How Incremental is the Processing of Perfective and Imperfective Aspect in Polish? An Exploratory Event-Related Potential Study

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Abstract: The present paper reports two ERP experiments in Polish that examined the processing of mismatches between perfective and imperfective verbs and temporal modifiers, which preceded the VP (Experiment 1) and followed it (Experiment 2). The mismatch between perfective verb and a preceding durative adverbial elicited an N400 on the object. No ERP effect was found for the analogous mismatch between imperfective verbs and a preceding time-span adverbial. The mismatching temporal adverbial elicited an early positivity (potentially an early P600) when it followed a perfective VP and a LAN when it followed an imperfective VP. The results suggest that: (i) the domain of aspectual interpretation in Polish is a VP; (ii) mismatches with perfective and imperfective verbs are resolved differently depending on the degree of their semantic specificity (only semantically underspecified imperfective verbs can be easily adjusted to the requirements of the preceding context); (iii) the position of the temporal adverbial plays a role in that a preverbal adverbial sets up a frame within which the eventuality should be interpreted and the aspectual value computed on AspP can be potentially adjusted to it (semantic integration reflected in N400), whereas a postverbal adverbial must agree with the aspectual value already computed on AspP (syntactic integration reflected in an early positivity or a LAN).

1. Introduction

While in theoretical linguistics a lot of attention has been paid to the category of aspect and its interpretation, it is only recently that the topic of how aspect is interpreted has attracted the attention of psycholinguists, and only very few psycholinguistic studies have been devoted to the processing of grammatical aspect in Slavic languages. The existing psycholinguistic studies related to the processing of aspect have focused mainly on the mechanisms involved in the resolution of aspectual mismatches in English and German (see, among others, Piñango, Zurif, and Jackendoff 1999; Todorova et al. 2000; Pickering et al. 2006; Piñango et al. 2006; Bott 2010; Brennan and Pylkkänen 2010; Paczynski, Jackendoff, and Kupenberg 2014; Husband and Stockall 2015). More recently, Bott and Gattnar (2015) conducted two eye-tracking experiments in which they investigated the processing of sentences with aspectual mismatches involving

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transitive achievement verbs (e.g., *win*, *spot*, *reach*) and durative *for X-time* adverbials in German (a non-aspect language) and in Russian (an aspect language). They showed that Russian readers immediately noticed the mismatch on the verbal region when a mismatching adverb preceded it, whereas German readers reacted to an analogous mismatch on the object. On the basis of this observation, they concluded that if a language has the grammatical means to express an aspectual distinction, the processor immediately commits to an aspectual interpretation (Bott and Hamm 2014, as quoted in Bott and Gattnar 2015: 6). This generalization is compatible with Filip and Rothstein's (2006) telicity parameter, according to which telic meaning is composed at the level of V in Russian and at the level of VP in English, and with Rothstein's (2015) broader generalization according to which there is a parametric difference between Russian (and potentially other Slavic languages) and English (and potentially other Germanic languages) aspectual systems in that in English aspectual operators operate at the VP level while in Russian they operate on the V. A different approach to the issue of incrementality of aspectual interpretation was presented by Husband and Stockall (2015). They argue that the composition of aspectual meaning proceeds cross-linguistically in two stages: first the verb and its direct object form the VP and then AspP is generated above it. In other words, the incremental commitment to aspectual interpretation is made once the full VP is formed and leads to the generation of a higher functional projection, AspP, where aspect is computed. They postulate that even when a verb has unambiguous event semantics, the commitment to an aspectual interpretation is made after the full VP has been processed. This shows that the question related to the domain over which the parser computes aspectual meanings is relevant but still under debate. For this reason, further studies using additional data from different languages are necessary. In order to further contribute to the discussion on the incrementality of aspectual interpretation, we will report two Event Related Potentials (ERP) experiments focusing on how the brain reacts online when it detects an aspectual mismatch in Polish, a language in which verbs are obligatorily specified as perfective or imperfective. In the reported experiments we contrasted contexts with perfective and imperfective accomplishment verbs with matching and mismatching temporal adverbials, that is, time span ('in X-time') and durative ('for X-time') adverbials. Additionally, in order to learn more about the timing of aspectual composition, we manipulated the word order. The matching and mismatching adverbials preceded the verb and its complement in Experiment 1 and they followed the verb and its complement in Experiment 2, as shown in (1a) and (1b) and (2a) and (2b) respectively.[1] In examples (1a) and (2a) perfective verbs (describing bounded eventualities) are compatible with time

[1] The symbol # is used to signal that this sentence is acceptable (on a less salient reading), but deviant at the first pass.

span and incompatible with durative adverbials. By contrast, in (1b) and (2b) imperfective verbs (describing unbounded eventualities) are compatible with durative adverbials and incompatible with time span adverbials.

(1) a. ✓ 'in X-time' + perfective

✓**W minutę** / *Przez minutę cichutko **otworzył** zamek,
in minute / for minute quietly open$_{PFV.PST.3SG.M}$ lock$_{ACC}$

żeby nie obudzić żony.
in order to … NEG wake.up$_{PFV.INF}$ wife$_{GEN}$

'He silently opened the lock in a minute in order not to wake up his wife.'

b. ✓ 'for X-time' + imperfective

#**W minutę** / ✓Przez minutę cichutko **otwierał** zamek,
in minute / for minute quietly open$_{IPFV.PST.3SG.M}$ lock$_{ACC}$

żeby nie obudzić żony.
in order to … NEG wake.up$_{PFV.INF}$ wife$_{GEN}$

'He was silently opening the lock for a minute in order not to wake up his wife.'

(2) a. ✓ perfective + 'in X-time'

Cichutko **otworzył** zamek ✓**w minutę** / #przez minutę,
quietly open$_{PFV.PST.3SG.M}$ lock$_{ACC}$ in minute / for minute

żeby nie obudzić żony.
in order to … NEG wake.up$_{PFV.INF}$ wife$_{GEN}$

'He silently opened the lock in a minute in order not to wake up his wife.'

b. ✓ imperfective '+ for X-time'

Cichutko **otwierał** zamek #**w minutę** / ✓przez minutę,
quietly open$_{IPFV.PST.3SG.M}$ lock$_{ACC}$ in minute / for minute

żeby nie obudzić żony.
in order to … NEG wake.up$_{PFV.INF}$ wife$_{GEN}$

'He was silently opening the lock for a minute in order not to wake up his wife.'

There are three research questions in the reported study: (i) Does the degree of semantic specificity of grammatical aspect (perfective being specific and imperfective being underspecified) play a role in the online processing? (ii) Is the domain of interpretation of grammatical aspect in Polish a V or a VP? (iii)

Does the resolution of mismatches between grammatical aspect and temporal adverbials depend on the (preverbal or postverbal) position of the latter? Regarding the first question, we expect that due to the differences in the semantic specificity, the mismatches with perfective aspect and imperfective verbs will either lead to different ERP signatures or alternatively to the same ERP signatures but with a stronger amplitude in the case of perfective condition. Concerning the second question, we expect that if the domain of aspectual interpretation is the verb, the ERP effects in mismatching conditions with a preverbal adverbial should be visible on the verb, or alternatively, if the domain of aspectual interpretation is VP, the effect should be visible on the object. Finally, regarding the third question, given that the sentence-initial adverbial sets up a frame for the aspectual interpretation, we might expect problems with semantics at discourse level integration on the following mismatching region. By contrast, when the mismatching adverbial follows the VP, we might expect difficulties with syntactic integration, since in this case the temporal adverbial must match the aspectual value already computed at the level of AspP.

The present paper has the following organization. First, in Section 2 we provide relevant descriptive facts about Polish aspect including some facts related to the differences in the semantic status of perfective and imperfective aspect and their interaction with temporal adverbials. Then, in Section 3 we provide brief overview of different approaches proposed in the literature pertaining to the question of the time course of aspectual interpretation and possible cross-linguistic differences regarding the size of the domain relevant for event interpretation. This part will be relevant for the formulation of our predictions regarding the question of incrementality of perfective and imperfective aspectual interpretation. In order to be able to formulate more precise predictions as to the expected ERP signatures, we will first, in Section 4.1., briefly characterize the ERP method and relevant ERP components and then in Section 4.2. we will review recent psycholinguistic ERP findings pertaining to the question of how the brain reacts when it detects aspectual mismatches. With the relevant background provided, we will formulate our predictions and provide the description of the present study (including an online acceptability rating questionnaire and ERP experiments) and the results in Sections 5.1. and 5.2. respectively. Section 6 will conclude the paper and suggest possible avenues for further research.

2. Aspect

2.1. General Remarks on Aspect

One of the standard assumptions about the computation of temporal/aspectual meanings is that tense scopes over grammatical aspect, which in turn

scopes over the lexical eventuality description of a verbal predicate, as schematically represented by means of de Swart's (1998: 348) model of aspectual composition in (3):

(3) $[_{TP}$ TENSE $[_{AspP}$ ASPECT* $[_{VP}$ $[_{V}$ EVENTUALITY DESCRIPTION$]]]]$[2]

In languages that do not possess a wide range of grammatical aspectual morphemes, aspectual meaning is computed mainly based on lexical aspect corresponding to the lowest layer in de Swart's model. By contrast, in languages that possess grammatical aspect (the aspect layer in de Swart's model) aspectual meaning is composed based on the interaction between lexical aspect (aspectual class) and the language-specific semantics of grammatical aspectual markers (typically manifested in the form of perfective and imperfective or progressive morphology) (see Comrie 1976; Dahl 1985; Binnick 1991; Smith 1997; Croft 2003). In this model, perfective and imperfective aspectual operators would act as eventuality description modifiers. One of the differences between perfective and imperfective aspect that most scholars postulate is that imperfective aspect involves a temporal perspective that falls inside an event which in turn excludes the event endpoints from view, whereas perfective aspect involves a temporal perspective that locates the temporal trace of an event within the reference time (see also Reichenbach 1947; Comrie 1976; Kamp and Reyle 1993; Klein 1994; Smith 1997; Kratzer 1998; Borik 2002; Kazanina and Phillips 2003). There are also scholars who say that only perfective aspect is a true aspectual operator and imperfective aspect is a non-aspect whose meaning is semantically underspecified (Paslawska and von Stechow 2003; Hacquard 2006; Willim 2006; Filip 2017). This already suggests that we should expect different ways of resolving mismatches with perfective and imperfective aspect resulting from their different degrees of semantic specificity.

2.2. Grammatical Aspect in Polish—Basic Facts[3]

In Polish, almost all verbs[4] (including infinitives) are either perfective or imperfective, see the examples in (1a) and (1b) for illustration. Additionally, most verbs in Polish have both perfective and imperfective variants.

[2] The Kleene star * indicates that there may be more aspectual operators.

[3] For a more detailed presentation of the grammatical aspect in Polish, see Klimek-Jankowska, Czypionka, Witkowski, and Błaszczak (2018), on which this section is based.

[4] With the exception of biaspectual verbs such as, for example, *anulować* 'to cancel' and *aresztować* 'to arrest'.

2.2.1. Perfective Aspect

Most perfective verbs pass a couple of standard tests used to diagnose perfectivity in Polish, as well as most Slavic languages (see Zinova 2016 for a detailed discussion). More specifically, what most perfective forms have in common is that they cannot be used as complements of phasal verbs: *zacząć* 'to begin', *kontynuować* 'continue', *skończyć* 'to finish', or as complements of the auxiliary *będzie* in periphrastic future constructions, as shown in (4) (cf. Wróbel 2001; Willim 2006; Filip 2017):

(4) zacząć/kontynuować/skończyć/będzie 'to begin/continue/finish/will'
✓czytać$_{IPFV}$ / *przeczytać$_{PFV}$ artykuł 'read/finish reading an article'
✓kwiczeć$_{IPFV}$ / *zakwiczeć$_{PFV}$ 'squeak repeatedly/start squeaking'
✓śpiewać$_{IPFV}$ / *pośpiewać$_{PFV}$ 'sing/sing for a while'
✓stukać$_{IPFV}$ / *stuknąć$_{PFV}$ 'knock repeatedly/knock once'

Furthermore, most perfective verbs do not form a present participle **przeczytając* 'while reading', **stuknąc* 'while knocking', **poczytając* 'while reading'. The present tense form of perfective verbs always makes reference to a future event as in *przeczyta* '(he/she) will read', *pośpiewa* '(he/she)will sing for a while' (see Filip 2017: 173).

Most Polish perfective verbs are morphologically marked by means of a prefix or a suffix, which are marked in italics in (5a,b) respectively (cf. Bogusławski 1963; Nagórko 1998; Wróbel 1999, 2001; Willim 2006) but there is no single dedicated perfective or imperfective morphological marker in Polish.

(5) a. pisać$_{IPFV}$ — *na*pisać$_{PFV}$ 'to write'
b. błyskać$_{IPFV}$ — błys*nąć*$_{PFV}$ 'to flash'

In spite of the fact that the class of perfective verbs is not uniform—there are final boundary perfectives, initial boundary perfectives, delimitative perfectives, and semelfactive perfectives—perfectives in Polish have individuation boundaries and they are used to refer to a single, well-delimited event occurring on a specific occasion, as postulated in Willim 2006 and Filip 2017. According to Laskowski (1984: 164), the prevailing function of perfective aspect is to focus on the transition between an action described by the verbal predicate and a result state.

2.2.2. Imperfective Aspect

Imperfective verbs form two classes: primary imperfectives ('unprefixed' verbs, see (6a), (7a)) and secondary imperfectives usually signaled by the presence of an *-ywa-* suffix and its allomorphs or by stem alternation (see (6b), (7b)).

(6) a. pisać$_{IPFV}$ 'to write'
b. podpis*ywać*$_{IPFV}$ 'to sign'

(7) a. bić$_{IPFV}$ 'to hit'
b. wbi*jać*$_{IPFV}$ 'to hammer'

In contrast to perfective verbs, imperfective verbs pass all the tests mentioned in Section 2.2.1. More precisely, they can be used as complements of phasal verbs and of the auxiliary *będzie* in periphrastic future constructions (see (4)) and they form present participles *czytając* 'while reading', *śpiewając* 'while singing'. Imperfective verbs in Polish are consistent with several readings and depending on context can refer to progressive, iterative, habitual, completed, and even resultative eventualities. In that sense imperfective verbs are semantically underspecified (see Wierzbicka 1967; Comrie 1976; Filip 1993/1999; Smith 1997; and Willim 2006; among others, for further discussion).

It has been pointed out that the basic reading of imperfective aspect is progressive as in, *Anna czytała*$_{IPFV}$ *gazetę, kiedy ktoś wszedł*$_{PFV}$ *do domu. Przerwała na chwilę, rozglądnęła się i nadal czytała*$_{IPFV}$. 'Anna read$_{IPFV}$ (lit., was reading) a newspaper when someone entered the house. She stopped reading for a moment, looked around and kept on reading.' (see Laskowski 1984; Padučeva 1996). On this reading the initial and final boundaries of the event denoted by the imperfective verb are not included in the reference time, and the imperfective verb refers to an event that is incomplete at the asserted interval (see Willim 2006: 200–201). However, it should be noted that the frequency of the various uses of imperfective verbs may depend on the semantics of the individual verb and on the context.[5] As stated in Laskowski 1984, the main function of imperfective verbs is to focus on the action.

Another reading of imperfective verbs is the plural-event reading. On this reading, an imperfective verb in Polish may refer to a series of delimited events repeated over an interval on a single occasion, e.g., *Jan pukał*$_{IPFV}$ *do drzwi przez pięć minut* 'Jan knocked$_{IPFV}$ (lit., was knocking) at the door for five minutes' or on several occasions, as in, for example, *Sąsiad podlewał ogród wieczorami* 'The neighbour watered$_{IPFV}$ the garden in the evening'. The latter type of plural-event reading of imperfective verbs is used to describe events

[5] We would like to thank a reviewer for pointing this out.

repeated over a longer stretch of time on several separate occasions by virtue of one's habits, duties, and/or disposition.[6]

2.2.3. Aspect and Temporal Modifiers

As mentioned above, Laskowski (1984: 164) states that the main function of perfective aspect is to focus on the transition between an action described by the verbal predicate and a result state, while the imperfective aspect focuses on the action itself. Both perfective and imperfective verbs can co-occur with temporal adverbials anchoring an event within the time axis (e.g., *Jan jadł/zjadł zupę o piątek* 'Jan was eating/Jan ate soup at five o'clock') with a different meaning effect. When an imperfective verb is used with an anchoring temporal adverbial, the meaning is that the action itself occurs at this point. By contrast, when perfective is used with an anchoring temporal adverbial, the meaning is that the transition between the action and its result state takes place at this point.

Regarding other temporal adverbials such as durative ('for X time') and time span ('in X-time') adverbials, the former are most compatible with imperfective verbs and the latter with perfective verbs. As stated in Laskowski 1984, the imperfective (in its single ongoing use) focuses on the action and hence can be modified by an adverbial that specifies its duration. On the other hand, the perfective focuses on the transition from the action to a result state and hence can be modified by an adverbial describing the amount of time needed for the transition. There are some exceptional perfective verbs such as, for example, the delimitative ones (*Marek posiedział godzinę w kawiarni* 'Marek sat$_{PFV}$ one hour in the café', *Janek przetańczył całą noc* 'Janek danced$_{PFV}$ the whole night through', or the saturative ones *Zosia napatrzyła się na wiele różnych sytuacji przez ostatnich pięć lat* 'Zosia had$_{PFV}$ her fill of different situations in the last five years', which are compatible with durative adverbials because here perfectivity does not mark a transition from an action to its result state but it temporally delimits the action.

[6] Imperfective verbs in Polish can also be used to talk about events that are planned or that are about to happen but have not started yet as in *Zaraz wysiadam$_{IPFV}$ z pociągu* 'I am getting off the train in a moment' (see Błaszczak and Klimek-Jankowska 2013 for further discussion), and as observed in Śmiech 1971: 44, Szwedek 1998: 414–15, and Willim 2006: 201–02, among others, imperfective aspect in Polish can also be used to talk about culminated events in special contexts in which the culmination is a matter of the so called telic presupposition or factivity as in *Kto gotował$_{IPFV}$ te ziemniaki?* 'Who cooked these potatoes?' (see also Grønn 2003; Altshuler 2012).

2.3. Asymmetries Between Perfective and Imperfective Aspect

In Polish and in most languages that manifest the distinction between perfective and imperfective aspect, the former is semantically more specific and has a more constrained distribution and the latter has a wider, more general meaning and occurs in a wider set of contexts. For the present paper it is important to note the difference between imperfective and perfective aspect as concerns incongruent combinations with a time span and a durative adverbial respectively.

In Section 2.2.2. we pointed out that imperfective aspect can have different interpretations, e.g., progressive (episodic ongoing), habitual, or iterative. As emphasized by Laskowski (1984: 170–71), while imperfective verbs do not allow for the modification by a time span adverbial in their single ongoing meaning, they are compatible with such adverbials under the plural event reading (where the time span adverbial describes the time needed to reach a transition point for each single event of the series of events). Consider (8).

(8) Maria gotowała obiad w godzinę.
Maria cook$_{\textbf{\textit{IPFV}}.PST.3SG.F}$ dinner in hour

[Impossible] 'Maria was cooking dinner in an hour (on a single occasion).'

'Maria cooked dinner in an hour (on several occasions).'

The spontaneous reaction to (8) is that it is deviant, as confirmed in the acceptability rating study described in Section 5.1. However with some effort it is possible to arrive at its secondary habitual interpretation, as indicated in the translation of (8) above.[7]

What is relevant in the context of the present study is the observation that while the mismatch between the imperfective verb and a time span adverbial can be resolved under the habitual interpretation, the mismatch between a perfective verb (being semantically very specific) and a durative adverbial cannot be resolved. Consider (9).

(9) *Maria ugotowała obiad przez godzinę.
Maria cook$_{\textbf{\textit{PFV}}.PST.3SG.F}$ dinner in hour

[Intended] 'Maria cooked$_{PFV}$ dinner for an hour.'

[Intended] 'Maria finished cooking dinner for an hour.'

[7] In that sense, imperfective aspect mismatches with a time span adverbial on its dominant single ongoing interpretation. This observation will play a role in the Predictions section (see Section 5.2.3.).

Unlike imperfective in (8), perfective can only be interpreted in one specific way and it can only denote a bounded episodic eventuality. Therefore, its meaning cannot be repaired (adjusted) to the meaning of the mismatching durative 'for X-time' adverbial. With these facts in mind, we might expect different brain reactions to contexts involving perfective and imperfective verbs and their mismatching adverbial modifiers, that is, a durative adverbial and a time span adverbial respectively.

3. Relevant Background on the Incrementality (Timing) of Aspectual Interpretation

There is a lot of controversy as to the domain of interpretation of aspect. In highly incremental approaches (Marslen-Wilson and Tyler 1980), it is assumed that the parser uses verbal information immediately and starts the interpretation right away when processing individual words. Frazier (1999) postulates a slightly weaker variant and argues that the parser must choose between grammatically incompatible meanings of a word or constituent immediately, by the end of the word or constituent, unless this conflicts with the dictates of the grammar. More recently, Pickering and Frisson (2001), Pickering et al. (2006), and Frisson (2009) claim that in the case of a semantically underspecified verb the processor does not commit to any of its possible senses but rather it initially activates an underspecified representation and subsequently homes in on the precise sense.

Regarding the processing of aspectual meanings, Husband and Stockall (2015) propose a two-stage model of aspectual processing. In the first stage, verbal and nominal properties license the construction of the VP and in the second stage AspP is projected and the parser is ready to commit to an aspectual interpretation based on the syntactic structure arrived at through the first stage. They based this conclusion on the results of their self-paced reading study in which they investigated the role of the verb and the direct object in aspectual interpretation in sentences with achievements such as *lose*, *find*, *reach* (clearly terminative) and accomplishments (unspecified for telicity) *read*, *build*, *repair* followed by plural NP objects with a definite determiner or by bare plural NP objects; see (10).

(10) a. The expert physicist lost the files on the formation of black holes.
b. The expert physicist lost files on the formation of black holes.
c. The expert physicist read the files on the formation of black holes.
d. The expert physicist read files on the formation of black holes.

Husband and Stockall (2015) report a main effect of the definite article on the noun position and an interaction between verb class and the definite article at

one position after the noun. More specifically, they obtained significant differences between accomplishment verbs with bare objects and accomplishment verbs with definite objects and significant differences between achievements with bare plural objects and accomplishments with bare plural objects. This could be evidence that telicity is only computed for full VPs and the VP that is atelic (accomplishments with bare plural objects) obtained significantly longer reading times on the object position and one position following the object. Additionally, they did not obtain any significant main effects of verb class between achievement and accomplishment infinitive verbs used in their lexical decision experiment. However, they report a significant interaction of lexical verb type and anteriority in their MEG study, where they report more positive activity in the anterior hemisphere and more negative activity in the posterior hemisphere for telic verbs. Their analyses were time-locked to the onset of the verb. Even though they provide evidence only from English, they argue that it should be cross-linguistically valid that aspectual interpretation is computed upon completion of the VP, since only then can AspP be generated and this is the place for the composition of aspectual meanings.

Stockall, Husband, and Beretta (2010) emphasize that they use the term **aspect** to refer to lexical aspect. Therefore it remains unresolved whether the same generalization can be extended to languages with grammatical aspect (for more discussion, see Husband and Stockall 2015). In this respect, Bott and Hamm (2014) postulate a cross-linguistic aspectual variation hypothesis according to which the processor immediately commits to an aspectual interpretation if a language has the grammatical means to express an aspectual distinction, as in Russian. In contrast, the parser does not immediately commit to an aspectual interpretation in a language that lacks grammatical means to express an aspectual distinction, as is the case in German. Evidence for this hypothesis was provided by Bott and Gattnar (2015). In their eye-tracking experiments, they compared the processing of Russian and German sentences with transitive achievement verbs (e.g., *win*, *spot*, *reach*) and mismatching durative 'for X-time' adverbials. Russian and German differ in how aspectual meanings are computed. Russian verbs are specified for either perfective or imperfective aspect. While perfective verbs view an event from the outside, the imperfective aspect views an event from the inside (Comrie 1976). By contrast, this opposition is not encoded in German verbs. However, both German and Russian achievement verbs denote punctual events, which are incompatible with durative adverbials. Based on Krifka 1992, Bott and Gattnar (2015) expected that in aspect languages perfective aspect determines the aspectual interpretation of verb phrases without relying on the semantic contribution of nominal arguments, whereas in non-aspect languages the nominal arguments are crucial for the aspectual interpretation of the VPs. They predicted that in Russian mismatches should be detected solely on the basis of the perfective verb and the adverbial, whereas in German the expectation was that the de-

tection of mismatches should rely on the entire verb-argument structure. Russian readers immediately noticed the mismatch independently of whether the verb preceded or followed its arguments, whereas German readers showed mismatch effects only after a complete predication. This generalization is compatible with Filip and Rothstein's (2006) telicity parameter, according to which telic meaning is composed at the level of V in Russian and at the level of VP in English, and with Rothstein's (2015) broader generalization according to which there is a parametric difference between Russian (and potentially other Slavic languages) and English (and potentially other Germanic languages) aspectual systems in that in English aspectual operators operate at the VP level while in Russian they operate on the V.

We decided to extend this line of research (in particular the research of Bott and Gattnar 2015) by testing the processing of perfective and imperfective verbs of accomplishment predicates in Polish. Concerning the mismatch with perfective verbs, based on the study by Bott and Gattnar (2015), we should expect an effect of the mismatch directly on the verb and not on its complement. An alternative prediction would be based on a more syntax-based approach proposed by Husband and Stockall (2015), according to which it should be cross-linguistically the case that the aspectual interpretation cannot happen before the VP is completed, which would mean that the effect of the aspectual mismatch should be reflected rather on the object (under the canonical word order).

Concerning imperfective aspect, as we pointed out in Section 2.2.2., imperfective aspect is a multiply ambiguous category with its single ongoing reading being dominant. In the theoretical literature, there are two major approaches to the composition of the meaning of imperfective aspect: compositional approaches and underspecification approaches. Regarding the former, imperfective aspect is treated either as a universal quantifier over events or situations (Bonomi 1995; Cipria and Craige 2000; Lenci and Bertinetto 2000; Arregui, Rivero, and Salanova 2014) or as an existential quantifier over singular or plural events in the denotation of verbal predicates (Ferreira 2005). Under the underspecification approach, imperfective aspect is regarded as a non-aspect (Paslawska and von Stechow 2003; Willim 2006) or it is assumed its meaning is semantically vacuous (underspecified) (Hacquard 2006). The underspecification view is compatible with the findings of a recent psycholinguistic study by Klimek-Jankowska et al. (2018) in which they compare the time-course of processing of analogous sentences with perfective and imperfective verbs and it is shown that reading measures are longer on sentence final regions in the latter case. This suggests that in the absence of any disambiguating contextual cues the parser delays the process of interpreting imperfective aspect in Polish. In a recent study by Lukassek et al. (2017), they report the results of their reading-time experiment and indicate that the specification of an underspecified structure—motion verbs in German—proceeds

effortlessly. Coming back to the question of the domain of interpretation of imperfective aspect, if its meaning is truly underspecified, we would not expect any immediate effect of a mismatch on the verb or object in mismatching conditions with sentence-initial adverbials. However, in mismatching conditions with a postverbal temporal adverbial (under the assumption that imperfective aspect is interpreted incrementally at AspP), a visible brain reaction to a mismatch is expected. This is so because at the level of AspP the aspectual value is computed and the parser has to commit to some interpretation, which in the absence of further contextual cues is the most frequent one. Since in all the experimental sentences singular NP objects were used, we expect the parser to favor the single ongoing interpretation (see Section 2.2.2.).[8]

In order to be able to formulate predictions as to expected ERP signatures, in the following section we briefly present the relevant linguistic ERP components and summarize findings of relevant ERP studies on aspectual mismatches.

4. ERP Studies on Aspectual Mismatches

4.1. A Brief Introduction to the ERP Method

As stated in Kaan (2007), event-related brain potentials (ERPs) have turned out to be extremely valuable for the cognitive neuroscience of language. This method is used in research on how language is processed in real time. Electrical brain activity is recorded by placing electrodes on the subject's scalp. ERPs are the brain waves that reflect the brain's reaction to a stimulus, which constitutes the event of interest. Several waveforms (also referred to as components) are distinguished as reflecting different aspects of word and sentence comprehension and production. A component can be defined on the basis of its polarity, latency, duration, and its distribution across the scalp. The name of the component usually corresponds to these characteristics. For instance, one of the most relevant components in linguistic research are the LAN, N400, and P600. The LAN (left anterior negativity) is a negative-going waveform peaking between 300–500 ms from the onset of the critical stimulus, and it is most prominent at left anterior scalp positions. This component is observed for grammatical violations, and it usually has been associated with difficulty with morpho-syntactic agreement processes (Friederici 2002). Some scholars take it to be a more general index of working memory load (Kluender and Kutas 1993a, b; Coulson, King, and Kutas 1998; Rösler et al. 1998). The second component, the N400, is also a negative going brain wave peaking between

[8] That the grammatical number of objects significantly affects the interpretation of imperfective verbs has been experimentally demonstrated by Klimek-Jankowska and Błaszczak (to appear)

300 and 500 ms after onset of the critical stimulus but with a right-central and posterior scalp distribution. According to Kaan (2007), the prevailing view of the N400 is that it reflects difficulty with semantically integrating the stimulus into the stimulus context. Its amplitude may be sensitive to the expectancy of a word in a given context, its frequency and semantic plausibility. The third most often elicited component in linguistic studies is the P600 component. It is a positive deflection with a posterior maximum peaking between, roughly, 500 and 900 ms. The P600 is standardly interpreted as reflecting a difficulty in syntactic integration (including monitoring and non-automatic revision processes) (Osterhout and Holcomb 1992; Hagoort, Brown, and Groothusen 1993; Friederici 2002).

4.2. Overview of Relevant Findings

In recent years there have been quite a few ERP studies investigating aspectual mismatches. However, those studies have been conducted mostly on English and German. We need to take into account the fact that the processing of aspect in Polish relies on the interaction between lexical aspect and grammatical aspect and therefore is different from aspectual interpretation based on lexical aspect, as is the case in Germanic languages (the exception being the progressive aspect in English; see Bott 2016).

In his study on aspectual coercion in German, Bott (2010; see also Bott 2016) reports a sustained anterior negativity (working memory LAN) in the time window 500–900 ms in response to additive coercion observed in sentences with an 'in X-time' prepositional phrase incompatible with a punctual achievement verb, as exemplified in *In zwei Stunden hatte der Förster die Falle entdeckt* ('Within two hours, the ranger had discovered the trap'), as compared to control sentences of the type *Vor zwei Stunden hatte der Förster die Falle entdeckt* ('Two hours ago the ranger had discovered the trap'). In addition, Bott (2010) reports a P600 in response to an unresolvable aspectual mismatch in sentences with a 'for X-time' adverbial phrase and a punctual achievement verb, as in *Ganze zwei Stunden hatte der Förster die Falle entdeckt* ('For two hours, the ranger had discovered the trap'), as compared to control sentences. Bott (2010) interprets the obtained P600 signature as an index of a semantic interpretation difficulty at the phrasal level. Regarding the sustained negativity (a working memory LAN), Bott (2010) takes it to reflect the enrichment of the achievement eventuality with an appropriate preparatory process, which has to be inferred on the basis of world knowledge leading to the enhancement of working memory load (pp. 226–27).

A similar finding has been recently reported by Paczynski, Jackendoff, and Kuperberg (2014). In their ERP study of neurocognitive mechanisms underlying aspectual coercion, they investigated the processing of punctive and durative verbs in contexts with three types of prepositional phrases: (i) punc-

tive, (ii) durative, and (iii) frequentative. They report a late, sustained negativity between 500–1200 ms for the comparison between punctive verbs in durative contexts (e.g., *For several minutes the cat pounced on the rubber mouse*) and punctive verbs in punctive contexts (e.g., *After several minutes the cat pounced on the rubber mouse*). Additionally, they obtained a late sustained negativity between 800–1200 ms for punctive verbs in durative contexts relative to punctive verbs in frequentative contexts (e.g., *Several times the cat pounced on the rubber mouse*). Both contexts (the one with a durative and the one with a frequentative adverbial) were found to require a reinterpretation of the punctive eventuality *pounce* into an iterative one. There is, however, an important difference in the mechanisms by which the required iterative interpretation is achieved. With a frequentative adverbial and a punctive verb, the iterative interpretation can be achieved through simple compositionality by combining the meaning of the frequentative phrase, *several times* (explicitly specifying the iterative character of the eventuality) and the meaning of the verb *pounce* without any need for an additional semantic (implicit) operator. By contrast, with a punctive verb *pounce* and a durative adverbial *for several minutes*, the iterative meaning cannot be achieved by simple composition. There is a need for an additional morphosyntactically unrealized mechanism of enriched composition, which is referred to as aspectual coercion. The authors suggest that it is the engagement of this morphosyntactically unrealized semantic operator in the interpretation of the linguistically described event that is reflected in the observed late sustained negativity. More specifically, this negativity reflects the increased working memory demands related to the elaborative semantic processing required to arrive at the correct interpretation of an event, which cannot be achieved through the simple composition of the meanings of the overtly realized elements of the sentence. Interestingly, the authors also observed a negativity in an earlier time window 300–400 ms, but it did not reach significance.

In a recent study, Yano (2018) takes this latter observation as motivation for his ERP experiment on additive and substractive aspectual coercion in Japanese. The hypothesis tested in his study was that the LAN observed in the previous studies actually consists of two subcomponents reflecting distinct cognitive functions: the earlier LAN is enhanced due to a prediction error pertaining to aspectual information, whereas the later LAN reflects some phases of the reinterpretation (p. 721). The reason why the earlier LAN was not detected in Bott's (2010) study on aspectual coercion in German and it did not reach statistical significance in Paczynski, Jackendoff, and Kuperberg 2014 is that the predictive mechanisms underlying it are only detectable when there is enough time for the prediction to arise, as Yano (2018) proved by manipulated the Stimulus Onset Asynchrony (SOA) and keeping the same experimental material. More precisely, in the long SOA condition, each phrase was presented for 700 ms with an inter-stimulus interval (ISI) of 100 ms, whereas

in the short SOA condition, each phrase was presented for 400 ms with a 100 ms ISI (p. 723). The early LAN was elicited only with the long SOA, whereas the late LAN was found in both conditions. Yano (2018: 729) suggests that the early anterior negativity may not reflect an aspectual reinterpretation process but rather a penalty arising from an incorrect prediction for the aspectual interpretation for the verb based on the preceding temporal adverb. The reinterpretation process is then reflected in the late LAN.

In the studies by Bott (2010), Paczynski, Jackendoff, and Kuperberg (2014), and Yano (2018), the focus was on the processing of incongruous combinations of aspectual meanings of verbs and adverbial phrases in languages in which aspectual interpretation relies predominantly on lexical aspect. Little is known about the neurocognitive mechanisms involved in the processing of incongruous combinations of aspectual verb meanings with mismatching adverbials or other conflicting aspectual markers in languages with a rich system of grammatical aspect (i.e., in languages where different aspectual meanings are morphologically realized). An exception to this is the study by Zhang and Zhang (2008), who studied violations in agreement between different markers of grammatical aspect in Chinese. Chinese has several aspectual markers; some of them can cooccur (*yijing* and *le*, both being perfective markers) and some of them create a mismatch (e.g., perfective *le* with a progressive *zhengzai*). In their study, Zhang and Zhang compared sentences with agreeing aspectual markers, for example, *Su Jun yijing* (PERF, 'already') *prepare le* (PERF) *fruit and cookies* ('Su Jun prepared fruit and cookies already') with sentences containing mismatching aspectual markers, as in *Su Jun zhengzai* (PROG 'ongoing') *prepare le* (PERF) *fruit and cookies*. They report a biphasic 200–400 ms left central and posterior negativity and P600 pattern for this comparison. The authors interpret the P600 as "reflect[ing] syntactic repair or the monitoring and resolution of conflict caused by the aspect disagreement" (p. 1042). Concerning the reported left central and posterior negativity, they argue that it is not a typical LAN (because of the lack of anterior distribution) nor a typical N400 (because of different spatial and temporal properties) (see also Dillon et al. 2015). Instead, they interpret the obtained negativity "as reflect[ing] either a failure to bind aspect markers or the detection of aspectual errors".

Interestingly, early negativity was also found by Flecken, Walbert, and Dijkstra (2015), who investigated the reaction of the brain in response to aspect agreement violations between temporal context and verb morphology in English contexts of the type **Right now, John swims in the pool* and **Every Tuesday, John is swimming in the pool*, as compared to *Right now, John is swimming in the pool* and *Every Tuesday, John swims in the pool*. All the experimental items were preceded by a question that triggered an expectation for a specific form of the verb in the experimental sentence, for example, *What is John doing in the pool right now?* and *What does John do in the pool every Tuesday?* The authors were interested in whether the ERP responses to aspectual agreement violations

would be similar to standard morphosyntactic (e.g., **Right now, the woman are swimming in the pool*) and semantic violations (e.g., **Today, the boy is cooking in the pool*) for which they report typical brain responses: P600 (in the time window 500–800ms) and N400 (in the time window 350–500 ms) respectively. By contrast, the aspectual agreement violation triggered an early negativity that was short-lived (time window 250–350 ms) and had a central scalp distribution with an anterior onset. The early negativity did not continue into the N400 or P600. They interpret the aspect-related Early Negativity as reflecting a violation of expectations regarding the form of the verb phrase (*is reading* vs. *reads*) triggered by the preceding temporal information (*right now, every Tuesday*) and the form of the preceding question. Since the early negativity bears some resemblance to the findings of earlier studies examining the violation of phonological or semantic expectations, the authors emphasize that early negativity might be part of a more general neural mechanism triggered by a violation of form-level expectations (see Flecken, Walbert, and Dijkstra 2015 for further discussion and references).

5. The Present Study

To assess the acceptability of the constructions being tested (see examples (1) and (2)), we performed an online acceptability rating study.

5.1. An Online Acceptability Rating Questionnaire

5.1.1. Description

Altogether, the material consisted of 136 sentences: 12 sentences per condition (12 x 8 conditions) plus 40 fillers (half grammatical, half ungrammatical). The sentences (both the experimental sentences and the fillers) used in the study were selected from the material prepared for the ERP experiment (see Section 5.2.2.).

The following combinations were tested: perfective verbs with matching 'in X-time' and mismatching 'for X-time' adverbials in preverbal and postverbal positions and imperfective verbs with matching 'for X-time' and mismatching 'in X-time' adverbials in preverbal and postverbal positions. The constructed sentences were distributed across four lists using Latin square design. Each list contained 24 experimental sentences plus 40 fillers (20 grammatical and 20 ungrammatical). The same 40 fillers were used in each list. All of the test items and fillers in each list were randomized. Different lists were created in order to alleviate the participants' fatigue and show lexical variation in each list. We obtained responses from 98 participants (18 for list 1, 24 for list 2, 26 for list 3, and 30 for list 4). All of the participants were na-

tive speakers of Polish and students from the University of Wrocław, Adam Mickiewicz University in Poznań, the University of Silesia in Katowice, or the John Paul II Catholic University of Lublin. None of them participated in the reported ERP study. The participants rated the acceptability of the tested sentences on a scale from 1 to 5, where 1 is totally unacceptable and 5 is totally acceptable.

5.1.2. Results

The results of the acceptability rating study are presented in Table 1 on the following page. Statistical analysis was conducted in the R program (version 3.6.3) on a Windows-compatible PC (R Development Core Team 2020). The differences in acceptability ratings between conditions in planned comparisons were determined by fitting the ordinal regression models using the polr function (MASS package Venables and Ripley 2002). The ordinal regression results for the relevant comparisons are summarized in Tables 2 and 3 on pages 42–43.

The results of the questionnaire study confirm that there is a clear difference between matching and mismatching conditions for perfective and imperfective conditions. Mismatching combinations were rated as significantly less acceptable than matching combinations both for perfective and imperfective aspect. This suggests that participants noticed the mismatch. There was also a significant difference in acceptability between grammatical and ungrammatical fillers, which suggests that participants read sentences attentively. Additionally, there was a significant difference between analogous mismatches with preverbal and postverbal adverbials. Mismatches (both perfective and imperfective) with postverbal adverbials were rated significantly less acceptable than the corresponding mismatches with preverbal adverbials. The obtained acceptability results suggest that we should expect a brain reaction to mismatches as compared to the corresponding matches and that the brain reaction might be different in the case of postverbal mismatches than in the case of preverbal mismatches.

5.2. ERP Experiment

To assess our research questions formulated in Section 1, two ERP experiments based on the same lexical material were conducted. In both experiments perfective and imperfective verbs were used in combination with a matching or mismatching temporal adverbial. Crucially, in Experiment 1 the temporal adverbial preceded the perfective/imperfective predicate, while in Experiment 2 the temporal adverbial was placed after it. The manipulation of the word order (the position of the temporal adverbial with respect to the ver-

Table 1. Proportions of acceptability rating

Condition	acc1	acc2	acc3	acc4	acc5
PFV_MISMATCH_PREVERBAL	0.24914676	0.24232082	0.23208191	0.19112628	0.08532423
PFV_MATCH_PREVERBAL	0.06506849	0.12671233	0.17123288	0.29794521	0.33904110
IPFV_MISMATCH_PREVERBAL	0.25255973	0.30716724	0.23549488	0.13993174	0.06484642
IPFV_MATCH_PREVERBAL	0.01706485	0.03754266	0.12969283	0.29692833	0.51877133
PFV_MISMATCH_POSTVERBAL	0.22685185	0.32870370	0.18055556	0.18287037	0.08101852
PFV_MATCH_POSTVERBAL	0.10084034	0.19327731	0.13865546	0.20168067	0.36554622
IPFV_MISMATCH_POSTVERBAL	0.39655172	0.39310345	0.21034483	0.00000000	0.00000000
IPFV_MATCH_POSTVERBAL	0.00000000	0.00000000	0.13605442	0.38775510	0.47619048
FILLER_CORR	0.01166181	0.02623907	0.04664723	0.12244898	0.79300292
FILLER_INCORR	1.00000000	0.00000000	0.00000000	0.00000000	0.00000000

Table 2. Relevant comparisons between matching and mismatching conditions—results of ordinal regression

Comparison	Value	Std. Error	T value	P value	comment
PFV_MATCH_PREVERBAL vs. PFV_MISMATCH_PREVERBAL	–1.6367548	1.538677e-01	–1.063742e+01	1.995824e-26	match pfv rated sig better
IPFV_MATCH_PREVERBAL vs. IPFV_MISMATCH_PREVERBAL	–2.72054562	1.583077e-01	–1.718518e+01	3.428786e-66	match ipfv preverb rated sig better
PFV_MATCH_POSTVERBAL vs. PFV_MISMATCH_POSTVERBAL	–1.5176152	1.551736e-01	–9.780112e+00	1.370584e-22	match pfv postverb rated sig better
IPFV_MATCH_PREVERBAL vs. IPFV_MISMATCH_POSTVERBAL	–3.58284425	1.584527e-01	–2.261144e+01	3.344733e-113	match ipfv postverb rated sig better

Table 3. Relevant comparisons between conditions with preverbal and postverbal adverbials—results of ordinal regression

Comparison	Value	Std. Error	T value	P value	comment
PFV_MATCH_PREVERBAL vs. PFV_MATCH_POSTVERBAL	–0.2137697	1.649421e-01	–1.296028e+00	1.949658e-01	NO SIG DIFF
IPFV_MATCH_PREVERBAL vs. IPFV_MATCH_POSTVERBAL	–0.01474372	1.517850e-01	–9.713554e-02	9.226188e-01	NO SIG DIFF
PFV_MISMATCH_PREVERBAL vs. PFV_MISMATCH_POSTVERBAL	–2.58513130	1.467523e-01	–1.761561e+01	1.869655e-69	mismatch pfv preverb rated sig better
IPFV_MISMATCH_PREVERBAL vs. IPFV_MISMATCH_POSTVERBAL	–1.10678785	1.496245e-01	–7.397101e+00	1.391898e-13	mismatch ipfv preverb rated sig better

bal predicate) is particularly relevant for determining the domain of aspectual interpretation of perfective and imperfective aspect.

5.2.1. Participants

Twenty eight native speakers of Polish (18 females, mean age 20.5, range 19–40) were recruited for Experiment 1 and a different group of twenty eight native speakers of Polish (22 females, mean age 20.5, range 22–24) were recruited for Experiment 2 all from the University of Wrocław at the Institute of English Studies.[9] Participants received partial course credit. All participants were right-handed according to the Edinburgh Handedness Inventory (Oldfield 1971) and had normal or corrected vision. None reported neurological or psychiatric disorders or traumas.

5.2.2. Material and Experimental Design

In each experiment there were four experimental parts. Each part contained the same verbal predicate, which differed in its aspectual form: it was perfective in two cases and imperfective in the other two. Only accomplishment verbs were included (see the Appendix), and all the verbs had the same form (third person singular masculine past) followed by a singular inanimate object. In the two perfective and imperfective sentences there was one with a matching temporal adverbial and another with a mismatching temporal adverbial, as shown in (11).

(11) **Experimental combinations**

Condition 1: PERFECTIVE_MISMATCH
Perfective verb + mismatching durative ('for X-time') temporal adverbial

Condition 2: PERFECTIVE_MATCH
Perfective verb + matching time span ('in X-time') temporal adverbial

Condition 3: IMPERFECTIVE_MISMATCH
Imperfective verb + mismatching time span ('in X-time') temporal adverbial

Condition 4: IMPERFECTIVE_MATCH
Imperfective verb + matching durative ('for X-time') temporal adverbial

[9] There are no ethical issues raised by the reported research. The study is in compliance with the EU legislation on ethics Charter of Fundamental Rights of the EU (2000/C 364/01) and ECHR and the Declaration of Helsinki (2013).

Experiments 1 and 2 were identical except for the positioning of the temporal adverbials. In Experiment 1 the temporal adverbial preceded the verbal predicate while in Experiment 2 it followed the verbal predicate. An example of a stimulus quartet used in Experiment 1 and Experiment 2 is provided in (12) and (13) respectively.

(12) **Experiment 1**

Condition 1: PERFECTIVE_MISMATCH

*Przez minutę	cichutko	**otworzył**	zamek,
for minute	quietly	open$_{PFV.PST.3SG.M}$	lock$_{ACC}$
żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

[Intended] 'He silently opened the lock for a minute in order not to wake up his wife.'

Condition 2: PERFECTIVE_MATCH

W minutę	cichutko	**otworzył**	zamek,
in minute	quietly	open$_{PFV.PST.3SG.M}$	lock$_{ACC}$
żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

'He silently opened the lock in a minute in order not to wake up his wife.'

Condition 3: IMPERFECTIVE_MISMATCH

W minutę	cichutko	**otwierał**	zamek,
in minute	quietly	open$_{IPFV.PST.3SG.M}$	lock$_{ACC}$
żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

[Impossible] 'He was silently opening the lock in a minute in order not to wake up his wife.'

Condition 4: IMPERFECTIVE_MATCH

Przez	**minutę**	cichutko	**otwierał**	zamek,
in	minute	quietly	open$_{IPFV.PST.3SG.M}$	lock$_{ACC}$
żeby		nie	obudzić	żony.
in order to …		NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

'He was silently opening the lock for a minute in order not to wake up his wife.'

(13) **Experiment 2**

Condition 1: PERFECTIVE_MISMATCH

*Cichutko	**otworzył**	zamek	**przez**	**minutę**,
quietly	open$_{PFV.PST.3SG.M}$	lock$_{ACC}$	for	minute

żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

[Intended] 'He silently opened the lock for a minute in order not to wake up his wife.'

Condition 2: PERFECTIVE_MATCH

Cichutko	**otworzył**	zamek	**w**	**minutę**,
quietly	open$_{PFV.PST.3SG.M}$	lock$_{ACC}$	in	minute

żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

'He silently opened the lock in a minute in order not to wake up his wife.'

Condition 3: IMPERFECTIVE_MISMATCH

Cichutko	**otwierał**	zamek	**w**	**minutę**,
quietly	open$_{IPFV.PST.3SG.M}$	lock$_{ACC}$	in	minute

żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

[Impossible] 'He was silently opening the lock in a minute in order not to wake up his wife.'

Condition 4: IMPERFECTIVE_MATCH

Cichutko	**otwierał**	zamek	**przez**	**minutę**,
quietly	open$_{IPFV.PST.3SG.M}$	lock$_{ACC}$	for	minute

żeby	nie	obudzić	żony.
in order to …	NEG	wake.up$_{PFV.INF}$	wife$_{GEN}$

'He was silently opening the lock for a minute in order not to wake up his wife.'

In each experiment 320 stimulus sentences were constructed. Out of these 320 stimuli, 160 sentences served as experimental items and 160 as fillers. There were 40 sentences per combination in each experiment (40 x 4 = 160). All experimental items had an identical structure consisting of a main clause and an embedded clause. The main clause consisted of a temporal modifier, a modal modifier, a verbal predicate, which was always in the third person singular masculine past form, and an inanimate singular object.

Since the same verbs were used in the compared sentences, we did not check their frequency as it was identical across the relevant conditions. We took extra steps to balance the length of our perfective and imperfective sentences. Because of the peculiarities of Polish aspectual morphology, bare imperfectives like *pisać* 'to write$_{IPFV}$' are normally shorter than their perfective counterparts, for example, *podpisać* 'to sign$_{PFV}$' (see Section 2.2.1. and 2.2.2.). To counterbalance this discrepancy in word length across perfective and imperfective conditions, we used 50% of bare imperfective forms, and the other 50% had a secondary (derived) form with additional imperfectivizing morphology, for example, *podpisywać* 'sign'). Notice that secondary imperfective forms are not only longer than bare imperfective verbs but also longer than the perfective forms from which they are derived. This resulted in creating pairs of perfective and imperfective verbs out of which 50% had a longer perfective form and 50% had a longer imperfective form.

Fillers were structurally similar to experimental items in that they also consisted of a main and an embedded clause, as illustrated in (14). Half of the fillers were ungrammatical. We used ungrammatical fillers to distract the participants from the main purpose of the experiment, and for this reason we used two types of grammatical violations in the embedded sentences (recall that the mismatches investigated in our experiments were present in the matrix sentences). The types of ungrammaticality consisted in either the use of a wrong aspectual form of the verb (see (14a)) or a wrong inflectional form of the verb (see (14b)). The ungrammatical forms are written in bold in the examples. The correct form in (14a) would be *dotknę* 'touch$_{PFV.PRS.1SG}$' and the correct form in (14b) would be *był zadowolony* 'was satisfied'.

(14) a. *Dam ci znać, zanim **dotykam**
give$_{PFV.PRS.1SG}$ you know before touch$_{IPFV.PRS.1SG}$
czarnej skrzynki.
black box
[Intended] 'I will let you know before I am touching the black box.'

b. *Ola spyta Janka o zdanie, żeby
Ola ask$_{PFV.PRS.3SG}$ Janek about opinion in order to
będzie zadowolony.
will.be satisfied
[Intended] 'Ola will ask Janek for his opinion so that he will be satisfied.'

Fillers were structurally similar to experimental items in that they also consisted of a main and an embedded clause. Half of the fillers were ungrammatical.

5.2.3. Planned Comparisons and Predictions

The following comparisons were planned for each experiment:

(15) **Experiment 1**: Temporal Adverbial – Verb – Object

Comparison 1:
Condition 1: PERFECTIVE_MISMATCH
Condition 2: PERFECTIVE_MATCH

Comparison 2:
Condition 3: IMPERFECTIVE_MISMATCH
Condition 4: IMPERFECTIVE_MATCH

(16) **Experiment 2**: Verb – Object – Temporal Adverbial

Comparison 3:
Condition 1: PERFECTIVE_MISMATCH
Condition 2: PERFECTIVE_MATCH

Comparison 4:
Condition 3: IMPERFECTIVE_MISMATCH
Condition 4: IMPERFECTIVE_MATCH

In what follows we present our predictions related to each of the comparisons based on the earlier discussion in Section 3 and 4.

Predictions Related to Comparison 1

A sentence-initial adverbial sets up a frame within which the eventuality should be interpreted. The eventuality to be integrated with a sentence-initial durative adverbial should also feature durative semantics. As discussed in Section 2.2.1., perfective aspect has a very specific (bounded) semantics that makes it semantically incompatible with a durative adverbial. This should lead to a problem with semantic integration of a perfective verb with the preceding durative adverbial. Hence, we expect an N400 signature in this case, which reflects semantic integration difficulties (see Kaan 2007 and references therein). The expected N400 might be followed by a P600 (usually taken to reflect syntactic repair or reprocessing; see, among others, Osterhout and Holcomb 1992; Hagoort, Brown, and Groothusen 1993; Gouvea et al. 2010), since this mismatch cannot be repaired, as discussed in Section 2.3.

If the domain of interpretation of perfective aspect in Polish is the verb, the predicted effects should be manifested directly on the verb. Alternatively, if the domain of interpretation of perfective aspect in Polish is not just the verb but the VP (as the input to AspP), the predicted effects should be manifested on the object.

Predictions Related to Comparison 2

In Comparison 2, the time span adverbial was also used sentence-initially and it was followed by an imperfective verb, which has an unbounded semantics. This may lead to a semantic-integration problem (as expected on the basis of our acceptability-rating study). However, as shown in Section 2.3., due to the underspecified semantics of imperfective aspect, the mismatch between a time-span adverbial and imperfective aspect is resolvable, unlike in the case of the mismatch in Comparison 1. Therefore, we can expect an N400 component but with a weaker amplitude than in Comparison 1.

If the resolution of the underspecification of imperfective aspect involves a kind of repair mechanism relying on working memory, comparable to that discussed in the literature for German and English, a late sustained negativity (a working memory LAN) is expected or a combination of an early and a late anterior negativity, as argued for by Yano (2018).

Alternatively, if the resolution of the underspecification of imperfective aspect involves a simple adaptation of the meaning of the verb to that imposed by a preceding temporal adverbial, possibly no increase in computational costs is involved. In this case the mismatching condition should not trigger any ERP effects (see Lukassek et al. 2017).

If the domain of interpretation of imperfective aspect is the same as the domain of perfective aspect in Polish, the possible N400 effect should be manifested in exactly the same position (namely either the object or the verb) in a mismatching context as in Comparison 1.

Predictions Related to Comparison 3

The mismatching durative adverbial is processed after the aspectual value on AspP is set (computed). In this case, we may expect an integration problem in terms of a dissonance between the aspectual value of a perfective verb computed at AspP and the value of the incoming adverbial. Given that the nature of this integration problem is more syntactic, the expected component may be a LAN (Gouvea et al. 2010; Yano 2018) or an early P600 (Molinaro, Barber, and Carreiras 2011). According to Molinaro, Barber, and Carreiras (2011: 908), while the LAN reflects violation of expectancy elicited by the trigger (in our case perfective aspect), an early P600 reflects problems with the structural

integration of the trigger (perfective aspect) and target (the mismatching adverbial) at the sentence level. This prediction is compatible with the results of our acceptability-rating questionnaire. Recall that postverbal mismatching conditions received significantly lower acceptability ratings than preverbal mismatching conditions.

Predictions Related to Comparison 4

A similar prediction as in Comparison 3 can be made in Comparison 4. Even though imperfective verbs have underspecified semantics, the parser commits to their preferred interpretation (aspectual value) at the level of AspP. Consequently, the following adverbial mismatching the preferred aspectual value may lead to a LAN component, which is taken to reflect morphosyntactic violations caused by a mismatch with predicted features (Molinaro, Barber, and Carreiras 2011; cf. also Yano 2018).

5.2.4. Procedure

Participants were tested individually in a single session. The whole experiment (including the application of electrodes) lasted for approximately 90 minutes. Following the application of the EEG electrodes, participants were seated one meter in front of a Samsung 22'' LCD screen in an electrically and acoustically shielded EEG chamber. Stimuli were presented in a white courier font, size 48, on a black background using the Presentation software by Neurobehavioral Systems Inc. (software package 16.3 12.20.12).

The experimental session was preceded by oral and written instructions and a practice session. Participants were instructed to avoid blinks or movements during sentence display and answer the questions as fast as possible. After the written instruction, participants received a practice block with 10 sentences, followed by explicit feedback. The practice session was followed by five experimental blocks containing 64 sentences each. After each block there was a break.

Each trial began with a fixation asterisk in the center of the screen for 1500 ms, followed by sentence presentation. Sentences were presented word-by-word, only the prepositional phrases were presented as chunks:

Przez minutę | cichutko | otworzył | zamek | żeby … .

Each segment appeared in the center of the screen for 500 ms, followed by a short 100 ms blank screen. Sentence-final words appeared with a period, and were followed by a 100 ms blank screen. Probes were presented for 500 ms. After that, the words TAK ('yes') and NIE ('no') were presented on the screen

for 3000 ms, as a prompt for the probe detection task. After 3000 ms, the presentation of the next trial began with the presentation of the new asterisk.

The language material was outlined in Section 5.2.2. We used 40 stimulus quartets supplemented by 160 fillers. 10% of all the sentences including experimental and filler sentences were followed by a probe detection task in which the participants' were to decide whether the displayed word (a probe) was used in the sentence just read. In the remaining 90% of the trials, the participants did nothing but reading silently. The probe words were equally distributed across conditions. There was an equal number of probes semantically or phonologically corresponding to different elements in main and embedded clauses. The probes were balanced for the expected YES and NO answers. The mean answer accuracy in the probe detection task was 91.5% (SD = 4.8%) in Experiment 1, and 96.2 (SD = 3.4) in Experiment 2.

In each experiment stimuli were pseudo-randomized in two versions (with descending and ascending order) and distributed over five blocks containing 64 items each. All participants saw all of the 320 sentences in each experiment.[10] The first randomization variation was presented to 14 participants, and 14 saw the second. Additionally, each version was further subdivided into two variants differing in the coding for YES and NO buttons to avoid any potential effects of lateralized readiness potential.

In Experiment 1 the ERPs were elicited for the verb and its object, whereas in Experiment 2 the ERPs were elicited for the temporal adverbial and the word following it, which was always the conjunction *żeby* 'in order to').

5.2.5. EEG Recordings and Data Processing

5.2.5.1. Recording

The EEG-activity was measured with 24Ag/AgCl-electrodes that were attached to the scalp using the Easycap system at Fz, FCz, Cz, CPz, Pz, POz, FC1, F3, C3, P3, O1, FC5, CP5, F7, P7, FC2, F4, C4, P4, O2, FC6, CP6, F8, P8. The ground electrode was positioned at AFz. Electrode positions were chosen in accordance with the international 10/20 system (Jasper 1958). Signals were referenced to the A1 electrode (left mastoid) and later re-referenced to the average of left (A1) and right (A2) mastoid. Horizontal eye activity was measured by placing two electrodes 2 cm lateral to the right (EOGR) and the left (EOGL) canthus. Vertical eye activity was measured by placing two electrodes 3 cm

[10] A more ideal way to present stimuli would be using Latin Square, which would avoid the repetition on lexical items. However, there is another important constraint in EEG, namely; a high number of item per condition is needed to get usable data. This would mean constructing a very high number of stimuli. So in EEG studies it is not uncommon that every participant sees the whole stimulus list.

above (EOGU) and below (EOGD) the pupil of the right eye. Electrode impedances were kept below 5 kΩ. All electrophysiological signals were digitized with a frequency of 250 Hz.

5.2.5.2. Data Processing

The data were processed using the Brain Vision Analyzer 2 software (Brain Products, Gilching). The raw data were inspected visually. Time windows, including strong, visible artefacts (like pauses or periods of strong movement), were manually removed before proceeding. An ICA blink correction was performed for the remaining data, using the Slope Algorithm for blink detection. After the blink correction, remaining artefacts were removed based on a semi-automatic Raw Data Inspection (maximal allowed voltage step: 50 μV/ms; maximal allowed difference: 200 μV/200 ms; lowest allowed activity: 0.5 μV/100 ms). The remaining data were segmented into time windows time-locked to the onset of the critical verb and its complement in Experiment 1 and to the critical adverbial and a word following it in Experiment 2.

Time windows began at –100 ms before the onset of the critical word, and ended at 1100 ms after the onset of the critical word. A baseline correction was performed for the 100 ms before the onset of the critical word. Averages were calculated per participant for all four conditions in Experiment 1 and 2 respectively.

The data from one participant in Experiment 1 were not taken into consideration due to a large number of artefacts. In Experiment 2 the data from two participants were not analysed statistically due to a large number of artefacts. The mean rejection rate over participants was 3.4% of the segments (SD = 5.2%) in Experiment 1 and 3.6% (SD = 8.9%) in Experiment 2.

In Experiment 1 mean rejection rates of segments per condition were: Condition 1 (verb/object): 1.5%/1.6% (SD = 2.3/2.3), Condition 2 (verb/object): 1.4%/1.4% (SD = 2.4/2.7), Condition 3 (verb/object): 1.3%/1.1% (SD = 2.0/1.5), Condition 4 (verb/object): 1.2%/0.8% (SD = 2.1/1.9). In Experiment 2 mean rejection rates of segments per condition were: Condition 1 (temporal adverbial/the word following the temporal adverbial): 1.4%/1.0% (SD = 2.6/2.5), Condition 2 (temporal adverbial/the word following the temporal adverbial): 1.4%/1.4% (SD = 1.2/1.4), Condition 3 (temporal adverbial/the word following the temporal adverbial): 1.4%/1.1% (SD = 3.8/3.0), Condition 4 (temporal adverbial/the word following the temporal adverbial): 2.0%/1.9% (SD = 5.3/5.1).

For visual presentation, grand averages were filtered with a 10 Hz low-pass filter.

5.2.6. Results and Discussion

5.2.6.1. Data Analysis

The time windows for the analysis were selected with reference to the literature on the processing of aspectual mismatches (Zhang and Zhang 2008; Bott 2010; Paczynski, Jackendoff, and Kuperberg 2014) and on visual inspection. We defined the following regions of interest (ROIs): left-posterior (C3, CP5, P3, P7, O1), right-posterior (C4, CP6, O2, P4, P8), right-anterior (F4, F8, FC2, FC6), left-anterior (F3, F7, FC1, FC5), and midline (Fz, FCz, Cz, CPz, Pz, POz). These regions of interest were chosen based on visual data inspection and previous studies (see Section 4.2.).

For the statistical analysis of the ERP data, we used mean amplitude values per time window per condition (Condition 1: PERFECTIVE_MISMATCH, Condition 2: PERFECTIVE_MATCH, Condition 3: IMPERFECTIVE_MISMATCH), Condition 4: IMPERFECTIVE_MATCH) in five regions of interest (ROIs). Separate analyses were conducted for each critical word: the verb and its object in Experiment 1, the temporal adverbial and the word following it in Experiment 2. Data were prepared and analyzed in R (R Development Core Team 2016), using the package ezANOVA (Lawrence 2016). Mean voltages for the single ROIs were calculated from the participants' condition mean of all electrodes in a ROI.

We calculated a repeated measures ANOVA of the mean voltages per condition for the chosen time windows in all five ROIs. Analyses were performed in a hierarchical fashion, that is, only statistically significant interactions were resolved. Interactions between CONDITION and ROI were pursued following the planned comparisons outlined above. Comparisons between conditions inside the single ROIs were performed using a repeated measures ANOVA of the mean voltages per condition. Greenhouse-Geisser corrections (Greenhouse and Geisser 1959) were applied when the degrees of freedom in the numerator were greater than 1, for which original degrees of freedom and corrected probability levels are reported. The statistical analysis was conducted for all the tested time windows and for all the planned comparisons and on the relevant positions for a given comparison. In what follows text only statistically significant effects are reported, unless stated otherwise.

5.2.6.2. Results

Experiment 1

No effects were found at the verb position in any of the comparisons. Effects were visible only at the object position and only in one comparison, namely

that between Condition 1: PERFECTIVE_MISMATCH and Condition 2: PERFECTIVE_MATCH, as reported below. Voltage difference maps and examples of curves are given in Figure 1 on the following page.

Negativity, time window 400–500 ms from the onset of the object

Comparison 1 (Condition 1: PERFECTIVE_MISMATCH vs. Condition 2: PERFECTIVE_MATCH): There was a statistically significant main effect of ROI ($F(4, 104) = 9.03$, $\varepsilon = .04$, $p < .001$), a statistically significant main effect of condition ($F(1, 26) = 13.42$, $\varepsilon = .03$, $p < .001$) and a statistically significant interaction of CONDITION and ROI ($F(4,104) = 3.43$, $\varepsilon = 0.01$, $p = .02$). The difference between conditions was statistically significant at left-posterior positions ($F(1, 26) = 5.94$, $\varepsilon = 0.03$, $p = .02$), right-anterior positions ($F(1, 26) = 5.74$, $\varepsilon = 0.02$, $p = .02$), left-anterior positions ($F(1, 26) = 6.96$, $\varepsilon = 0.04$, $p = .01$), and midline positions ($F(1, 26) = 23.71$, $\varepsilon = 0.07$, $p < .001$). Waveforms for PERFECTIVE_MISMATCH were more negative-going than waveforms for PERFECTIVE_MATCH at left-posterior, right-anterior, left-anterior, and midline positions. The difference between the conditions was the strongest at the midline and left-anterior positions.

Experiment 2

Effects were visible only at the temporal adverbial but not at the word following it (i.e., the conjunction *żeby*) in two comparisons, that between Condition 1: PERFECTIVE_MISMATCH and Condition 2: PERFECTIVE_MATCH and between Condition 3: IMPERFECTIVE_MISMATCH and Condition 4: IMPERFECTIVE_MATCH, as reported below. Voltage difference maps and examples of curves are given in Figure 2 on page 56 and Figure 3 on page 57.

Early positivity, time window 200–400 ms from the onset of the temporal adverbial

Comparison 3 (Condition 1: PERFECTIVE_MISMATCH vs. Condition 2: PERFECTIVE_MATCH): There was a statistically significant main effect of ROI ($F(4, 100) = 8.94$, $\varepsilon = .08$, $p < .001$), a statistically significant main effect of condition ($F(1, 25) = 16.63$, $\varepsilon = .06$, $p < .001$), and a statistically significant interaction of CONDITION and ROI ($F(4,100) = 6.49$, $\varepsilon = 0.03$, $p < .01$). The difference between conditions was statistically significant at left-posterior positions ($F(1, 25) = 16.27$, $\varepsilon = 0.11$, $p < .001$), right-anterior positions ($F(1, 25) = 4.41$, $\varepsilon = 0.04$, $p < .05$), and left-anterior positions ($F(1, 25) = 19.97$, $\varepsilon = 0.18$, $p < .001$). Waveforms for PERFECTIVE_MISMATCH were more positive-going than waveforms for

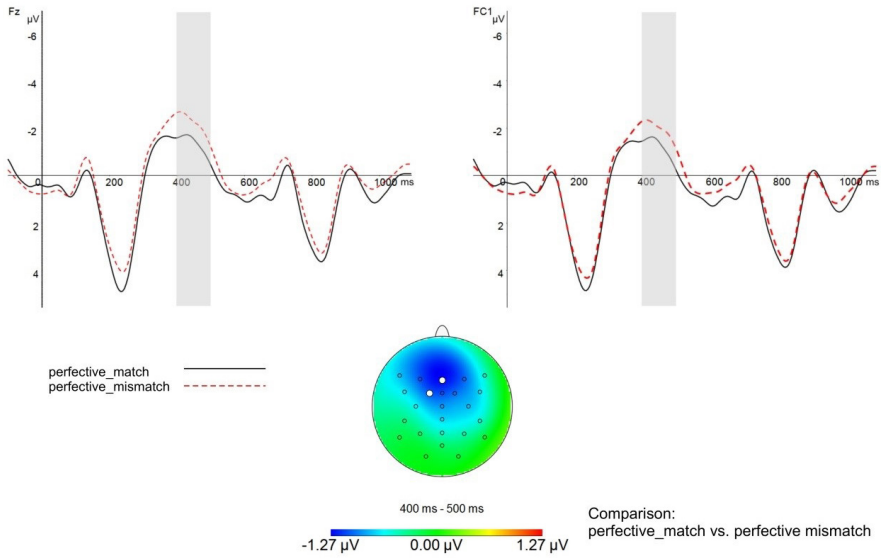

Figure 1. Comparison 1 PERFECTIVE_MATCH and PERFECTIVE_MISMATCH. In the upper part: Grand-average ERP pattern for the observed N400 effect on two selected electrode sites: Fz and FC1. In the lower part: Mean voltage difference maps (PERFECTIVE_MISMATCH minus PERFECTIVE_MATCH) for the time window from 400–500 ms.

PERFECTIVE_MATCH at left-posterior, right-anterior, and left-anterior positions. The difference between the conditions was the strongest at the left-anterior and left-posterior positions.

Negativity (LAN), time window 200–400 ms from the onset of the temporal adverbial

Comparison 4 (Condition 3: IMPERFECTIVE_MISMATCH vs. Condition 4: IMPERFECTIVE_MATCH): There was a statistically significant main effect of ROI ($F(4, 100) = 6.99$, $\varepsilon = .08$, $p < .01$) and a statistically significant interaction of CONDITION and ROI ($F(4,100) = 9.36$, $\varepsilon = 0.02$, $p < .001$). The difference between conditions was statistically significant only at left-anterior positions ($F(1, 25) = 11.19$, $\varepsilon = 0.09$, $p < .01$). Waveforms for IMPERFECTIVE_MISMATCH were more negative-going than waveforms for IMPERFECTIVE_MATCH only at left-anterior positions.

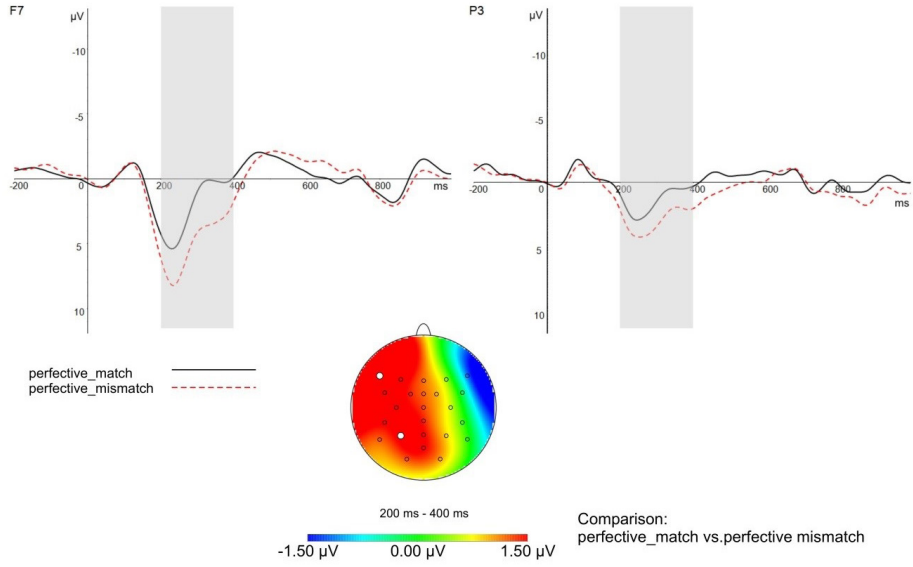

Figure 2: Comparison 3 PERFECTIVE_MATCH and PERFECTIVE_MISMATCH. In the upper part: Grand-average ERP pattern for the observed early positivity effect on two selected electrode sites: F7 and P3. In the lower part: Mean voltage difference maps (PERFECTIVE_MISMATCH minus PERFECTIVE_MATCH) for the time window from 200–400 ms.

5.2.7. Discussion

In the following, we will discuss the different findings separately and relate them to the predictions made in Section 5.2.3.

Discussion Related to Comparison 1

In Comparison 1 between Condition 1: PERFECTIVE_MISMATCH and Condition 2: PERFECTIVE_MATCH we found a negativity with a frontal, central, and posterior distribution in the time window from 400–500 ms from the onset of the object. No effects were observed at the verb position. We interpret it as an N400 component with a wider distribution (recall that a classical N400

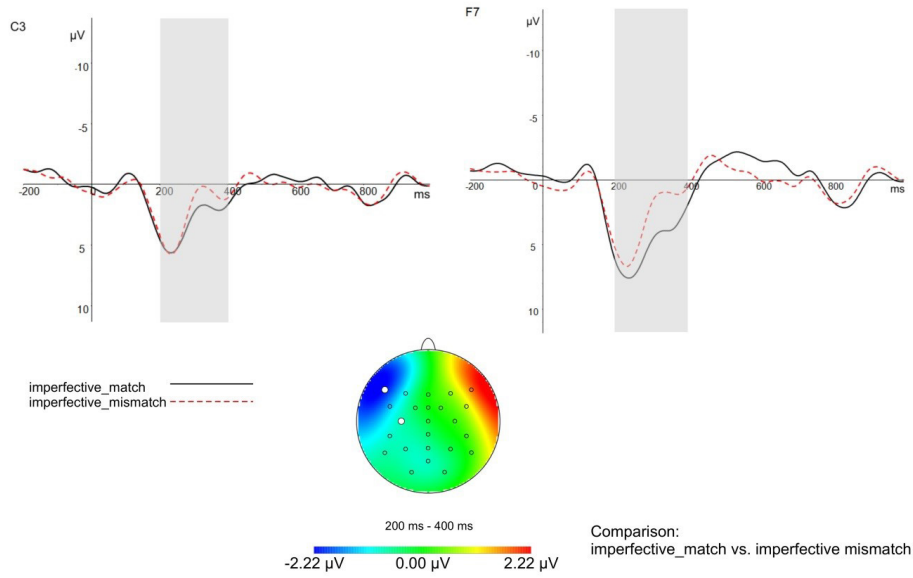

Figure 3: Comparison 4 IMPERFECTIVE_MATCH and IMPERFECTIVE_MISMATCH. In the upper part: Grand-average ERP pattern for the observed LAN effect on two selected electrode sites: C3 and F7. In the lower part: Mean voltage difference maps (IMPERFECTIVE_MISMATCH minus IMPERFECTIVE_MATCH) for the time window from 200–400 ms.

has a centro-posterior distribution).[11] This result is compatible with our prediction that the mismatch between the preverbal durative adverbial and perfective verb should lead to an integration problem at the (discourse) semantic level. Our N400 component was not followed by a P600 component.

Our data were similar to the those tested in Flecken, Walbert, and Dijkstra (2015), who studied a mismatch between present continuous and present simple verbs in English and the preceding temporal adverbs *right now* and *every Tuesday*. They found a short-lived early negativity in the time window (250–350ms), which was not followed by P600. Flecken, Walbert, and Dijkstra

[11] It should be remarked that in the literature a frontal negativity (FN400) has been reported. However, the FN400 is treated as functionally different from a classical (centro-posterior) negativity (N400) (Bridger et al. 2012; Stróżak, Abedzadeh, and Curran 2016, but see Voss and Federmeier 2011 for a different view). It is usually associated with some effect of "familiarity" (e.g., Bridger et al. 2012) or conceptual implicit memory (Voss and Paller 2009). Thus the FN400 is not taken as a pure language component. We would like to thank a reviewer for pointing this out.

(2015) take the early negativity to reflect the violation of a form-level expectation. However, there is an important issue that prevents us from adopting this interpretation. Namely, if our observed negativity was a reflection of a form-level expectation created by a biasing context, it should be present in both mismatching contexts with perfective and imperfective verbs, contrary to fact (see below).

In light of the fact that the observed effect was visible only on the object but not on the verb, it can be concluded that the domain of aspectual interpretation for perfective aspect in Polish is not the verb but the whole VP.

Discussion Related to Comparison 2

In Comparison 2 between Condition 3: IMPERFECTIVE_MISMATCH and Condition 4: IMPERFECTIVE_MATCH no effects were found on the verb, the object, or the following word. The lack of ERP effects is in fact compatible with the prediction that due to the semantic underspecification of an imperfective verb its meaning can be naturally adjusted to the temporal meaning of the preceding temporal adverbial. This operation does not seem to be associated with additional processing costs, which is in line with Lukassek et al. 2017.

The lack of an effect precludes a conclusion as to the domain of aspectual interpretation of imperfective aspect.

Discussion Related to Comparison 3

In Comparison 3 between Condition 1: PERFECTIVE_MISMATCH and Condition 2: PERFECTIVE_MATCH) we found a positivity in the time window from 200–400 ms from the onset of the temporal adverbial. Given the strongest left-anterior distribution of the elicited positivity, we interpret it as an early P600 with a more frontal distribution (see Friederici, Hahne, and Saddy 2002, Kutas, Van Petten, and Kluender 2006, Molinaro, Barber, and Carreiras 2011). This finding is compatible with our initial prediction that the nature of the mismatch in question is more related to a problem of structural integration than to one of semantic integration. As predicted, the ERP effect was elicited on the mismatching temporal adverbial; however, it was not a LAN but an early P600. Following Molinaro, Barber, and Carreiras 2011, we take it to reflect difficulties with the structural integration of the trigger (here: perfective aspect) and target (here: the mismatching adverbial) at the sentence level. However, it should be noted that our early P600 was visible in an earlier time window than in other studies, which also elicited this component. This might be due to the fact that a different language and different constructions were tested. Also, the interpretation of this component is a matter of dispute (see Kutas, Van Petten, and Kluender 2006 for a detailed discussion). Further

studies are needed before a stronger conclusion about the exact nature of this component can be drawn.

Discussion Related to Comparison 4

In Comparison 4 between Condition 3: IMPERFECTIVE_MISMATCH and Condition 4: IMPERFECTIVE_MATCH) we found a negativity in the time window between 200–400 ms from the onset of the temporal adverbial. Given the exclusive left-anterior distribution of this negativity, we interpret this component as a LAN. Following Molinaro, Barber, and Carreiras 2011 and Yano 2018, we take it to be an index of a violation based on detection of a mismatch with predicted features. As in Comparison 3, the elicited component reflects a more structural than (discourse) semantic integration problem.

6. General Discussion: Concluding Remarks

The goal of this paper has been to contribute to the debate on the processing of grammatical aspect (perfective and imperfective) in contexts with mismatching temporal modifiers (*w godzinę* 'in an hour' and *przez godzinę* 'for an hour'). Regarding the issue of incrementality of aspectual interpretation, the results of ERP experiments conducted on Polish suggest that the domain of aspectual interpretation of perfective aspect is a VP and not just a verb. This conclusion was based on the fact that the problems in processing perfective verbs preceded by an incongruent 'for X-time' modifier related not directly to the verb but to the object and manifested themselves in the form of an N400, which we interpret as an indicator of problems in (discourse) semantic integration. This finding is compatible with Stockall, Husband, and Beretta's (2010) view that the incremental commitment to aspectual interpretation is made once the full VP is formed and leads to the generation of a higher functional projection AspP, where aspect is computed.[12] Our results seem to contradict the conclusions of Bott and Gattnar (2015) and of Rothstein (2015), who claim that in languages that have grammatical aspect, the domain of aspectual interpretation is the verb. The difference in our results and those of Bott and Gattnar (2015) may be related to the fact that they tested perfective verbs of achievement predicates and we used perfective verbs of accomplishment predicates. Future research is needed to compare the processing of accomplishment and

[12] A reviewer is right in pointing out that this result is counterintuitive since in Slavic languages for perfective, as opposed to imperfective, the object does not alter the temporal phasal structure of the event. However, what the result suggests is that, in purely hierarchical terms, even if the object does not alter the interpretation of perfective verbs, the parser waits for the object to form a full VP and project AspP above it because the aspectual value is computed at the level of AspP.

achievement predicates. This would probably require a different method, since in ERP studies we would need to collect at least 40 different transitive verbs of achievement, which may be challenging (if not impossible), as there is a restricted number of transitive verbs belonging to this lexical aspectual class.

In the case of imperfective aspect, no analogous ERP signature was detected on the object when the verb was preceded by a mismatching adverbial. This may suggest that with imperfective aspect, which is semantically underspecified, its interpretation can be adapted to match the semantics of the preceding temporal adverbial. The adaptation does not seem to be a costly operation as it did not elicit any ERP effect. It should be noticed, however, that the question of how easily an imperfective verb can adapt its interpretation seems to be determined by the position of a mismatching adverbial. If it follows the verb, the results suggest that the parser computes the aspectual value at AspP and commits to an interpretation. For the examples investigated the preferred interpretation is the single ongoing event reading because singular objects are used, in the absence of any other cue. This preferred aspectual value is incompatible with the following temporal adverbial, giving rise to the structural integration of the trigger (imperfective aspect) and target (the mismatching adverbial) at the sentence level.

One may wonder why the mismatch between a preceding time-span adverbial and an imperfective verb did not trigger any ERP effect, but the mismatch was rated as significantly less acceptable than the corresponding matching condition in the acceptability rating study. These seemingly contradictory results in fact do have a plausible explanation. As correctly pointed out by Yano (2018: 731), ERPs measure how costly a word or a construction is for the parser to process and not how acceptable a resulting sentence (i.e., the final representation of an entire sentence) is.

Concerning the interpretation of the ERP effects, the findings from the ERP study on Polish show that unlike in studies on languages relying predominantly on lexical aspect in the aspectual interpretation, no late sustained negativity (a working memory LAN) was found. If, as claimed by Bott (2010), Paczynski, Jackendoff, and Kuperberg (2014), and Yano (2018), a late anterior negativity reflects a tacit aspectual reinterpretation mechanism. The fact that neither perfective nor imperfective aspect elicited this component in our study suggests that a different mechanism is involved in detecting and resolving aspectual mismatches in Polish. Importantly, we observed that perfective and imperfective aspect behave differently in mismatching contexts with preverbal adverbials. Unlike imperfective aspect, perfective aspect is semantically very specific and leaves no room for contextually determined adaptation/readjustment. Independently of whether the mismatching durative 'for X-time' adverbial preceded or followed the perfective verb and its object, the parser noted this violation. This violation triggered an N400 on the object of

the perfective verb when it was preceded by a mismatching adverbial. When the perfective VP was followed by a mismatching adverbial, it gave rise to an early P600. Interestingly, while a mismatching temporal adverbial following the imperfective verb gave rise to a similar difficulty at the structural level, reflected as a LAN, no effect was observed in the imperfective condition with a preceding mismatching time-span adverbial, since in this case a tacit meaning adaptation was possible.

Taken together, our findings lend credibility to the view that the domain of aspectual interpretation in Polish is VP. Moreover, there are important asymmetries in the way perfective and imperfective verbs are processed, which can be attributed to the different degree of their semantic specificity. More specifically, only in the case of semantically underspecified imperfective verbs is the mismatch resolvable, but only when a mismatching adverbial is used preverbally. In this case, the results of our study show that the meaning of imperfective verbs can be adjusted to the meaning of the mismatching adverbial and this operation does not seem to be costly for the parser. Finally, our study shows that whereas mismatches with preverbal adverbials lead to discourse semantic integration problems (as reflected in the N400 elicited on the object in the perfective condition), mismatches with postverbal adverbials cause more structure-related integration problems (as reflected in an early P600 and a LAN component for perfective and imperfective conditions respectively).

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References

Altshuler, Daniel G. (2012) "Aspectual meaning meets discourse coherence: A look at the Russian imperfective". *Journal of semantics* 29(1): 39–108.

Arregui, Ana, María Luisa Rivero, and Andrés Salanova. (2014) "Cross-linguistic variation in imperfectivity". *Natural language and linguistic theory* 32(3): 307–62.

Binnick, Robert I. (1991) *Time and the verb: A guide to tense and aspect*. New York/Oxford: Oxford University Press.

Błaszczak, Joanna and Dorota Klimek-Jankowska. (2013) "Futures, futurates, plans, and forces". Uwe Junghanns, Dorothee Fehrmann, Denisa Lenertová, and Hagen Pitsch, eds. *Proceedings of Formal Description of Slavic Lan-*

guages 9, Göttingen 2011. Frankfurt am Main: Peter Lang, 9–35. [*Linguistik international*, 28.]

Bogusławski, Andrzej. (1963) "Czasowniki dokonane niedokonane i ich stosunki wzajemne". Witold Doroszewski, ed. *Z polskich studiów slawistycznych*. Warsaw: Polska Akademia Nauk, 153–59.

Bonomi, Andrea. (1995) "Aspect and quantification". Pier Marco Bertinetto, Valentina Bianchi, James Higginbotham, and Mario Squartini, eds. *Temporal reference, aspect and actionality*. vol. 1. Torino: Rosenberg and Sellier, 93–110.

Borik, Olga. (2002) *Aspect and reference time*. Ph.D. dissertation, Utrecht University. [Published 2006 by Oxford University Press.]

Bott, Oliver. (2010) *The processing of events*. Amsterdam: John Benjamins Publishing.

————. (2016) "Can semantic theories be tested experimentally? The case of aspectual coercion". Joanna Błaszczak, Anastasia Giannakidou, Dorota Klimek-Jankowska, and Krzysztof Migdalski, eds. *Mood, aspect, modality revisited: New answers to old questions*. Chicago, IL: The University of Chicago Press, 346–80.

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. Available online: https://doi.org/10.1080/23273798.2015.1029499.

Bott, Oliver and Fritz Hamm. (2014) "Cross-linguistic variation in the processing of aspect". Barbara Hemforth, Barbara Mertins, and Cathrine Fabricius-Hansen, eds. *Psycholinguistic approaches to meaning and understanding across languages*. Cham: Springer, 83–109. [*Studies in theoretical psycholinguistics*, 44.]

Brennan, Jonathan and Liina Pylkkänen. (2010) "Processing psych verbs: Behavioural and MEG measures of two different types of semantic complexity". *Language and cognitive processes* 25(6): 777–807.

Bridger Emma K., Regine Bader, Olga Kriukova, Kerstin Unger, and Axel Mecklinger. (2012) "The FN400 is functionally distinct from the N400". *NeuroImage* 63: 1334–42. Available online: http://dx.doi.org/10.1016/j.neuroimage.2012.07.047.

Cipria, Alicia and Craige Roberts. (2000) "Spanish imperfecto and preterito: Truth conditions and aktionsart effects in a situation semantics". *Natural language semantics* 8(4): 297–347.

Comrie, Bernard. (1976) *Aspect: An introduction to the study of verbal aspect and related problems*. Cambridge: Cambridge University Press. [Reprinted 1995.]

Croft, William. (2003) *Typology and universals*. Second edition. Cambridge: Cambridge University Press.

Coulson Seana, Jonathan W. King, and Marta Kutas. (1998) "Expect the unexpected: Event related brain response to morphosyntactic violations". *Language and cognitive processes* 13: 21–58.

Dahl, Östen. (1985) *Tense and aspect systems*. Oxford: Blackwell.

de Swart, Henriëtte. (1998) "Aspect shift and coercion". *Natural language and linguistic theory* 16(2): 347–85.

Dillon Brian, Andrew Nevins, Alison C. Austin, and Colin Phillips. (2012) "Syntactic and semantic predictors of tense in Hindi: An ERP investigation". *Language and cognitive processes* 27(3): 313–44.

Ferreira, Marcelo B. (2005) *Event quantification and plurality*, Ph.D. dissertation, Massachusetts Institute of Technology.

Filip, Hana. (1993/1999) *Aspect, situation types, and noun phrase semantics*. Ph.D. dissertation, University of California at Berkeley. [Published 1999 as *Aspect, eventuality types and noun phrase semantics*. New York/London: Garland Publishing.]

————. (2017) "The semantics of perfectivity". *Italian journal of linguistics* 29(1): 167–200.

Filip, Hana and Susan Rothstein. (2006) "Telicity as a semantic parameter". James Lavine, Steven Franks, Mila Tasseva-Kurktchieva, and Hana Filip, eds. *Formal approaches to Slavic linguistics: The Princeton meeting 2005*. Ann Arbor, MI: Michigan Slavic Publications, 139–56.

Flecken, Monique, Kelly Walbert, and Ton Dijkstra. (2015) "'Right now, Sophie swims in the pool?!': Brain potentials of grammatical aspect processing". *Frontiers in psychology* 6: 1764. Available online: http://doi.org/10.3389/fpsyg.2015.01764.

Frazier, Lyn. (1999) *On sentence interpretation*. Dordrecht: Kluwer.

Friederici, Angela D. (2002) "Towards a neural basis of auditory language processing". *Trends in cognitive science* 6: 78–84. Available online: http://doi.org/10.1016/S1364-6613(00)01839-8.

Friederici, Angela D., Anja Hahne, and Douglas Saddy. (2002) "Distinct neurophysiological patterns reflecting aspects of syntactic complexity and syntactic repair". *Journal of psycholinguistic research* 31(1): 45–63.

Frisson, Steven. (2009) "Semantic underspecification in language processing". *Language and linguistic compass 3(1):* 111–27.

Gouvea Ana C., Colin Phillips, Nina Kazanina, and David Poeppel. (2010) "The linguistic processes underlying the Nina P600". *Language and cognitive processes* 25(2): 149–88.

Greenhouse, Samuel. W. and Seymour Geisser. (1959) "On methods in the analysis of profile data". *Psychometrika* 24: 95–112.

Grønn, Atle. (2003) *The semantics and pragmatics of the Russian factual imperfective*. Ph.D. dissertation, University of Oslo.

Hacquard, Valentine. (2006) *Aspects of modality*. Ph.D. dissertation, Massachusetts Institute of Technology.

Hagoort, Peter, Colin Brown, and Jolanda Groothusen. (1993) "The syntactic positive shift (SPS) as an ERP measure of syntactic processing". *Language and cognitive processes* 8: 439–83.

Husband, Matthew and Linnaea Stockall. (2015) "Building aspectual interpretation online". Roberto G. de Almeida and Christina Manouilidou, eds.

Cognitive science perspectives on verb representation and processing. Cham: Springer, 157–86.

Jasper, Herbert. H. (1958) "The ten-twenty electrode system of the International Federation". *Electroencephalography and clinical neurophysiology* 10: 371–75.

Kaan, Edith. (2007) "Event-related potentials and language processing: A brief overview". *Language and linguistics compass* 1(6): 571–91.

Kamp, Hans and Uwe Reyle. (1993) *From discourse to logic*. Dordrecht: Kluwer.

Kazanina, Nina and Colin Phillips. (2003) "Russian children's knowledge of aspectual distinctions". Barbara Beachley, Amanda Brown, and Frances Conlin, eds. *BUCLD 27 Proceedings*. Somerville, MA: Cascadilla Press, 390–401.

Klein, Wolfang. (1994) *Time in language*. London and New York, NY: Routledge.

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. Available online: http://doi.org/10.1556/2062.2018.65.2–3.4.

Klimek-Jankowska, Dorota and Joanna Błaszczak (to appear). "Implications of the number semantics of NP objects on the interpretation of imperfective verbs in Polish". Mojmír Dočekal and Marcin Wągiel, eds. *Formal approaches to number in Slavic and beyond*. Berlin: Language Science Press [*Open Slavic linguistics*, anticipated 2020/2021.]

Kluender, Robert and Marta Kutas. (1993a) "Subjacency as a processing phenomenon". *Language and cognitive processes* 8: 573–633.

————. (1993b) "Bridging the gap: Evidence from ERPs on the processing of unbounded dependencies". *Journal of cognitive neuroscience* 5: 196–214.

Kratzer, Angelika. (1998) "More structural analogies between pronouns and tenses". Devon Strolovitch and Aaron Lawson, eds. *Semantics and linguistic theory 8*. Ithaca, NY: CLC Publications, 92–110.

Krifka, Manfred. (1992) "Thematic relations as links between nominal reference and temporal constitution". Ivan A. Sag and Anna Szabolcsi, eds. *Lexical matters*. Stanford, CA: CSLI, 29–53.

Kutas, Marta, Cyma K. Van Petten, and Robert Kluender. (2006) "Psycholinguistics electrified 2: 1994–2005". Matthew J. Traxler and Morton A. Gernsbacher, eds. *Handbook of psycholinguistics*. 2nd edition. New York, NY: Elsevier, 659–724.

Laskowski, Roman. (1984) "Kategorie morfologiczne języka polskiego—charakterystyka funkcjonalna". Renata Grzegorczykowa, Roman Laskowski, and Henryk Wróbel, eds. *Gramatyka współczesnego języka polskiego—Morfologia*. Warsaw: Wydawnictwo PWN, 121–69.

Lawrence, Michael A. (2016) ez: Easy analysis and visualization of factorial experiments. R package version 4.4-0. Available online: https://CRAN.R-project.org/package=ez.

Lenci, Alessandro and Pier Marco Bertinetto. (2000) "Aspect, adverbs, and events: Habituality vs. perfectivity". James Higginbotham, Fabio Pianesi, and Achille C. Varzi, eds. *Speaking of events*. Oxford/New York, NY: Oxford University Press, 245–87.

Lukassek, Julia, Anna Prysłopska, Robin Hörnig, and Claudia Maienborn. (2017) "The semantic processing of motion verbs: Coercion or underspecification?". *Journal of psycholinguistic research* 46(4): 805–25.

Marlsen-Wilson, William and Lorraine Tyler. (1980) "The temporal structure of spoken language understanding". *Cognition* 8(1): 1–71.

Molinaro, Nicola, Horacio A. Barber, and Manuel Carreiras. (2011) "Grammatical agreement processing in reading: ERP findings and future directions". *Cortex*, 47(8): 908–30. Available online: http://dx.doi.org/10.1016/ j.cortex.2011.02.019.

Nagórko, Alicja. (1998) *Zarys gramatyki polskiej (ze słowotwórstwem)*. Warsaw: Wydawnictwo PWN.

Oldfield, R. Carolus. (1971) "The assessment and analysis of handedness: The Edinburgh inventory". *Neuropsychologia* 9: 97–113.

Osterhout, Lee and Phillip J. Holcomb. (1992) "Event-related brain potentials elicited by syntactic anomaly". *Journal of memory and language* 31: 785–806.

Paczynski, Martin, Ray Jackendoff, and Gina Kuperberg. (2014) "When events change their nature: The neurocognitive mechanisms underlying aspectual coercion". *Journal of cognitive neuroscience* 26(9): 1905–17. Available online: http://doi.org/10.1162/jocn_a_00638.

Padučeva, Elena V. (1996) *Semantičeskie Issledovanija: Semantika vremeni i vida v russkom jazyke. Semantika narrativa*. Moscow: Jazyki russkoj kul'tury.

Paslawska, Alla and Arnim von Stechow. (2003) "Perfect readings in Russian". Artemis Alexiadou, Monika Rathert, and Armin von Stechow, eds. *Perfect explorations*. Berlin: Mouton de Gruyter, 307–62.

Pickering, Martin J., Brian McElree, Steven Frisson, Lillian Chen, and Matthew J. Traxler. (2006) "Underspecification and aspectual coercion". *Discourse processes* 42(2): 131–55.

Pickering, Martin J. and Steven Frisson. (2001) "Processing ambiguous verbs: Evidence from eye movements". *Journal of experimental psychology: Learning, memory, and cognition* 27(2): 556–73.

Piñango, Maria Mercedes, Aaron Winnick, Rashad Ullah, and Edgar Zurif. (2006) "Time-course of semantic composition: The case of aspectual coercion". *Journal of psycholinguistic research* 35(3): 233–44.

Piñango, Maria Mercedes, Edgar Zurif, and Ray Jackendoff. (1999) "Real-time processing implications of enriched composition at the syntax-semantics interface". *Journal of psycholinguistic research* 28: 395–414.

R Development Core Team. (2016) *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.

R Development Core Team. (2020) *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.

Reichenbach, Hans. (1947) *Elements of symbolic logic*. New York, NY: Macmillan.

Rösler, Frank, Thomas Pechmann, Judith Streb, Brigitte Röder, and Erwin Hennighausen. (1998) "Parsing of sentences with varying word order: Word-by-word variations of processing demands are revealed by event-related brain potentials". *Journal of memory and language* 38: 150–76.

Rothstein, Susan. (2015) "Some contrasts between aspectual operators in English and Slavic". Paper presented at Grammaticalization and language change, Formal Description of Slavic Languages 11, Potsdam, December 2–4, 2015.

Śmiech, Witold. (1971) *Funkcje aspektów czasownikowych we współczesnym języku ogólnopolskim*. Wrocław: Zakład Narodowy im. Ossolińskich.

Smith, Carlota S. (1997) *The parameter of aspect*. Dordrecht: Kluwer.

Stockall, Linnaea, E. Matthew Husband, and Alan Beretta. (2010) "The online composition of events". *Queen Mary's OPAL #19 Occasional Papers Advancing Linguistics*: 1–32.

Stróżak, Paweł, Delora Abedzadeh, and Tim Curran. (2016) "Separating the FN400 and N400 potentials across recognition memory experiments". *Brain research* 1635: 41–60. Available online: http://dx.doi.org/10.1016/j.brainres.2016.01.015.

Szwedek, Aleksander. (1998) "English resultant, affected and eventive objects in Polish grammar". *Studia Anglica Posnaniensia* 33: 411–19.

Todorova, Marina, Kathy Straub, William Badecker, and Robert Frank. (2000) "Aspectual coercion and the online computation of sentential aspect". Lila R. Gleitman and Aravind K. Joshi, eds. *Proceedings of the 22nd Annual Conference of the Cognitive Science Society*. Mahwah, NJ: Lawrence Erlbaum Associations, 3–8.

Venables, William and Brian Ripley. (2002) *Modern applied statistics with S*. 4th edition. New York: Springer.

Voss, Joel L. and Kara D. Federmeier. (2011) "FN400 potentials are functionally identical to N400 potentials and reflect semantic processing during recognition testing". *Psychophysiology* 48(4): 532–46. Available online: http://doi.org/10.1111/j.1469-8986.2010.01085.x.

Voss Joel L. and Ken A. Paller. (2009) "An electrophysiological signature of unconscious recognition memory". *Nature neuroscience* 12(3): 349–55. Available online: http://doi.org/10.1038/nn.2260.

Wierzbicka, Anna. (1967) "On the semantics of verbal aspect in Polish". *To honor Roman Jakobson: Essays on the occasion of his seventieth birthday*, vol. 3. The Hague: Mouton, 2231–49.

Willim, Ewa. (2006) *Event, individuation, and countability. A study with special reference to English and Polish*. Kraków: Jagiellonian University Press.

Wróbel, Henryk. (1999) "Czasownik". Renata Grzegorczykowa, Roman Laskowski, and Henryk Wróbel, eds. *Gramatyka współczesnego języka polskiego*. Volume 2: *Morfologia*. Warsaw: Wydawnictwo Naukowe PWN, 536–84.

Wróbel, Henryk. (2001) *Gramatyka języka polskiego* [The grammar of Polish]. Kraków: Od Nowa.

Yano, Masataka. (2018) "Predictive processing of aspectual information: Evidence from event-related brain potential". *Language, cognition, and neuroscience* 33(6): 718–33. Available online: http://doi.org/10.1080/23273798.2017.1416150.

Zhang, Yaxu and Jingting Zhang. (2008) "Brain responses to agreement violations of Chinese grammatical aspect". *NeuroReport* 19(10): 1039–43.

Zinova Yulia. (2016) *Russian verbal prefixation: A frame semantic analysis*. Ph.D. dissertation, Heinrich-Heine-University.

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Appendix

Below is the list of the imperfective and perfective verbs (in their infinitival forms) and their objects that was used in Experiments 1 and 2.

otwierać/otworzyć zamek	to unlock$_{IPFV/PFV}$ lock
myć/umyć stół	to wash$_{IPFV/PFV}$ table
przeglądać/przejrzeć tekst	to brows$_{IPFV/PFV}$ text
studiować/przestudiować manuskrypt	to examine$_{IPFV/PFV}$ manuscript
analizować wynik/przeanalizować wynik	to analyze$_{IPFV/PFV}$ results
czytać/przeczytać rozdział	to read$_{IPFV/PFV}$ chapter
zmieniać/zmienić wstęp	to change$_{IPFV/PFV}$ introduction
badać/zbadać teren	to explore$_{IPFV/PFV}$ terrain
pić/wypić sok	to drink$_{IPFV/PFV}$ juice
formułować/sformułować wniosek	to formulate$_{IPFV/PFV}$ conclusion
pisać/napisać list	to write$_{IPFV/PFV}$ letter
przyprawiać/przyprawić sos	to season$_{IPFV/PFV}$ sauce
czyścić/wyczyścić samochód	to clean$_{IPFV/PFV}$ car
odkurzać/odkurzyć pokój	to vacuum$_{IPFV/PFV}$ room
przyszywać/przyszyć guzik	to sew (on)$_{IPFV/PFV}$ button
kosić/skosić trawnik	to mow$_{IPFV/PFV}$ lawn
przygotowywać/przygotować obiad	to prepare$_{IPFV/PFV}$ dinner
zamykać/zamknąć garaż	to close$_{IPFV/PFV}$ garage
prasować/wyprasować obrus	to iron$_{IPFV/PFV}$ tablecloth
prać/wyprać ręcznik	to wash$_{IPFV/PFV}$ towel
naprawiać/naprawić rower	to repair$_{IPFV/PFV}$ bike
tynkować/otynkować dom	to plaster$_{IPFV/PFV}$ house
remontować/wyremontować dach	to haul$_{IPFV/PFV}$ roof
parkować/zaparkować wóz	to park$_{IPFV/PFV}$ car

malować/pomalować płot	to paint$_{IPFV/PFV}$ fence
niszczyć/zniszczyć dokument	to destroy$_{IPFV/PFV}$ document
wstrzykiwać/wstrzyknąć lek	to inject$_{IPFV/PFV}$ medicine
podlewać/podlać ogród	to water$_{IPFV/PFV}$ garden
zmazywać/zmazać napis	to erase$_{IPFV/PFV}$ text
wyrywać/wyrwać krzew	to pluck$_{IPFV/PFV}$ bush
zasłaniać/zasłonić kadłub	to cover$_{IPFV/PFV}$ hull
skrapiać/skropić makowiec	to sprinkle$_{IPFV/PFV}$ poppyseed cake
przykrywać/przykryć tapczan	to cover$_{IPFV/PFV}$ bed
przesiewać/przesiać żwir	to sieve (through)$_{IPFV/PFV}$ gravel
brudzić/ubrudzić ganek	to dirty$_{IPFV/PFV}$ porch
piec/upiec sernik	to bake$_{IPFV/PFV}$ cheesecake
wiercić/wywiercić otwór	to drill$_{IPFV/PFV}$ hole
rozprowadzać/rozprowadzić barwnik	to distribute$_{IPFV/PFV}$ colour
rozczesywać/rozczesać warkocz	to uncomb$_{IPFV/PFV}$ braid
zakładać/założyć spodnie	to put (on)$_{IPFV/PFV}$ trousers