Experimental evidence on aspectual coercion:
The case of Polish adverbial participles

Patrycja Jabłońska,
Joanna Błaszczak,
Dorota Klimek-Jankowska,
Krzysztof Migdalski
Goal of the talk

- to contribute to the discussion on aspectual coercion
- by looking at novel contexts with anterior and simultaneous adverbial participles in Polish
Terminological note

- Temporal adverbial participles → converbs

- Two types of converbs:
  - simultaneous converbs
  - anterior converbs

- Simultaneity:
  - EVENT-1 TIME coincides with EVENT-2 TIME
  - [Event-1 While going home], [Event-2 he was smoking].

- Anteriority:
  - EVENT-1 TIME precedes with EVENT-2 TIME
  - [Event-1 After leaving home], [Event-2 he smoked a cigarette].
Terminological note

Temporal adverbial participles $\rightarrow$ conversbs

Two types of conversbs:
- simultaneous conversbs
- anterior conversbs

Simultaneity:
- EVENT-1 TIME coincides with EVENT-2 TIME
  - [Event-1 While going home]

Anteriority:
- EVENT-1 TIME precedes EVENT-2 TIME
  - [Event-1 After leaving home], [Event-2 he smoked a cigarette]
Why converses and why Polish?

- Some background on coercion
  - theoretical
  - psycholinguistic
Theoretical background

- There has been a lot of discussion on the nature of aspectual coercion mostly in English and mostly focussing just on iterative coercion illustrated in (1).
  - (1) John jumped for ten minutes.

- Mismatch between
  - the lexical aspect of the verb → an instantenous (punctual) eventuality and
  - the durative adverbial.
Theoretical background

- There has been a lot of discussion on the nature of aspectual coercion mostly in English and mostly focusing just on iterative coercion illustrated in (1).

(1) John jumped for ten minutes.

Mismatch between the lexical aspect of the verb \( \rightarrow \) an instantaneous (punctual) eventuality and the durative adverbial.

Adjustment:

- A shift from a punctual into an iterative eventuality
  \( \text{Ev} \rightarrow \text{ev, ev, ev, ...} \)
  - As an interactive eventuality
    it is compatible now with a durative adverbial.

\textit{aspectual coercion}

\textit{(iterative coercion)}
Theoretical background

Most researchers (e.g., Pustejovsky 1995, Jackendoff 1997, de Swart 1998 and Rothstein 2004) assume that aspectual coercion is triggered by a mismatch between two expressions that have to be composed.

Dölling (to appear) suggests that these approaches are too restrictive since they preclude sentence-external sources of adjustment observable in (2):

(2) #Fred played the piano for one year.
Theoretical background

Most researchers (e.g., Pustejovsky 1995, Jackendoff 1997, de Swart 1998 and Rothstein 2004) assume that aspectual coercion is triggered by a mismatch between two expressions that have to be composed. Dölling (to appear) suggests that these approaches are too restrictive since they preclude sentence-external sources of adjustment observable in (2):

(2) #Fred played the piano for one year.

- The VP fulfills the selectional restriction of the durative adverbial.
- BUT: The literal reading of the sentence is incompatible with our experiential knowledge.
  → Nobody can play a piano for one year without a pause.

Hence *play the piano* is coerced into a *habitual* interpretation.
Psycholinguistic background

- In one of the most recent analysis of coercion, Bott (2010) provides psycholinguistic data related to three different types of coercion.

- In his ERP study on additive coercion in German, he found a LAN (working memory LAN) component.
Different types of coercion

Apart from the iterative coercion, there are two other types of coercion in which the internal structure of the event nucleus gets modified:

- either the nucleus is updated with additional aspectual information (→ additive coercion)
- or only a subcomponent of the aspectual nucleus goes into the coerced meaning (→ subtractive coercion).
Different types of coercion

- Subtractive coercion takes place when, for instance, an accomplishment gets coerced into an activity:
  - (3) John wrote a letter for hours.

In (3), the accomplishment is stripped off its culmination.

accomplishment = activity + culmination
Additive coercion takes place when some part of an eventuality is added to the nucleus in the coerced meaning as it is the case when an achievement is coerced into an accomplishment.

(4) John found the keys in 10 minutes.

In (4), a preparatory phase is added to the nucleus. preparatory phase + achievement = accomplishment activity (e.g., searching) + culmination (finding the key) $\rightarrow$ accomplishment
Motivation for our study

- With this background in mind, we decided to investigate the psycholinguistic underpinnings of coercion in Polish.
Why Polish?

- Unlike languages studied so far (English, German) in Polish every verb is marked either by perfective or imperfective aspect.

Polish verbs:
- imperfective morphology $\rightarrow V_{\text{IMPF}}$, or
- perfective morphology $\rightarrow V_{\text{PERF}}$

- Verbal forms and meanings thus appear to be fixed.
  - Little or no room for coercion?
Two essential questions

- Do we have aspectual coercion in Polish?
  - If yes, is it costly for the processing?
  - What ERP components does it elicit?

- Given that in Polish, the overt aspect morphology can block aspectual coercion, what happens in the brain when there is a mismatch between an overtly marked aspectual form and some other expression in a sentence selecting for the opposite aspectual value?
Why converbs?

- It turned out that in Polish a perfect setting for investigating these two questions is provided by sentences with simultaneous and anterior converbs.

Examples (English translations):
- **SIM**: ‘Ann was going to the room (while) smoking a cigarette in a hurry.’
- **ANT**: ‘Ann entered the room (after) having smoked a cigarette in a hurry.’
Converbs: Polish examples

**SIM:**

(5) Anna szła do pokoju paląc papierosa w pośpiechu.
   Ann walk.imp to room smoke-sim.prt cigarette in hurry
   ‘Ann was going to the room (while) smoking a cigarette in a hurry.’

**ANT:**

(6) Anna weszła do pokoju zapaliwszy papierosa w pośpiechu.
   Ann perf-walk to room perf-smoke-ant.prt cigarette in hurry
   ‘Ann entered the room (after) having smoked a cigarette in a hurry.’
Simultaneous converbs

- A *simultaneity* morpheme -ĄC obligatorily selects for an imperfective verbal stem:

  - *paląc* ‘smoke.impf-sim.prt’

  vs.

  - *zapaląc* ‘perf-smoke-sim.

  🎉 SIM $\rightarrow$ V_{IMPF}

  ☹ SIM $\rightarrow$ V_{PERF}
Anterior converbs

An **anteriority** morpheme -**WSZY** obligatorily selects for a perfective verbal stem:

- **zapaliwszy** ‘perf-smoke-ant.prt’

vs.

- *paliwszy* ‘smoke.impf-ant.prt’


😊 **ANT** → **V** _PERF_

😊 **ANT** → **V** _IMPF_
Problem 1

- Given that a simultaneity morpheme -ĄC semantically selects for an imperfective verbal stem, which ERP component will be elicited when this morpheme is combined with a perfective verbal stem?

- This scenario would lead to a mismatch between the aspectual value preferred by the simultaneity morpheme and an aspectual value of the verbal stem.
Problem 2

- Given that an anteriority morpheme -WSZY semantically selects for a perfective verbal stem, which ERP component will be elicited when this morpheme is combined with an imperfective verbal stem?

- This scenario would lead to a mismatch between the aspectual value preferred by the anteriority morpheme and an aspectual value of the verbal stem.
Expectation

- Both violations should elicit the same ERP component.
- We expected it to be either
  - a P600 component found in contexts in which there is a need for a morpho-syntactic repair or
  - an N400 found in contexts in which there is a problem with an integration of some linguistic element with the surrounding semantic context.
Moreover, we wanted to see whether there would arise any ERP components in contexts in which there is a mismatch between the semantics of a converb in a converbial clause and the eventuality in the main clause:

- ‘Ann was going to the room (after) having smoked a cigarette in a hurry.’
- ‘Ann entered the room (while) smoking a cigarette in a hurry.’
Problem 3

(7) Anna *szła* do pokoju *zapaliwszy* papierosa w pośpiechu.

   Ann *walk.*imp to room  *perf*-smoke-*sim.prt* cigarette in hurry

   ‘Ann was going to the room (after) having smoked a cigarette in a hurry.’

(8) Anna *weszła* do pokoju *paląc* papierosa w pośpiechu.

   Ann  *perf*-walk to room  *smoke.*imp-*ant.prtl* cigarette in hurry

   ‘Ann entered the room (while) smoking a cigarette in a hurry.’
Problem 3

(7) Anna *szła* do pokoju *zapaliwszy* papierosa w pośpiechu.

Ann *walk.imp* to room *perf-smoke-sim.prt* cigarette in hurry

‘Ann was going to the room (after) having smoked a cigarette in a hurry.’

The anteriority converb in (7) requires that the eventuality in the main clause follows the eventuality it denotes. If that was to be the case, the imperfective eventuality in the main clause would have to be added an inception. This process would be an instance of Bott’s additive coercion in which we add an element of aspectual meaning to the nucleus of an eventuality in a coerced meaning.

(8) Anna *weszła* do pokoju *paląc* papierosa w pośpiechu.

Ann *perf-walk-to room cigarette in hurry*

‘Ann entered the room (while) smoking a cigarette in a hurry.’
Expectation

In his ERP study on additive coercion in German, Bott found a LAN (working memory LAN) component (an achievement is coerced into an accomplishment by adding a preparatory phase).

(4) John found the keys in 10 minutes.

In (4), a preparatory phase is added to the nucleus. preparatory phase + achievement = accomplishment activity (e.g., searching) + culmination (finding the key) → accomplishment
Expectation

- We expected to find a similar effect in contexts of the type exemplified in (7) for Polish.
  - Anna **szła** do pokoju **zapaliwszy** papierosa w pośpiechu.
    - ‘Ann **was going** to the room (after) **having smoked** a cigarette in a hurry.’

In this example we also have a kind of additive coercion, namely an **inceptive** coercion.
An inception is added to the event nucleus
inception + durative/unbounded eventuality → bounded eventuality
Problem 4

Will there be any effects for different configurations of SIM/ANT converbs and perf/impf main verbs?
Experimental material

- With these problems in mind we constructed the following material.
Design of the experiment

- 2 sets of data:
  - Set A
  - Set B

- 3 conditions in each set:
  - Condition 1: Control
  - Condition 2: Morphology
  - Condition 3: Pragmatics
Design of the experiment

**Conditions:**

- **Condition 1 (set A and B): Control**
  - [main clause *imperfective* verb ] + [ SIM convert -ĄC ]
  - [main clause *perfective* verb ] + [ANT convert -WSZY]

- **Condition 2 (set A and B): Morphology**
  - [main clause *imperfective* verb ] + [*perf verb-ĄC ]
  - [main clause *perfective* verb ] + [*impf verb-WSZY]

- **Condition 3 (set A and B): Pragmatics**
  - [main clause *imperfective* verb ] + [ANT convert -WSZY]
  - [main clause *perfective* verb ] + [SIM convert -ĄC ]
Experimental design

- **Condition 1: Control**

  - Set A: \([\text{main clause imperfective verb }] + [\text{SIM converb -ĄC}]\)
  - Set B: \([\text{main clause perfective verb }] + [\text{ANT converb -WSZY}]\)

No violation whatsoever
No processing difficulty
Experimental design

- **Condition 2: Morphology**

  Set A [main clause **imperfective** verb ] + [ * verb-ĄC ]

  Set B [main clause **perfective** verb ] + [ * verb-WSZY ]

- perfective verb
- imperfective verb
- SIM
- ANT

- **SIM** → V_{IMPF}
- **SIM** → V_{PERF}
- **ANT** → V_{PERF}
- **ANT** → V_{IMPF}
Experimental design

- **Condition 3: Pragmatics**

  - Set A [\textit{main clause imperfective verb}] + [\textit{ANT} conv verb -WSZY]
  - Set B [\textit{main clause perfective verb}] + [\textit{SIM} conv verb -ĄC]

No grammatical violation

BUT:

Processing difficulty due to a potential mismatch between the semantics of conversbs and the main clause eventuality
Experimental technique

- Event-related brain potentials → ERPs
The ERP technique is a useful tool for investigating cognitive processes on-line because of its very high temporal (millisecond-by-millisecond) resolution (Kutas & van Petten 1994).
Event-related brain potentials (ERPs)

- ERP effects (so-called components) have been found in response to linguistically distinct experimental manipulations.
Our study on online processing of aspectual coercion
Method

- 43 monolingual Polish students, Ø 23.9 years
- 2 sets:
  - set A $\rightarrow$ imp main verb
  - set B $\rightarrow$ perf main verb
- Each subject saw 150 experimental sentences (50 per condition) + 150 distractors
- randomly presented, distributed over six blocks containing 50 sentences
- Presentation:
  - in the center of the screen, full PPs, otherwise word by word, 550ms per segment
Time lapse for a sample trial:

Set A

<table>
<thead>
<tr>
<th>Fixation cross</th>
<th>Anna 550 ms</th>
<th>szła 550 ms</th>
<th>do pokoju 550 ms</th>
<th>paląc 550 ms 140, 141, 142</th>
<th>papierosa 550 ms 150, 151, 152</th>
<th>w pośpiechu 550 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Accuracy question 4000 ms
70, 80, 90 (140)
71, 81, 91 (141)
72, 82, 92 (142)
99 – Time out

The critical word for us was the converb.
The length of the critical words was controlled for.
**Time lapse for a sample trial:**

**Set B**

<table>
<thead>
<tr>
<th>Action</th>
<th>Time (ms)</th>
<th>Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixation cross</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Anna</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>weszł a</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>do pokoj y</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>zapaliwsz y</td>
<td>550</td>
<td>240, 241, 242</td>
</tr>
<tr>
<td>papierosa</td>
<td>550</td>
<td>250, 251,</td>
</tr>
<tr>
<td>w pośpiechu</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>Accuracy question</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>170, 180, 190 (240)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>171, 181, 191 (241)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>172, 182, 192 (242)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99 – Time out</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The critical word for us was the converb.*

*The length of the critical words was controlled for.*
Method

Task:
- acceptability judgment questions after each sentence
- used to control the level of attention and the degree of processing difficulty
- within a maximal interval of 4000ms by pressing one out of three buttons)

Possible answers:
- ACCEPTABLE
- UNACCEPTABLE
- I DO NOT KNOW

To avoid the effects of lateralized readiness potential half of the participants were performing the task with the right hand, and the other half with the left hand.
In Condition 1 (control condition) in sets A and B
- the expected answer was ACCEPTABLE.

In Condition 2 (morphological violation condition)
- the expected answer was UNACCEPTABLE.

In the case of Condition 3 (pragmatic condition)
- the judgments were more delicate
- no a priori correct answers assumed

Only in Conditions 1 and 2 the high number of incorrect answers could be the reason for throwing out the data from the analysis since it would indicate that a subject paid no or little attention.
EEG recording

- sampling rate of 250Hz
- 32 electrode cap
- high cut-off filter 30Hz
- Only trials with correct answers in the acceptability judgment task and without artifacts were selected.
We present results relevant to our research problems:
- morphological violations
- pragmatic/semantic mismatches → repair strategies
Morphological violation

- Results for set A
- Relevant comparison: Cond 1 x Cond 2
  - Condition 1: Control
    - [main clause imperfective verb] + [SIM converb –ĄC]
  - Condition 2: Morphology
    - [main clause imperfective verb] + [*perf verb–ĄC]
Morphological violation / Set A

- P-600-like component visible globally but strongest in the centroparietal region (Pz, CPz, C4, Poz)

Condition 1  
(control)

Condition 2  
(morph.)

Condition 3  
(pragm.)
ERP Components (Classics)

- P600/late Positivity
  - a positivity peaking between 600 and 900ms (posterior)
  - a late positive shift with a maximum over parietal and central midline electrode sites
ERP Components

- P600/late Positivity
  - No undisputed interpretation:
    - mostly taken to reflect costs of (syntactic) reanalysis and repair (e.g., Osterhout & Holcomb 1992; Friederici 1995)
    - an index for the inability of the parser to assign the preferred interpretation to the input (Hagoort et al. 1993)
    - an index of syntactic integration difficulty in general (Kaan et al. 2000)
    - a syntactic and semantic index of integration difficulty at the phrasal level (Bott 2010)
Discussion

- Morphological violation:
  \[[\text{main clause imperfective verb}] + [\text{*perf verb-ĄC}]\]

- Interpretation:
  - The parser has problems with combining the SIM morpheme with a perfective stem.
  - A reflex of difficulty in syntactic and semantic integration of two elements at phrasal level.
Morphological violation

- Results for set B
- Relevant comparison: Cond 1 x Cond 2
  - Condition 1: Control
    - [main clause perfective verb ] + [ ANT converb –WSZY ]
  - Condition 2: Morphology
    - [main clause perfective verb ] + [*impf verb –WSZY ]
Morphological violation / Set B

Condition 1 (control)
Condition 2 (morph.)
Condition 3 (pragm.)

N-400 strongest centrally and frontally.
Central anterior: Fz, Cz, FCz, C3

P-600 strongest centroparietal: Pz, CPz, C4, POz
Discussion

Why P600?

Morphological violation:

\[ \text{main clause perfective verb } + \text{ *imperfective verb-WSZY } \]

Interpretation:

The parser has problems with combining the \textbf{ANT} morpheme with an imperfective stem.

A reflex of difficulty in syntactic and semantic integration of two elements at phrasal level.
Why N400 in addition to P600?
ERP Components (Classics)

- N400
  - a negativity with a latency peak typically around 400 ms
  - usually largest over central and parietal electrode sites, with a slightly larger amplitude over the right than over the left hemisphere
Why N400 in addition to P600?

N400

- No undisputed interpretation:
  - response to violations of lexical semantic expectations
  - reflex of difficulties with the interpretation of a new word in the current semantic representation of the sentence
- N400 is sensitive to word frequency (Osterhout et al. 2004)
Why N400 in addition to P600?

N400

- No undisputed interpretation:
  - response to violations of lexical semantic expectations
  - reflex of difficulties with the interpretation of a new word in the current semantic representation
  - N400 is sensitive to word frequency (Osterhout et al. 2004)

Possible interpretation:
Anteriority converbs are less frequent than simultaneity converbs
Why N400 in addition to P600?

The second explanation (Brehm-Jurish 2005):

- The N400 reflects not only the difficulty in the semantic integration of a word within one sentence, but is also sensitive to discourse-level semantic integration.
- The amplitude of the N400 effect reflects a difficulty in the integration of a new word with the current discourse.
Why N400 in addition to P600?

- Condition 2: Morphology

\[ \text{main clause } \textit{imperfective} \text{ verb } + \text{[} \ast \text{perf verb-ĄC} \text{]} \quad \text{P600} \]

\text{strong preference for simultaneity } \rightarrow \text{ small integration cost}

\[ \text{main clause } \textit{perfective} \text{ verb } + \text{[} \ast \text{impf verb-WSZ} \text{]} \quad \text{P600 N400} \]

\text{simultaneity vs. anteriority } \rightarrow \text{ no preference } \rightarrow \text{ high integration cost } \rightarrow \text{ N400}
Pragmatic/semantic mismatches

- Relevant comparison
- Condition 3/set A x Condition 1/set B

Condition 1: Control
- \( \text{main clause imperfective verb } + [ \text{ANT converb -WSZY} ] \)

Condition 3: Pragmatics
- \( \text{main clause imperfective verb } + [ \text{ANT converb -WSZY} ] \)

inceptive coercion
-- NO EFFECT
Pragmatic/semantic mismatches:
Cond 3/A x Cond 1/B
No effect. Why?

- Unlike the additive coercion (from an achievement to an accomplishment) in Bott's (2010) analysis (which elicited LAN), inceptive coercion is not costly for the parser.

- It is more difficult to add a semantically relevant activity to a culmination than to add an inception to a given eventuality.
Pragmatic/semantic mismatch

- Condition 1/set B: Control
  \[
  \text{[main clause perfective verb] + [ANT converb -WSZY]}
  \]

- Condition 3/set B: Pragmatics
  \[
  \text{[main clause perfective verb] + [SIM converb -ĄC]}
  \]
Pragmatic/semantic mismatch

Condition 3 Set B

Condition 1 (control)
Condition 2 (morph.)
Condition 3 (pragm.)

N-400 strongest frontally.
Central anterior: Fz, Cz, FCz, C3

P-600 strongest centroparietal: Pz, CPz, C4, POz
Pragmatic/semantic mismatch

- **Condition 1/set B: Control**
  \[ \text{main clause } \text{perfective verb } + [\text{ANT converb -WSZY}] \]

Unambiguous anteriority → small integration cost

- **Condition 3/set B: Pragmatics**
  \[ \text{main clause } \text{perfective verb } + [\text{SIM converb -AĆ}] \]

Inclusion instead of an expected simultaneity → an increased integration cost → N400
Problems with integrating a converbial eventuality with the current temporal discourse

Morphological violations:
*perf + -ĄC and *impf + -WSZY

P600

N400
Thank you for your attention!

http://www.ifa.uni.wroc.pl/linguistics/
http://www.ifa.uni.wroc.pl/trait/
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