 scalp electrodes (mounted on an elastic cap, WaveGuard original) using the eego software (ANT-neuro B.V., Enschede, Netherlands). An additional EOG electrode was placed above the left eyebrow to record eye movements. Electrode impedances were always kept below 10 kΩ. Data were acquired at a 500 Hz sampling rate with the common average reference. The offline processing was done in Brain Vision Analyzer 2.1 (Brain Products, GmbH, Munich, Germany). Offline filtering was performed using a band-pass filter (0.1–30 Hz), followed by automatic eye blink correction. The data were segmented into epochs starting 200 ms before the onset of the critical word (the target verb) and lasting until 1000 ms post-word onset. The artefact rejection (+/–100 μV threshold) was performed only on a section of each epoch (-200–1000 ms) that was included in the statistical analysis. The data were corrected relative to the 200 ms pre-stimulus baseline and were averaged per subject and per condition. All participants, except the one who was excluded, were above the threshold of 60% of averaged trials in all conditions.

2.5   Data analysis

For EEG analysis, averaged values (in μV) were extracted per participant, per condition, and per region of interest. The scalp electrodes were divided into nine regions of interest: left anterior (LA; F7, F3, FC5), midline anterior (MA; Fz, FC1, FC2), right anterior (RA; F4, F8, FC6), left central (LC; C3, CP5), midline central (MC; Cz, CP1, CPz, CP2), right central (RC; C4, CP6), left posterior (LP; P7, P3, O1), midline posterior (MP; Pz, POz), and right posterior (RP; P4, P8, O2). Mean amplitudes were analysed in three time windows (400–600 ms, 600–800 ms and 800–1000 ms).

For the statistical analysis, repeated measures ANOVAs were used with the following within subject factors: grammaticality (two levels: grammatical and ungrammatical), hemisphere (two levels: left and right hemisphere), and anteriority (three levels: anterior, central, and posterior). The significance level was set to $p < .05$. For each time window, two global repeated measures ANOVAs were performed, first for the lateral regions (all factors included), and then for the midline regions (factor hemisphere excluded). Follow-up tests were applied to those interactions that turned out at least marginally significant ($p<.1$) and that contained the factor *grammaticality*. The Geisser and Greenhouse (1959) correction was applied in cases when the assumption of sphericity was violated.

3   Results

3.1   Behavioural data

The accuracy analysis of grammaticality judgments for the experimental sentences in the ERP experiment showed that grammatical sentences were judged correctly in 88% of trials (range: 50–100%; SD: 14.9), while ungrammatical sentences were judged correctly in 93% of trials (range: 65–100%; SD: 9.1).

3.2   ERP data

In the first time window **(400–600 ms)**, the lateral analysis showed a significant interaction between grammaticality and anteriority ($F(1, 15) = 8.51$, $p = .011$, $\eta^2 = .362$), which did not yield any significance in the follow-up analysis (all ps > .1). Similarly, a significant interaction between grammaticality and anteriority in the midline also failed to provide any significant results in the follow-up tests (all ps > .1).

The factor *grammaticality* was marginally significant in the following time window (**600–800 ms**) in the lateral analysis ($F(1, 15)$ = 3.57, p = .078, η^2 = .19), while it reached significance in the midline ($F(1, 15)$ = 8.52, p = .011, η^2 = .36). In both instances, ungrammatical sentences elicited a more positive response than grammatical sentences.

In the last time window **(800-1000 ms)**, the factor *grammaticality* was marginally significant on its own ($F(15)$ = 4.33, p = .055, η^2 =22), as well as in an interaction with the factor *anteriority* ($F(2, 30)$ = 3.67, p = .061, η^2 = .2). Post-hoc analysis showed that ungrammatical sentences were more positive than grammatical sentences in the central ($t(15)$ = -2.79, p = .014) and posterior regions ($t(15)$ = -2.75, p = .015), while the effect was absent in the anterior regions (p > .1). Finally, there was a main effect of grammaticality in the midline ($F(1, 15)$ = 7.36, p = .016, η^2 = 0.33), with ungrammatical sentences eliciting a more positive waveform than grammatical sentences. The scalp topography for the relevant time windows is shown in Figure 1. ERP waveforms time-locked to the onset of the critical word across nine regions of interest are shown in Figure 2.
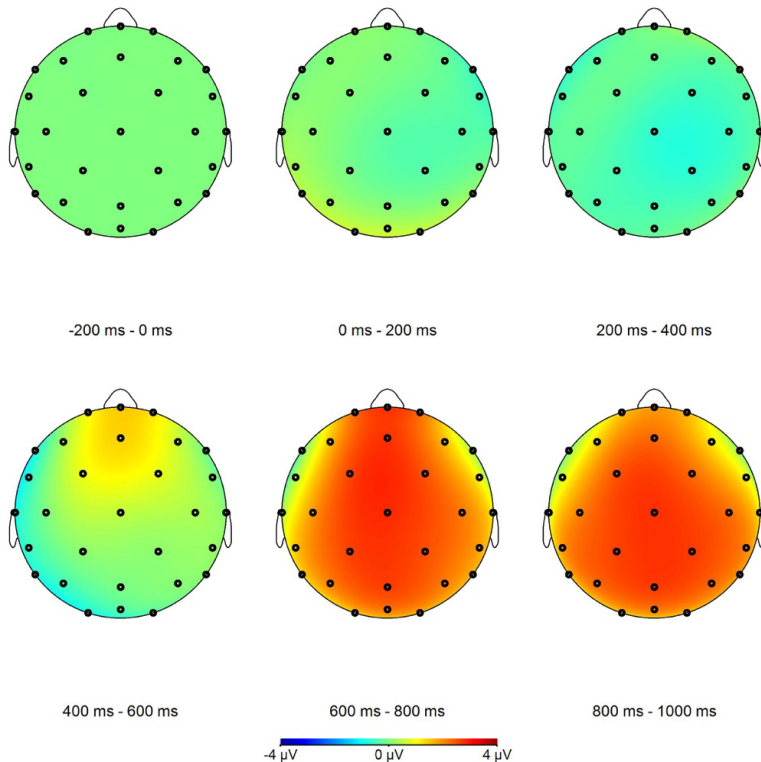

FIGURE 1. Topographic maps show a difference between grammatical and ungrammatical sentence processing with the effects observed in the 600-800 and 800-1000 ms time windows.
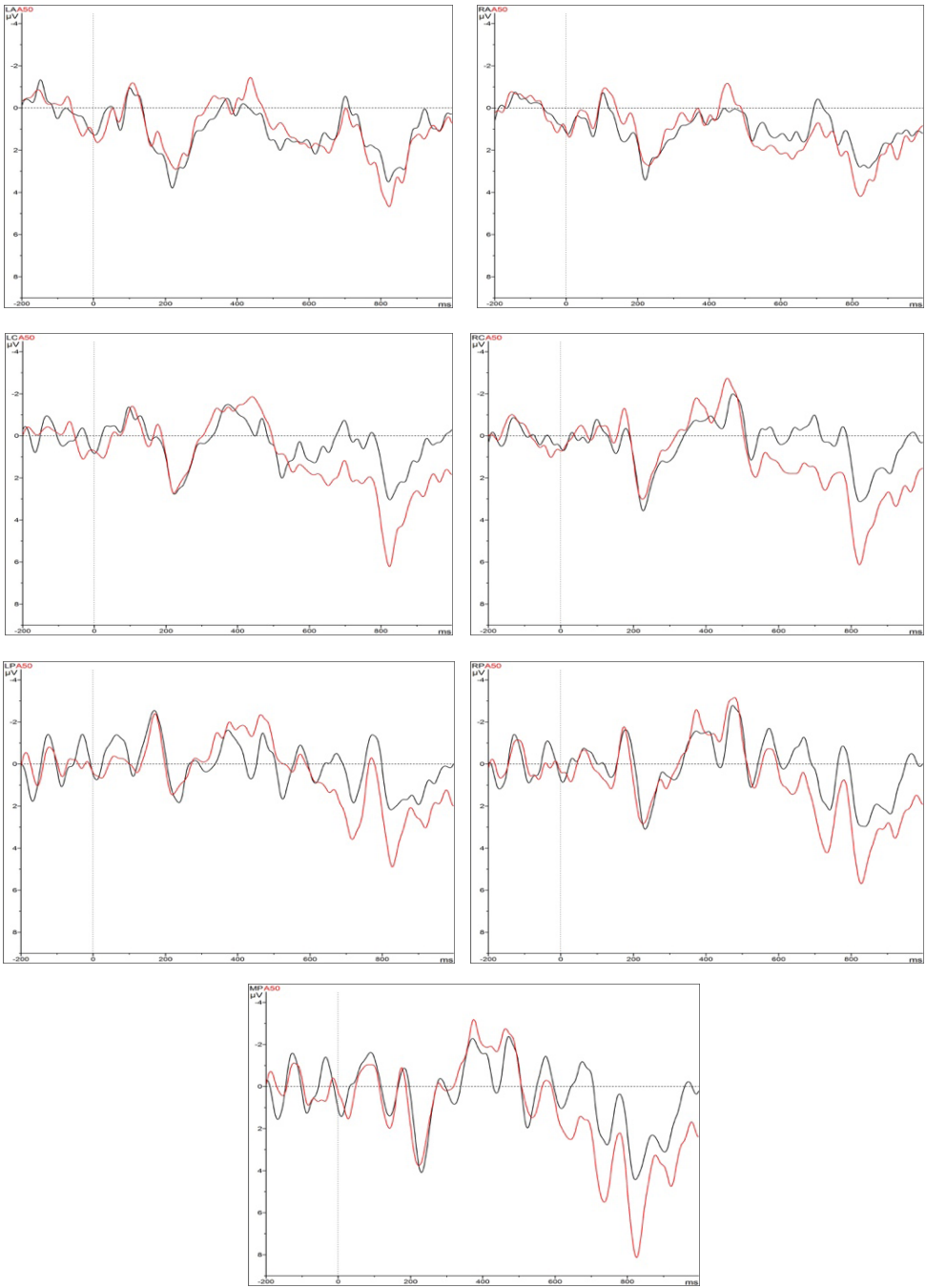
Figure 2. Grand average ERPs from the onset of the verb across nine ROIs: black lines represent grammatical sentences and red lines represent ungrammatical sentences.

4   Discussion

4.1   *Processing grammatical aspect in BCS*

The ERP experiment investigated violations of the present time frame of the sentence by a perfective verb form in BCS. The research question addressed the processing of aspectual violations in BCS and how it compares to English. We first discuss the results obtained for the BCS aspectual violations, and then compare aspect processing in BCS and English to answer our research question.

In the ERP experiment, aspectual violations in BCS resulted in a positivity in central and posterior regions that was absent in anterior regions. The posterior P600 is typically seen as reflecting structural and syntactic repair (Friederici 2002). Therefore, this P600 may reflect the reanalysis and repair processes that are triggered by the inability of the parser to integrate the incongruous aspectual form into the temporal frame of the sentence. Hagoort and Brown (2000) argue for two subcomponents of the P600: an early subcomponent with anterior and posterior distributions and a late one with only a posterior distribution. The early subcomponent is evoked by the inability to integrate the information in the preceding context and the late one is attributed to reanalysis and repair processes. To a certain degree, the effect of aspectual violations in our study supports this classification, as the P600 effect in the 800–1000 ms time window had central and posterior distributions but not anterior. Hence, the P600 effect in the 600–800 ms is understood as reflecting the difficulty in integrating the incongruous aspectual form in the context, while the late P600 might reflect a reanalysis and repair process.

To be more precise, we assume that in the sentences used in our study the temporal lexical adverb sets the time frame. When the parser encounters the verb form with a [+perfective] feature that is not congruous with such temporal frame, this triggers the structural repair at the level of the aspect feature and reanalysis processes. Consequently, a P600 and not an N400 is evoked by aspectual violations despite the fact that sentences with aspectual violations are essentially semantic violations: the perfective meaning of completion violates the wider sentence context which expresses the real present unfolding at the moment of speech. However, aspectual meanings are conveyed by grammaticalized aspectual affixes in BCS. As such, aspectual violations set in motion structural repair and reanalysis processes.

Even though there is an important methodological difference between our study and two studies that focused on Mandarin Chinese, our results are in line with the findings of Zhang and Zhang (2008) and Hao, Xun and Lu (2021), which found the P600 for aspectual violations. BCS aspect violations, however, did not result in the N400-like component as in Hao, Xun and Lu (2021). Hao, Xun and Lu suggest that in sentences with aspectual violations the punctual lexical aspect of the verb creates expectations for non-progressive morphology. When the progressive marker occurs, this causes a semantic mismatch that is reflected in the N400-like component. However, Hao, Xun and Lu (2021) claim that the mismatch between the lexical aspect of the verb and aspectual morphology eventually leads to a syntactic repair (the P600), as aspect markers are involved in syntax. In our study, however, despite their semantic basis and the expectation of the non-perfective morphology due to the semantics of the topicalized temporal expression, aspectual violations did not lead to the N400 (like) component, but to the immediate repair and reanalysis at the aspect feature as reflected in the P600. However, our study did not involve a local mismatch of aspects on the verb, as the lexical and grammatical aspects expressed by the verb were congruous in this work. The ERP effects that we found for the disagreement between aspectual features of the verb phrase and the wider sentence context are in line with another study that investigated the same type of non-local violations involving the category of aspect.

More precisely, our results and the findings of Zeller and Clasmeier (2020) are complementary, as both studies had a similar methodological design and Russian is another Slavic language with the same aspectual oppositions and a very similar aspectual system to BCS. Zeller and Clasmeier (2020) investigated violations of habitual temporal context by a perfective verb form in Russian and reported a P600 in the 800–1000 ms time window for aspectual violations. Our ERP results, however, differ significantly from those presented by Flecken, Wallbert and Dijkstra (2015) – the first ERP study that investigated the incongruity between aspectual feature on the verb and time frame of the sentence in English.

4.2   A comparison with English

In Flecken, Wallbert and Dijkstra (2015), aspectual violations (*Every day, Sophie is swimming in the pool*; *Right now, Sophie swims in the pool*) elicited a short early negativity (250–350 ms) which was not followed by either an

N400 or a P600. The authors argue that the negativity modulation that they observed arose because the progressive (*is swimming*) and the aspectually un-marked simple form (s*wims*) differ lexically, the former involving a periphras-tic construction starting with the auxiliary 'be'. Hence the early negativity may reflect the violation of the expectation of the auxiliary 'be' in the verb phrase. We did not expect or find the early negativity that Flecken, Wallbert and Dijkstra (2015) reported because aspect in English and BCS have differ-ent aspectual systems. BCS imperfective and perfective aspect is conveyed by aspectual morphology and not periphrastically. Moreover, in our study, unlike in Flecken, Wallbert and Dijkstra (2015), the verb form was kept constant in grammatical and ungrammatical sentences.

We found a P600 for aspectual violations in BCS, while Flecken, Wallbert and Dijkstra (2015) did not for those in English. The answer to our research question is thus that grammatical aspect is not processed in the same way in BCS and English, as reflected in the different ERP components that aspect mismatch elicited: P600 in BCS and a short early negativity (250–350 ms) in English.

We argue that the reason for this difference in processing of aspect is a strik-ing difference between the English and BCS aspectual systems. In BCS, aspectual meanings are straightforwardly encoded by either the imperfec-tive or perfective verb form, and there is no overlap in aspect distribution and certainly not in the real present time frame. Consequently, in our ERP experiment the perfective meaning of BCS verbs could not be forced into an interpretation that would be compatible with the time frame of the sen-tence which yielded an immediate effect – a P600. In English, however, one aspectual meaning can be conveyed by different forms (perfective meaning can be conveyed by present perfect and simple past), and one form can con-vey different aspectual meanings (present perfect can express imperfective and perfective meanings), which means that there is much more room for an overlap between the forms and the aspectual meanings they convey. The parser might not have detected aspectual violations in Flecken, Wallbert and Dijkstra' sentences because the forms that were used to create violations can have secondary aspectual meanings that are compatible with the time frame of the sentence. More precisely, even though this use is restricted, the progressive aspect can be used in habitual contexts in English (e.g., *She is al-ways losing her keys*) and conversely, simple forms can be used in progressive contexts (e.g., *And now we whisk the egg whites with a fork*).

5   Conclusion

This study provided a linguistic description of grammatical aspect and an empirical insight into its processing. More precisely, we studied the aspectual system of BCS in an ERP experiment and compared the processing of BCS and English aspectual systems. We noted that in BCS grammatical aspect is intrinsic to time reference, while English grammaticalizes aspect only partly and simple forms are not marked for this. BCS aspect is encoded synthetically via affixes, while English grammaticalizes aspect periphrastically. Most importantly, we elaborated the claim that the distribution of aspectual oppositions in BCS is straightforward – perfective and imperfective verb forms cannot be used in the same context with the same or similar meaning. Moreover, imperfective verb forms cannot be used in the real present time frame at all. English, on the other hand, shows a flexible system where different verb forms may express the same or similar aspectual semantics. For example, while the progressive form primarily expresses a durative meaning, it can also express habitual semantics that are normally expressed by aspectually unmarked forms.

To address the question of how such morphosyntactic and semantic differences between these two aspectual systems are reflected in processing, we conducted an ERP study on BCS aspect and compared our findings to those of Flecken, Wallbert and Dijkstra (2015), who explored electrophysiological responses to violations of English aspect. Our results are in line with most previous ERP studies on grammatical aspect – aspectual violations trigger immediate reanalysis and repair processes reflected in the P600 component. Interestingly, violations of aspect in English did not yield a clear electrophysiological response in Flecken, Wallbert and Dijkstra (2015).

We speculated that such strikingly different electrophysiological responses to aspectual violations in BCS and English might be indicative of two profoundly different aspectual systems. In BCS, the parser instantly detected violations of grammatical aspect because the distribution of aspectual oppositions is clear – perfective verbs cannot be used in imperfective contexts such as the real present time frame. In the English aspectual system, where the progressive aspectual opposition and non-aspectually marked forms may be used in the same or similar contexts, violations did not yield a clear ERP effect. We suggested that, rather than processing violations of English aspect instantly upon encountering them, the parser may have forced the interpretation of the contextually incongruous verb form into a less frequent but plausible secondary interpretation that is compatible with the time frame of the sentence.

References

Aarts, Bas. 2001. *English Syntax and Argumentation*. Hampshire: Palgrave Macmillan.

Alexander, Louis G. 1988. *Longman English Grammar*. Harlow: Pearson Education Limited.

Allen, Mark, William Badecker, and Lee Osterhout. 2003. "Morphological analysis in sentence processing: An ERP study." *Language and Cognitive Processes* 18 (4): 405–30. https://doi.org/10.1080/01690960244000054.

Altshuler, Daniel. 2014. "A typology of partitive aspectual operators." *Natural Language and Linguistic Theory* 32 (3): 735–75.

Anstatt, Tanja, and Christina Clasmeier. 2012. "Wie häufig ist poplakat'? Subjektive Frequenz und russischer Verbal- aspect." *Wiener Slawistischer Almanach* 70: 129–63.

Bastiaanse, Roelien. 2013. "Why reference to the past is difficult for agrammatic speakers." *Clinical Linguistics and Phonetics* 27 (4): 244–63. https://doi.org/10.3109/02699206.2012.751626.

Bates, Douglas, Martin Maechler, Ben Bolker, and Steve Walker. 2015. "Fitting linear mixed-effects models using lme4." *Journal of Statistical Software* 67 (1): 1–48. https://www.jstatsoft.org/article/view/v067i01.

Bhatt, Rajesh, and Roumyana Pancheva. 2005. "Aspect: An overview." Handout for *LSA 130: The Syntax and Semantics of Aspect.* http://web.mit.edu/rbhatt/www/lsa130/l1.pdf.

Biber, Douglas, Stig Johansson, Geoffrey Leech, Susan Conrad, and Edward Finegan. 1999. *Longman Grammar of Spoken and Written English*. Harlow: Pearson Education Limited.

Binnick, Robert I. 1991. *Time and the Verb: A Guide to Tense & Aspect*. New York and Oxford: Oxford University Press.

Bornkessel-Schlesewsky, Ina, and Matthias Schlesewsky. 2008. "An alternative perspective on "semantic P600" effects in language comprehension." *Brain Research Reviews* 59: 55–73.

Bott, Oliver, and Anja Gattnar. 2015. "The cross-linguistic processing of aspect – An eyetracking study on the time course of aspectual interpretation in Russian and German." *Language, Cognition and Neuroscience* 30 (7): 877–98. https://doi.org/10.1080/23273798.2015.1029499.

Brouwer, Harm, Hartmut Fitz, and John Hoeks. 2012. "Getting real about semantic illusions: Rethinking the functional role of the P600 in language comprehension." *Brain Research* 1446: 127–43. https://doi.org/10.1016/j.brainres.2012.01.055.

Bybee, Joan L. 1985. *Morphology: A Study of the Relation between Meaning and Form*. Amsterdam: John Benjamins.

Bybee, Joan L., and Östen Dahl. 1989. "The creation of tense and aspect systems in the languages of the world." *Studies in Language* 13 (1): 51–103.

Chow, Wing-Yee, and Colin Phillips. 2013. "No semantic illusions in the semantic P600 phenomenon: ERP evidence from Mandarin Chinese." *Brain Research* 1506: 76–93. https://doi.org/10.1016/j.brainres.2013.02.016.

Comrie, Bernard. 1976. *Aspect*. Cambridge: Cambridge University Press.

—. 1985. *Tense*. Cambridge: Cambridge University Press.

Čirgić Adnan, Ivo Pranjković, and Josip Silić. 2010. *Gramatika crnogorskog jezika*. Podgorica: Pobjeda AD Podgorica.

Čordalija, Nermina. 2021. "Neurolinguistic and psycholinguistic approaches to studying tense, aspect, and unaccusativity." PhD diss., University of Groningen.

Dahl, Östen. 1985. *Tense and Aspect Systems*. Oxford: Basil Blackwell.

De Swart, Henriette. 2012. "Verbal Aspect." In *The Oxford Handbook of Tense and Aspect*, edited by Robert Binnick, 752–81. New York: Oxford University Press.

Drummond, Alex. 2020. "Ibex farm". http://spellout.net/ibexfarm/.

Gasparov, Boris. 1990. "Notes on the 'Metaphysics' of Russian aspect." In *Verbal Aspect in Discourse: Contributions to the Semantics of Time and Temporal Perspective in Slavic and Non-Slavic Languages*, edited by Nils B. Thelin, 191–212. Amsterdam: John Benjamins.

Gehrke, Berit. 2007. "Goals and Sources are aspectually equal: Evidence from Czech and Russian prefixes." *Lingua* 118: 1664–89. https://doi.org/10.1016/j.lingua.2007.05.011.

Greenbaum, Sidney, and Gerald Nelson. 2009. *An Introduction to English Grammar*. London and New York: Routledge.

Greenbaum, Sidney, and Randolph Quirk. 1990. *A Student's Grammar of the English Language*. Harlow: Longman.

Greenhouse, Samuel W., and Seymour Geisser. 1959. "On methods in the analysis of profile data." *Psychometrika* 24: 95–112. https://doi.org/10.1007/BF02289823.

Filip, Hana. 1999. *Aspect, Eventuality Types and Noun Phrase Semantics*. New York and London: Garland Publishing.

Flecken, Monique, Kelly Wallbert, and Ton Dijkstra. 2015. "'Right now, Sophie *swims in the pool?!': Brain potentials of grammatical aspect processing." *Frontiers in Psychology* 6: 1764. https://doi.org/10.3389/fpsyg.2015.01764.

Friederici, Angela D. 2002. "Towards a neural basis of auditory sentence processing." *Trends in Cognitive Sciences* 6 (2): 78–84. https://doi.org/10.1016/s1364-6613(00)01839-8.

Friederici, Angela D., Anja Hahne, and Axel Mecklinger. 1996. "Temporal structure of syntactic processing: Early and late event-related potential effects." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 22 (5): 1219–48. https://doi.org/10.1037//0278-7393.22.5.1219.

Hao, Yuxin, Xun Duan, and Lu Zhang. 2021. "Processing aspectual agreement in inflexionless language: An ERP study of Mandarin Chinese." *Brain Sciences* 11 (9): 1236. https://doi.org/10.3390/brainsci11091236.

Hagoort, Peter, and Colin M. Brown. 2000. "ERP effects of listening to speech compared to reading: the P600/SPS to syntactic violations in spoken sentences and rapid serial visual presentation." *Neuropsychologia* 38 (11): 1531–49. https://doi.org/10.1016/S0028-3932(00)00053-1.

Hagoort, Peter. 2003. "How the brain solved the binding problem for language: A neurocomputational model of syntactic processing." *Neuroimage* 20 (Supplement 1): S18–S29. https://doi.org/10.1016/j.neuroimage.2003.09.013.

Hasselgård, Hilde, Per Lysvåg, and Stig Johansson. 2011. *English Grammar: Theory and Use*. Oslo: Universitetsforlaget.

Jacobs, Roderick A. 1995. *English Syntax: A Grammar for English Language Professionals*. New York: Oxford University Press.

Jahić, Dževad, Senahid Halilović, and Ismail Palić. 2000. *Gramatika bosanskoga jezika*. Zenica: Dom štampe Zenica.

Kaan, Edith. 2007. "Event-related potentials and language processing: A brief overview." *Language and Linguistics Compass* 1 (6): 571–91. https://doi.org/10.1111/j.1749-818X.2007.00037.x.

Kaan, Edith, Anthony Harris, Edward Gibson, and Phillip Holcomb. 2000. "The P600 as an index of syntactic integration difficulty." *Language & Cognitive Processes* 15 (2): 159–201. https://doi.org/10.1080/016909600386084.

Klajn, Ivan. 2001. *Gramatika srpskog jezika*. Beograd: Zavod za užbenike i nastavna sredstva Beograd.

Klimek-Jankowska, Dorota, Anna Czypionka, Wojciech Witkowski, and Joanna Błaszczak. 2018. "The time course of processing perfective and imperfective aspect in Polish – Evidence from self-paced reading and eye-tracking experiments." *Acta Linguistica Academica: An International Journal of Linguistics* 65 (2–3): 293–351. http://doi.org/10.1556/2062.2018.65.2–3.4.

Kolk, Herman, and Dorothee Chwilla. 2007. "Late positivities in unusual situations." *Brain and Language* 100 (3): 257–61. https://doi.org/10.1016/j.bandl.2006.07.006.

Krifka, Manfred. 1992. "Thematic relations as links between nominal reference and temporal constitution." In *Lexical Matters*, edited by Ivan Sag and Ana Szabolcsi, 29–53. Stanford: CSLI Publications.

Kutas, Marta, and Kara D. Federmeier. 2011. "Thirty years and counting: finding meaning in the N400 component of the event-related brain potential (ERP)." *Annual Review of Psychology* 62: 621–47. https://doi.org/10.1146%2Fannurev.psych.093008.131123.

Kutas, Marta, and Steven A. Hillyard. 1980. "Reading senseless sentences: Brain potentials reflect semantic incongruity." *Science* 207 (4427): 203–5. https://doi.org/10.1126/science.7350657.

Kutas, Marta, Cyma K. Van Petten, and Robert Kluender. 2005. "Psycholinguistics electrified II (1994-2005)." In *Handbook of Psycholinguistics,* edited by Matthew J. Traxler and Morton A. Gernsbacher, 659–724. New York: Elsevier Press.

Lascarides, Alex. 1991. "The progressive and the imperfective paradox." *Synthese* 87: 401–47.

Link, Godehard. 1987. "Algebraic semantics of event structures." In *Proceedings of the Sixth Amsterdam Colloquium*, edited by Jappe Groenendijk, Martin Stokhof and Frank Veltman, 243–62. Amsterdam: Institute for Logic, Language and Computation.

Madden, Carol J., and Rolph A. Zwaan. 2003. "How does verb aspect constrain event representations." *Memory & Cognition* 31 (5): 663–72.

Mezhevich, Irina. 2008. "A feature-theoretic account of tense and aspect in Russian." *Nat Lang Linguist Theory* 26: 359–401. https://doi.org/10.1007/s11049-008-9038-0.

Neville, Helen J., Janet L. Nicol, Andrew Barss, Kenneth I. Forster, and Merrill F. Garrett. 1991. "Syntactically based processing classes: evidence from event-related potentials." *Journal of Cognitive Neuroscience* 3 (2): 151–65. https://doi.org/10.1162/jocn.1991.3.2.151.

Novak-Milić, Jasna, and Marica Čilaš-Mikulić. 2013. "Glagolski vid u inojezičnome hrvatskome – izazov na mnogim razinama." In *Jezik kao informacija,* edited by Anita Peti Stantić and Mateusz-Milan Stanojević, 47–60. Zagreb: Hrvatsko društvo za primijenjenu lingvistiku.

Osterhout, Lee, and Janet Nicol. 1999. "On the distinctiveness, independence, and time course of the brain responses to syntactic and semantic anomalies." *Language and Cognitive Processes* 14 (3): 283–317. https://psycnet.apa.org/doi/10.1080/0169096 99386310.

Pesetsky, David, and Esther Torrego. 2004. "The syntax of valuation and the interpretability of features." In *Phrasal and Clausal Architecture: Syntactic Derivation and Interpretation,* edited by Simin Karimi, Vida Samiian and Wendy K. Wilkins, 262–94. Boston: University of Massachusetts. https://doi.org/10.1075/la.101.14pes.

Popov, Srđan, Gabriele Miceli, Brana Ćurčić-Blake, and Roelien Bastiaanse. 2020. "The role of semantics and repair processes in article-noun gender disagreement in Italian: An ERP study." *Brain and Language* 206: 104787. https://doi.org/10.1016/j.bandl.2020.104787.

Portner, Paul. 1998. "The progressive in modal semantics." *Language* 74 (4): 760–87. https://doi.org/10.2307/417002.

Ramchand, Gilian. 2004. "Time and the event: The semantics of Russian prefixes." *Nordlyd* 32 (2): 323–66. https://doi.org/10.7557/12.72.

Reichenbach, Hans. 1947. *Elements of Symbolic Logic*. New York: The Macmillan Company.

Riđanović, Midhat. 1976. *A Synchronic Study of Verbal Aspect in English and Serbo-Croatian.* University of Michigan: Slavica Publishers.

—. 2012. *Bosnian for Foreigners*. Sarajevo: Rabic Publishing Company.

Silić, Josip, and Ivo Pranjković. 2007. *Gramatika hrvatskoga jezika*. Zagreb: Školska knjiga.

Slabakova, Roumyana. 2005. "Perfective prefixes: What they are, what flavors they come in, and how they are acquired." In *Formal Approaches to Slavic linguistics*, edited by Steven Franks, Frank Y. Gladney and Mila Tasseva-Kurktchieva, 324–41. Ann Arbor, Michigan: Michigan Slavic Publications.

Smith, Carlota S. 1991. *The Parameter of Aspect.* Dordrecht: Kluwer Academic Publishers.

—. 1997. *The Parameter of Aspect.* Dordrecht: Kluwer Academic Publishers.

—. 2013. "Tense and aspect: Time across languages." In *Semantics: An International Handbook of Natural Language Meaning*, edited by Caudia Maienborn, Kaus von Heusinger and Paul Portner, 2581–608. Berlin: De Gruyter Mouton.

Stevanović, Mihailo. 1989. *Savremeni srpskohrvatski jezik: Gramatički sistemi i književno-jezička norma*. Beograd: Naučna knjiga.

Sussex, Roland, and Paul Cubberley. 2006. *The Slavic Languages*. New York: Cambridge University Press.

Swinney, David. 1979. "Lexical access during sentence comprehension: (Re)consideration of context effects." *Journal of Verbal Learning and Verbal Behavior* 18 (6): 645–59. https://doi.org/10.1016/S0022-5371(79)90355-4.

Tatevosov, Sergei. 2011. "Severing perfectivity from the verb." *Scando-Slavica* 57 (2): 216–44. https://doi.org/10.1080/00806765.2011.631782.

Tanner, Darren, Sarah Grey, and Janet G. Van Hell. 2017. "Dissociating retrieval interference and reanalysis in the P600 during sentence comprehension." *Psychophysiology* 54 (2): 248–59. https://doi.org/10.1111/psyp.12788.

Ter Meulen, Alice. 1985. "Progressives without possible worlds." In *Papers from the regional meeting of the Chicago Linguistic Society*, edited by William H. Eilfort, Paul D. Kroeber and Karen L. Peterson, 408–23. Chicago: Chicago Linguistic Society.

Tokmačić, Ines, and Srđan Popov. 2019. "Time reference processing in Bosnian/Croatian/ Serbian: An ERP study." In *Studies in Language and Mind 3: Selected Papers from the 6th and 7th Workshop on Psycholinguistic, Neurolinguistic and Clinical Linguistic Research,* edited by Sabina Halupka-Rešetar and Silvia Martinez-Ferreiro, 15–43. Novi Sad: University of Novi Sad.

Van Herten, Marieke, Dorothee J. Chwilla, and Herman J. Kolk. 2006. "When heuristics clash with parsing routines: ERP evidence for conflict monitoring in sentence perception." *Journal of Cognitive Neuroscience* 18 (7): 1181–97. https://doi.org/10.1162/jocn.2006.18.7.1181.

Verkuyl, Henk. 1999. *Aspectual Issues. Structuring Time and Quantity*. Stanford: CSLI Publications.

Vlach, Frank. 1981. "The semantics of the progressive." In *Syntax and Semantics 14: Tense and Aspect*, edited by Philip J. Tedeschi and Annie Zaenen, 271–92. London: Academic Press.

Willim, Ewa. 2006. *Event, Individuation and Countability. A Study with Special Reference to English and Polish*. Krakow: Jagiellonian University Press.

Zhang, Yaxu, and Jingting Zhang. 2008. "Brain responses to agreement violations of Chinese grammatical aspect." *Cognitive Neuroscience and Neuropsychology* 19 (10): 1039–43. https://doi.org/10.1097/wnr.0b013e328302f14f.

Zeller, Jan Patrick, and Christina Clasmeier. 2020. "Každyj den' turist *otdoxnul na pljaže. An event-related potentials study on the processing of aspectual violation in Russian iterative sentences." *Russian Linguistics* 44: 297–320. https://doi.org/10.1007/s11185-020-09230-1.