

# Hierarchical structure of Polish gender: Evidence from eye-tracking

Zuzanna Fuchs, University of Iowa  
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# Main Goal

- To argue for hierarchical organization of Polish grammatical gender features
- Eye-tracking study using the Visual World Paradigm (first psycholinguistic study on Polish gender)
- Overarching goal of showing how experimental evidence can directly bear on linguistic theory.

# Grammatical gender

Grammatical gender (henceforth just “gender”) is a **category** that divides nouns into classes that determine their co-occurrence with other associated words in a noun phrase and clause (Hockett 1958; Corbett 1991; Kramer 2015)

# Signs of gender

The only reliable indication of gender is the behavior of “associated words” (Hockett 1958) -- agreement in the nominal or verbal domain.

el { libroo  
techoo  
zapatoo  
pozoo } rojo

la { mesaa  
manzanaa  
camisaa  
sillaa } roja

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sal? ‘salt’  
papel? ‘paper’

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la { mesaa  
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camisaa  
sillaa  
sala } roja

# Leaving the semantic core behind



# Arbitrariness of gender

<i>el libro</i>	Spanish	‘the book.MASC’
<i>książka</i>	Polish	‘(the) book.FEM’
<i>das Buch</i>	German	‘the book.NEUT’

# Variation in internal structure of gender feature

- Languages can vary in number of gender values...
  - 2 genders
  - 3 genders
  - 4+ genders
- And criteria that might determine belonging to a gender category.
  - Animacy or humanness
  - Natural gender
  - Morphophonological features

# Contribution of psycholinguistic evidence

- General question: what is the internal structure of the gender category?
- Formal investigations sometimes offer competing conclusions
- Precedent for psycholinguistic evidence to help in adjudicating between competing analyses (ex. Spanish, Fuchs et al. 2015, among many others)
- Similar goal for Polish in this talk

# Outline

- Gender in Polish - formal approaches
- Methodology
- Participants & Results
- Implications
- Further questions

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# Gender in Polish

Three genders:            feminine                    masculine                    neuter

Morphological  
correlates on noun:            -a                                    C                                    -o

# Gender in Polish

Three genders:	feminine	masculine	neuter
Morphological correlates on noun:	-a	C	-o
	rzecz 'thing' sól 'salt' pięść 'fist'	mężczyzna 'man' sędzia 'judge'	coś 'something' muzeum 'museum'

# Gender in Polish

Concord in the noun phrase:

stara	czzerwona	książka
old.F	red.F	book.F

stary	czzerwony	stół
old.M	red.M	table.M

stare	czzerwone	jabłko
old.N	red.N	apple.N

# Gender in Polish

Three genders:            feminine                    masculine                    neuter

Morphological  
correlates on noun:            -a                                    C                                    -o

Gender marked  
on adjectives:                    -a                                    -i/-y                                    -ie/-e

(6-case system)

# Gender in Polish

Concord in the noun phrase:

stara	czzerwona	książka
old.F	red.F	book.F
stary	czzerwony	stół
old.M	red.M	table.M
stare	czzerwone	jabłko
old.N	red.N	apple.N

\*Polish is not Russian

- Russian, which also has 3 genders, has vowel reduction that leads to ambiguity in agreement endings.
- Polish has no such vowel reduction -- all agreement morphology is transparent.

# Distribution in the lexicon

Masculine: ~48%

Feminine: ~38%

Neuter: ~14%

(Janssen 2016)

# Default gender

- Neuter is the default (inanimate) gender in Polish:

*pro*<sub>+Neut</sub>    był-o                    zimn-o.  
                  be-PST.3SG.N        cold-N

“It was cold.”

*[impersonal construction, no overt controller]*

# Gender in Polish

Relevant aspects of the structure of the noun phrase:

- No overt determiners
- **Prenominal modifiers**
  - Post-nominal modifiers allowed but marked
- Elements that inflect for gender:
  - Demonstrative pronouns
  - **Attributive and predicative adjectives**
  - Relative pronouns
  - Verbs in past tense and future imperfective
  - Numerals (not classic agreement targets, see Klockmann 2012 and Lyskawa 2020)

# Existing investigations of Polish gender

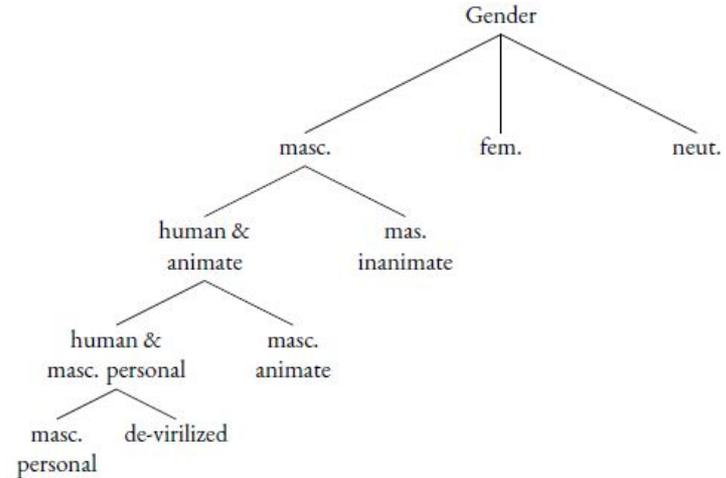
- Since gender is “reflected in the behavior of associated words” (Hockett 1958), formal investigations of Polish gender look for evidence of gender categories in the [declensional paradigms of agreeing elements](#).
- These analyses posit anywhere between 3 (Klemensiewicz 1960) and 9 (Schenker 1955) genders.

# Existing investigations of Polish gender

	<b>Empirical domain</b>	<b># genders</b>
<b>Mańczak 1956, Dukiewicz et al. 1984</b>	accusative case, adj. <i>dobry</i> ‘good’	5
<b>Szober 1963</b>	nominative case	3 sg, 2 pl
<b>Swan 2015</b>	pronouns	4
<b>Schenker 1955, Saloni &amp; Świdziński 2001</b>	numerals	9
<b>Corbett 1983</b>	all cases, sg & pl, adjectives	3 genders

# Existing investigations of Polish gender

- Commonly adopted:  
Corbett (1983)
  - 3 global genders
  - masculine divided into four subgenders



# Existing investigations of Polish gender

	singular		plural			
	animate	inanimate	personal	de-virilized	animate	inanimate
nom.	duży	duży	duzi	duże	duże	duże
gen.	dużego	dużego	dużych	dużych	dużych	dużych
dat.	dużemu	dużemu	dużym	dużym	dużym	dużym
acc.	dużego	duży	dużych	dużych	duże	duże
inst.	dużym	dużym	dużymi	dużymi	dużymi	dużymi
loc.	dużym	dużym	dużych	dużych	dużych	dużych

Subgenders: “agreement classes which control minimally different sets of agreements, [...] typically not including the most basic form (usually the nominative singular).”

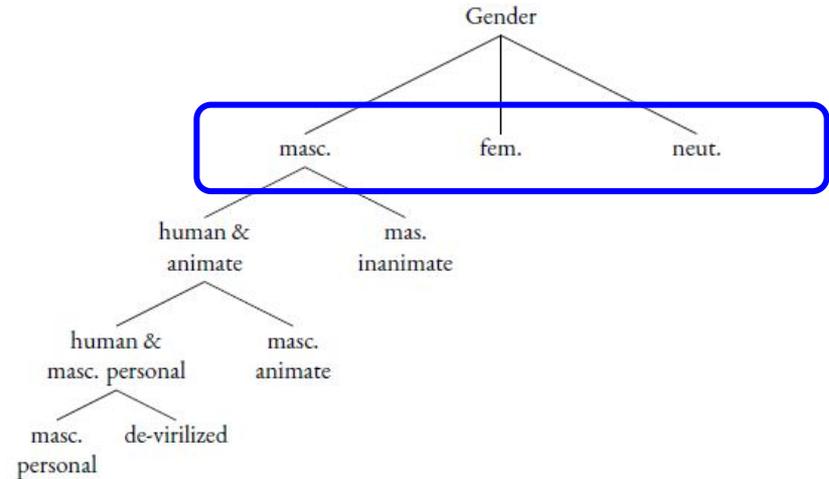
(Corbett 1983)

# Existing investigations of Polish gender

- Membership in subgenders of masculine appears to be at least in part semantically determined (ex. animate vs inanimate).
- Status of animacy feature in Polish gender system is subject to further investigation (cf. English loanwords treated as animate accusative, Fuchs 2013).

# Existing investigations of Polish gender

- What formal analyses have in common:
  - 3 global genders in the nominative singular
  - Flat structure of the three global genders



# Research questions & scope

	masc.	neut.	fem.
nom.	dobry	dobrze	dobrze
gen.	dobrego	dobrego	dobrej
dat.	dobremu	dobremu	dobrej
acc.	dobry	dobrze	dobrze
inst.	dobrym	dobrym	dobrze
loc.	dobrym	dobrym	dobrej

Syncretism within the global genders (masculine and neuter) suggests flat structure may not be adequate.

# Research questions & scope

First psycholinguistic study of adult L1 Polish gender

## **Scope**

three global Polish genders, inanimate nouns

## **Research question**

What is the internal structure of the Polish gender feature -- flat or hierarchical?

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## **Research question**

What is the internal structure of the Polish gender feature -- flat or hierarchical?

## **Strategy**

Observe how speakers use gender information on associated words -- prenominal adjectives.

# Outline

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- **Methodology**
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# Methodology

Gender + Eye-tracking = **facilitative use of gender  
in the Visual World Paradigm (VWP)**

Spanish -- Lew-Williams & Fernald (2007, 2010), Gruter et al (2012), Dussias et al. (2013)

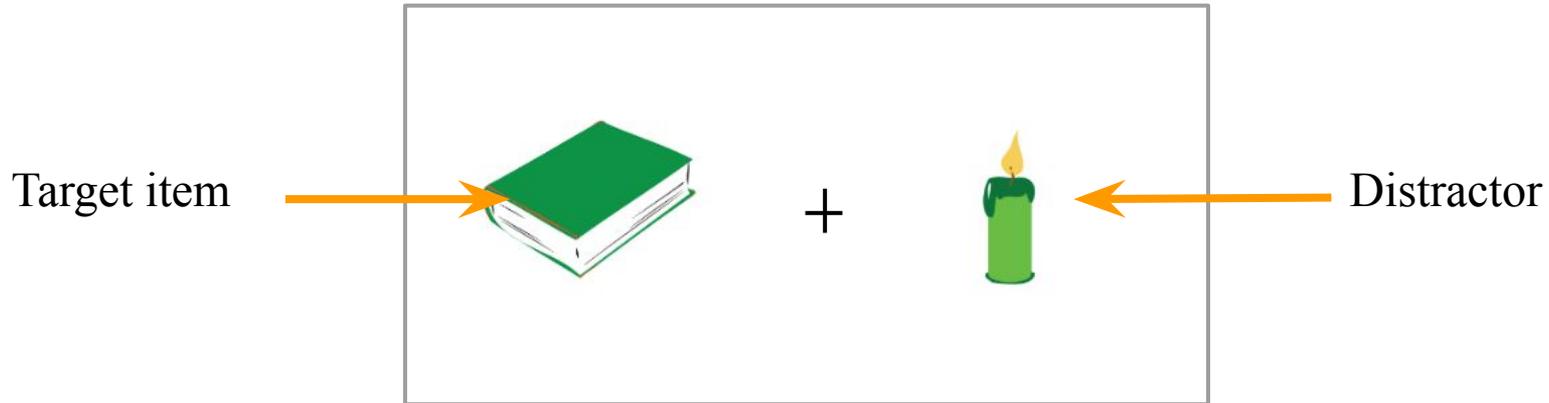
Dutch -- Loerts (2012), Loerts et al (2013), Bouwer et al (2018)

German -- Hopp (2013, 2016), Hopp & Lemmerth (2018)

Among others...

# How the VWP works

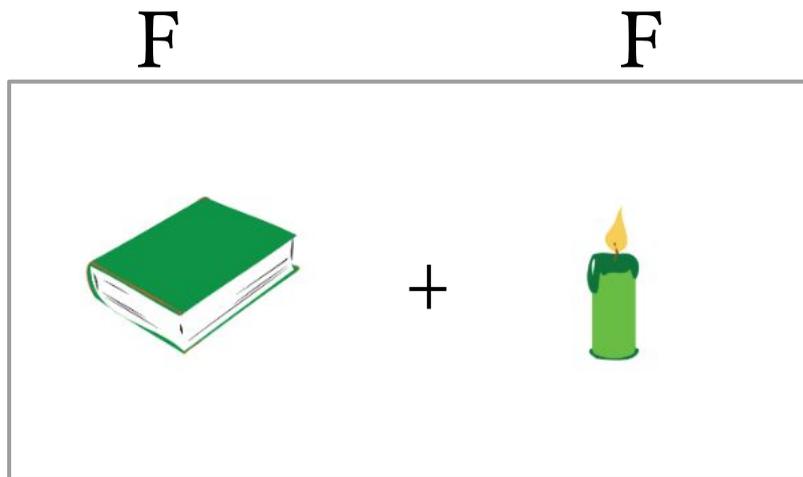
Task: to look at the item that is asked about as quickly as possible.



Gdzie jest zielona książka ?

Where is green.F book

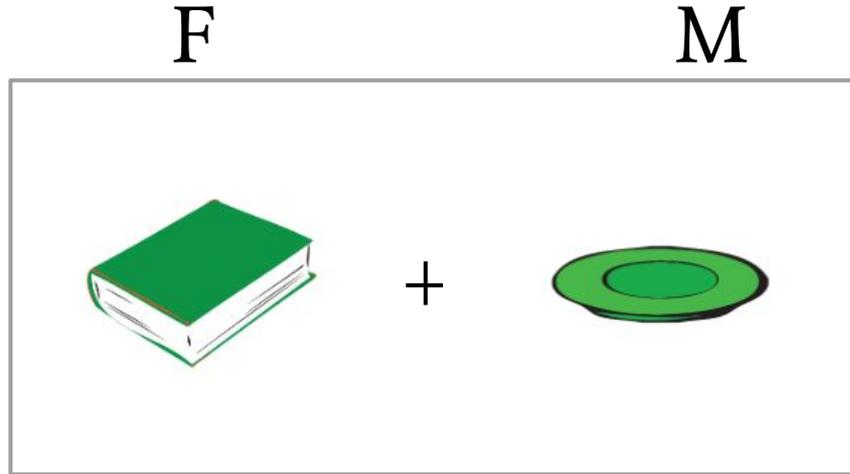
# Match condition



Gdzie jest zielona... ?

Where is green.F ...

# Mismatch condition



Gdzie jest zielona... ?

Where is green.F ...

# How it works

- **Dependent measure:**  
time of first fixation after the onset of the gender-marked adjective (reaction time).
- **What we hope to see:**  
using the gender information on adjectives in *mismatch* conditions to fixate on target item *faster* than in *match* conditions.

# Previous findings

- Faster fixation times on mismatch conditions than on match conditions
  - Spanish (Lew-Williams & Fernald 2007, 2010; Gruter et al 2012, Dussias et al. 2013)
  - German (Hopp 2013, 2016; Hopp & Lemmerth 2018)
  - Dutch (Loerts 2012, Loerts et al 2013, Bouwer et al 2018)
  - Russian (Sekerina 2015)
  - Norwegian (Lundquist et al. 2016, Lundquist & Vangsnes 2018)

# Predictions

- If Polish gender has a **flat structure**, there should be **no asymmetries** in participants' ability to use each gender feature to facilitate lexical retrieval.
- If Polish gender has a **hierarchical structure**, we **may expect asymmetries** in participants' ability to use each gender feature to facilitate lexical retrieval.

# Predictions

Predictions:

If speaker can use gender facilitatively → first fixation on target item will be faster for mismatch condition than match condition

If speaker cannot use gender facilitatively → first fixation on target item will be about equal for mismatch and match conditions

# Predictions

Predictions:

If speaker can use gender facilitatively → first fixation on target item will be faster for mismatch condition than match condition\*

If speaker cannot use gender facilitatively → first fixation on target item will be about equal for mismatch and match conditions

\*Mismatch conditions need not be equal to each other!

# Experimental design

match



F

match



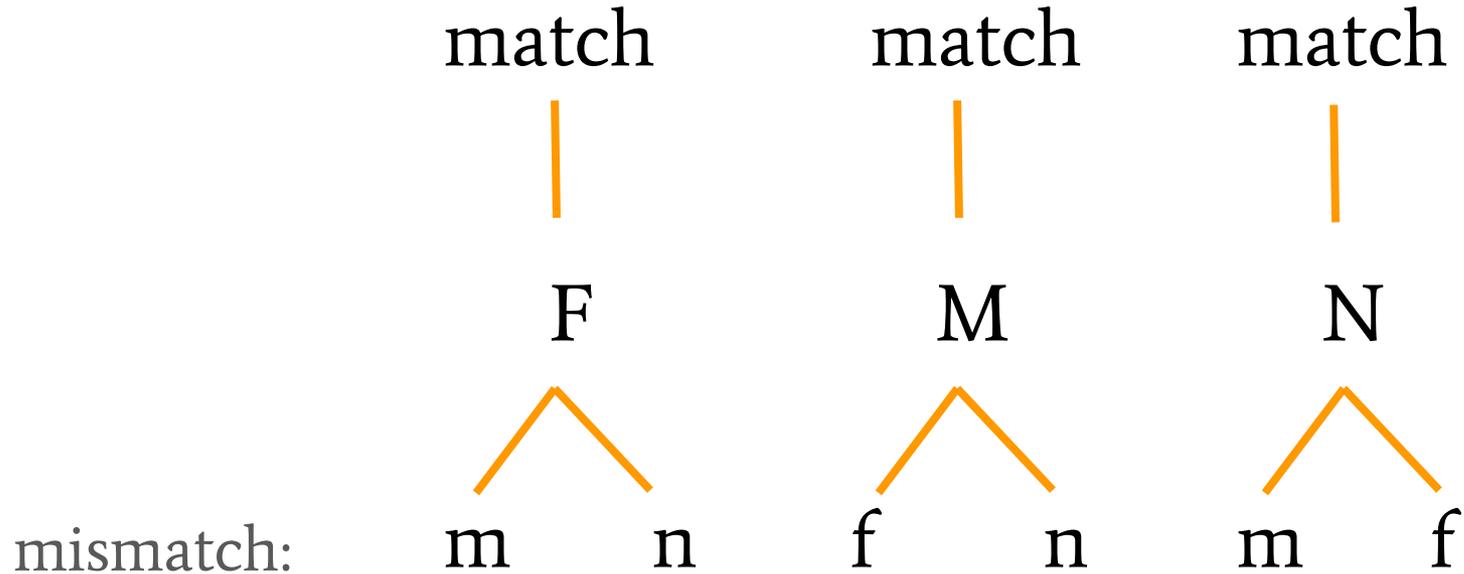
M

match



N

# Experimental design

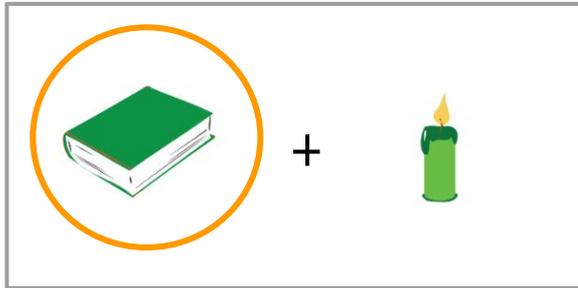


# Experimental design

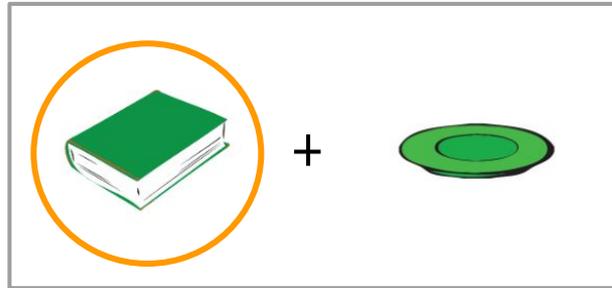
Gdzie jest zieloną książka? [feminine, nominative singular]

Where is green.F book.F

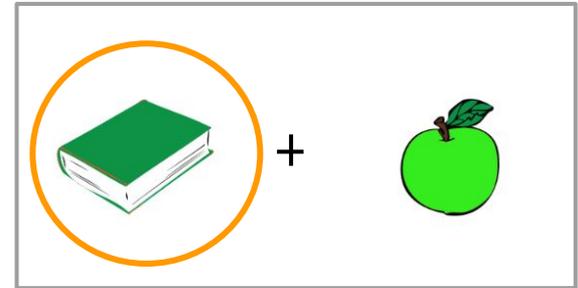
“Where is (the) green book?”



Match



MismatchM



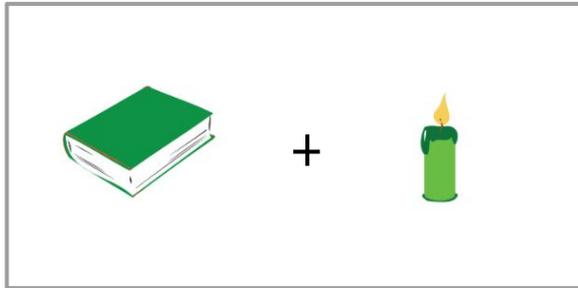
MismatchN

# Experimental design

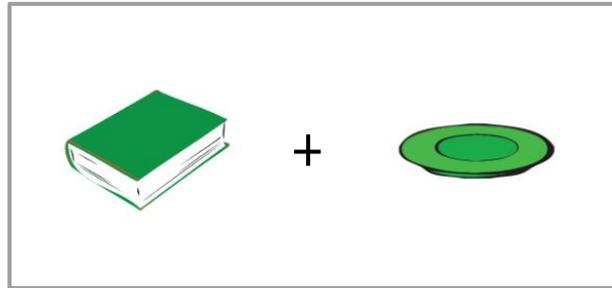
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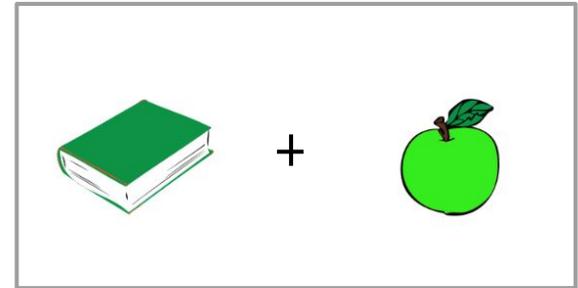
“Where is (the) green book?”



Match



MismatchM

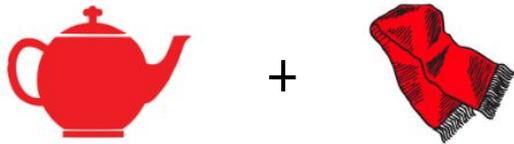


MismatchN

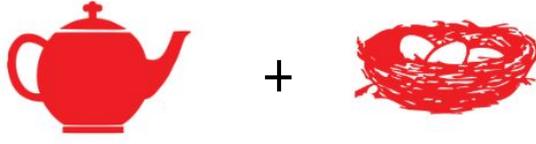
# Experimental design

Gdzie jest czerwony czajnik?  
Where is red.M teapot.M  
“Where is (the) red teapot?”

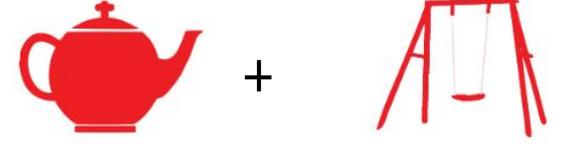
[masculine, nominative singular]



Match



MismatchN



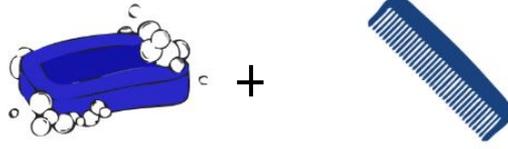
MismatchF

# Experimental design

Gdzie jest niebieskie mydło? [neuter, nominative singular]  
Where is blue.N soap.N  
“Where is the blue soap?”



Match



MismatchM

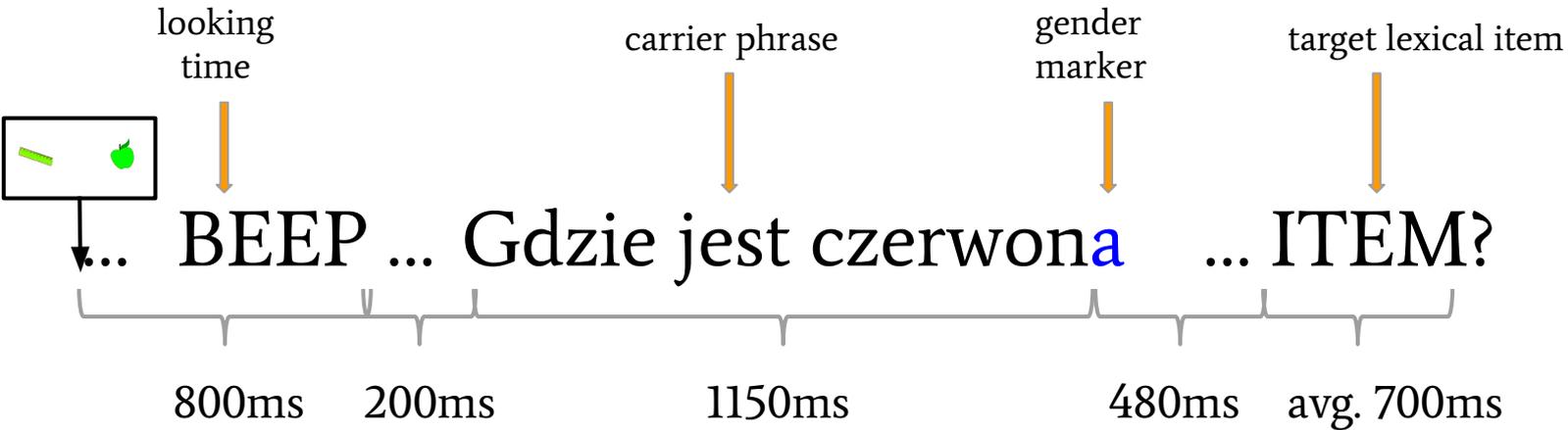


MismatchF

# Experimental materials

- auditory recorded by male speaker of Polish, recently immigrated from Poland
- spliced to ensure consistent timing and no co-articulation effects

# Experimental materials



Each trial lasted 6 seconds, with 1 second in between.

# Procedure

## Pre-tasks

- LEAP-Q (translated into Polish by Ewa Brzezińska)
- Vocabulary task

## Eye-tracking task

- 2 x 54 trials
- Unlimited break

Total time: ~45 minutes

Participants were compensated for their time

# Outline

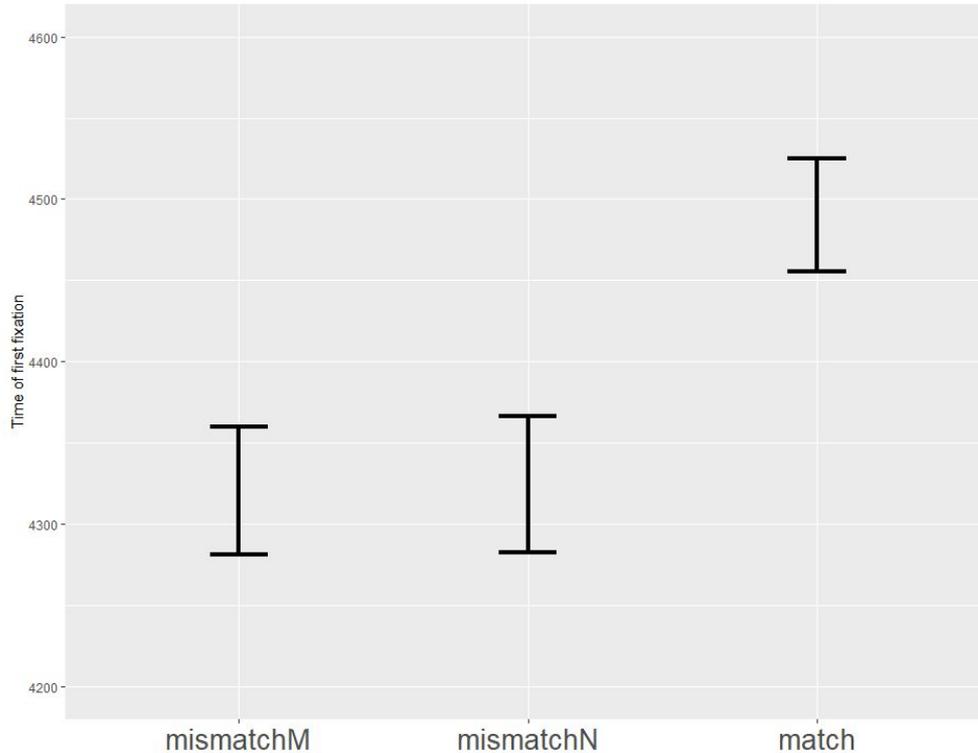
- Gender in Polish - formal approaches
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# Participants

23 adult speakers of Polish recently immigrated to the USA, spent 18+ years in Poland

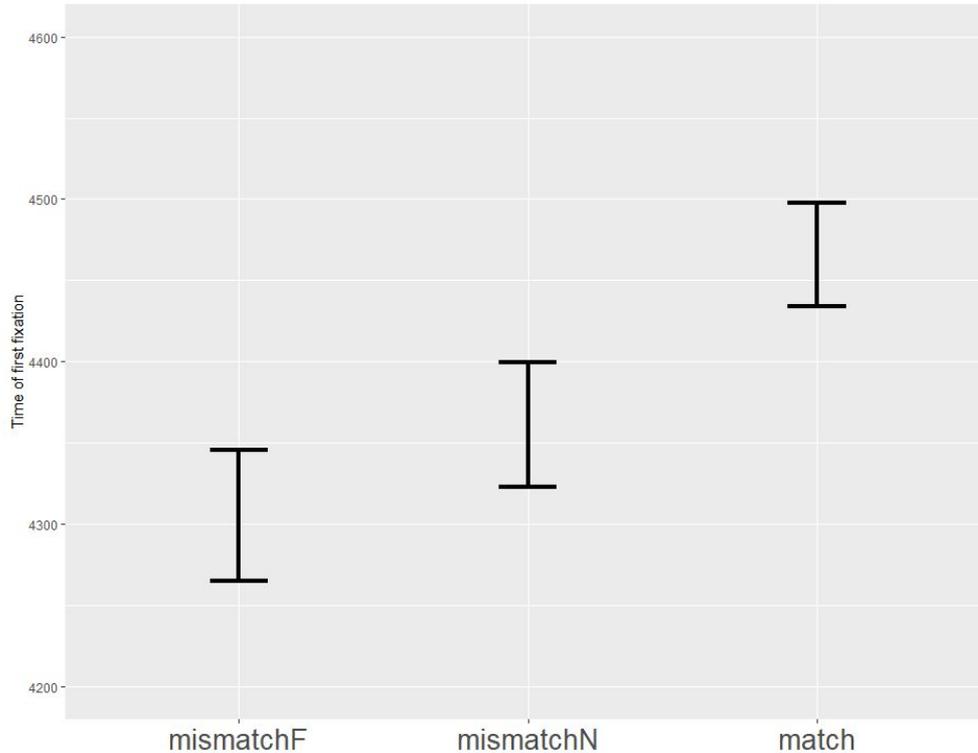
<i>n</i>	Age	Years in Polish-speaking environment			
		Country	Family	Work/ School	
23	31.8 (8.7)	25.0 (8.7)	24.2 (10.8)	19.8 (9.7)	
Education level					
High school	Some college	College	Some graduate	Masters	PhD
1	2	3	0	9	8

# Results: Feminine target item



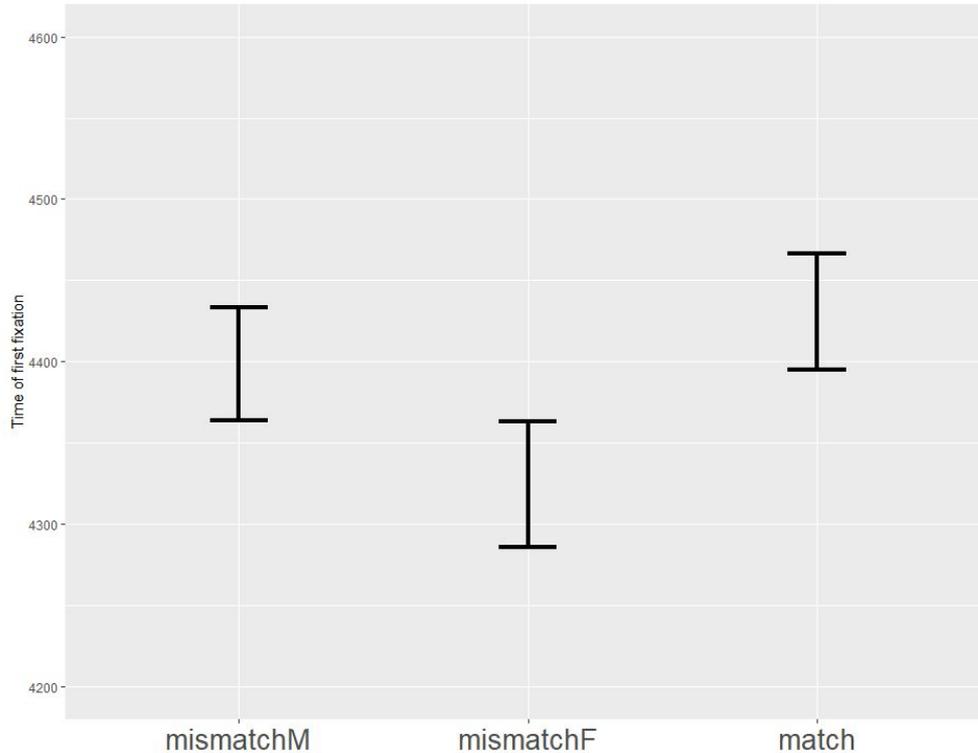
- Can use gender to facilitate lexical retrieval.
- No significant difference between mismatch conditions.

# Results: Masculine target item



- Use gender to facilitate lexical retrieval.
- This process is slowed in the presence of a neuter distractor.

# Results: Neuter target item



- Participants can use neuter to facilitate lexical retrieval if the distractor is feminine...
- ... but not if the distractor is masculine.

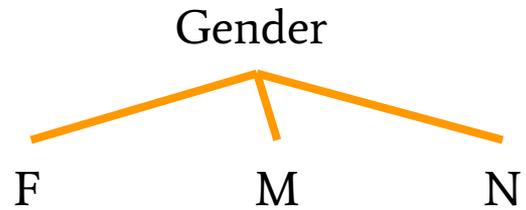
# Putting it all together

- F is “on its own”, so the main contrast is between F and “everything else”.
- N slightly interferes with M.
- M strongly interferes with N.

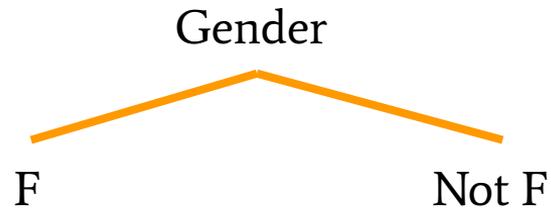
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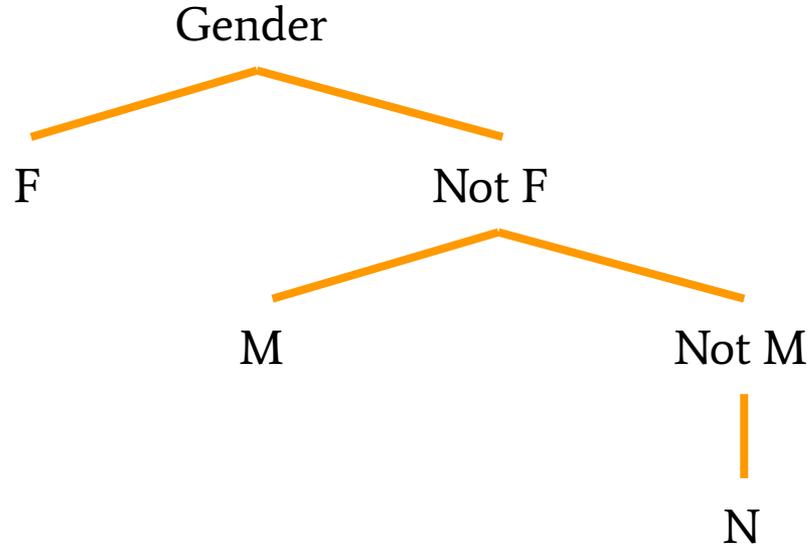
# Hierarchical geometry of Polish gender



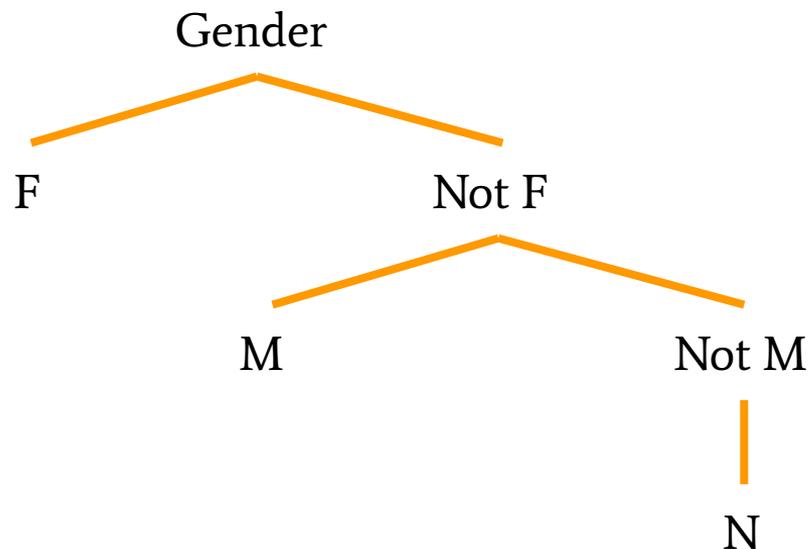
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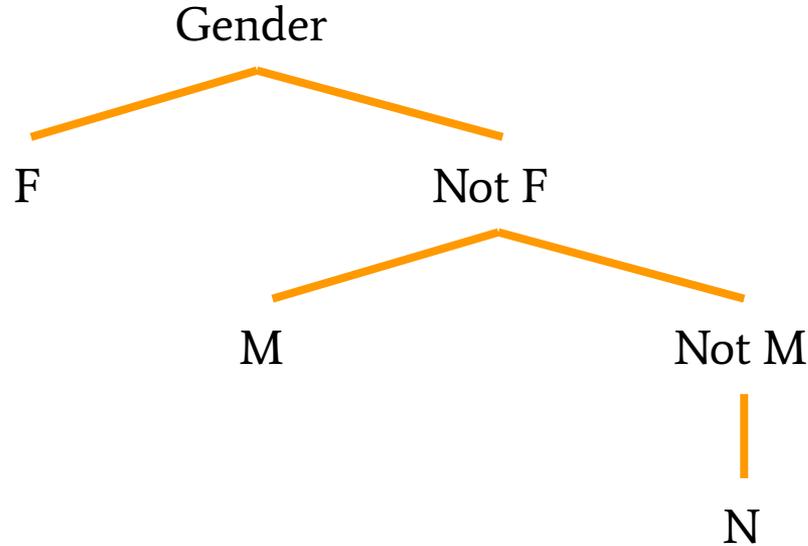


# Hierarchical geometry of Polish gender



	masc.	neut.	fem.
nom.	dobry	dobre	dobra
gen.	dobrego	dobrego	dobrej
dat.	dobremu	dobremu	dobrej
acc.	dobry	dobre	dobrą
inst.	dobrym	dobrym	dobrą
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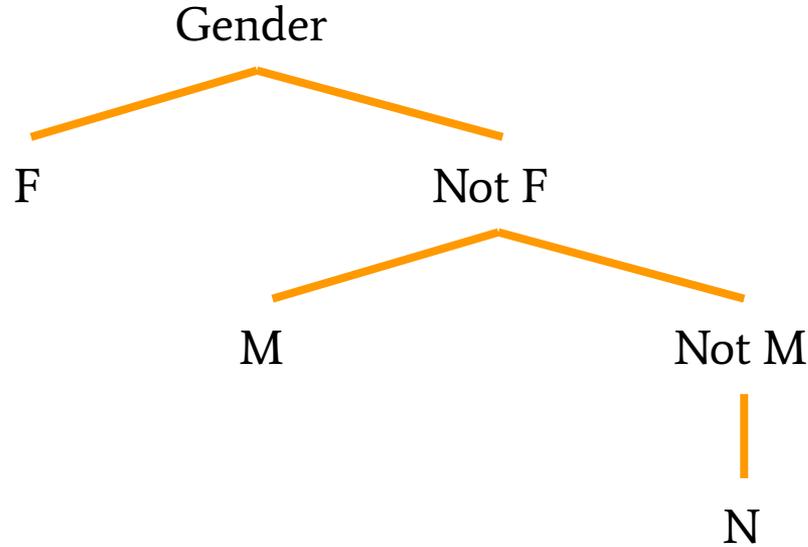
# Hierarchical geometry of Polish gender



Reminiscent of an analysis of Russian gender as grouping masculine and neuter together as [-FEM] versus feminine [+FEM] (Halle & Matushansky 2006).

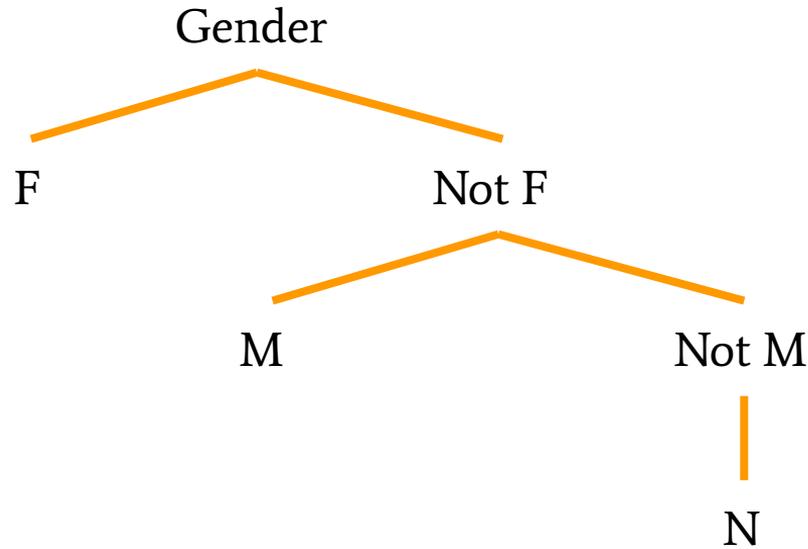
Brings 3-gender systems more in line with 2-gender systems (ex. Spanish.)

# Hierarchical geometry of Polish gender



This is more consistent with the hierarchical representation of features (starting with Harley & Ritter 2002)

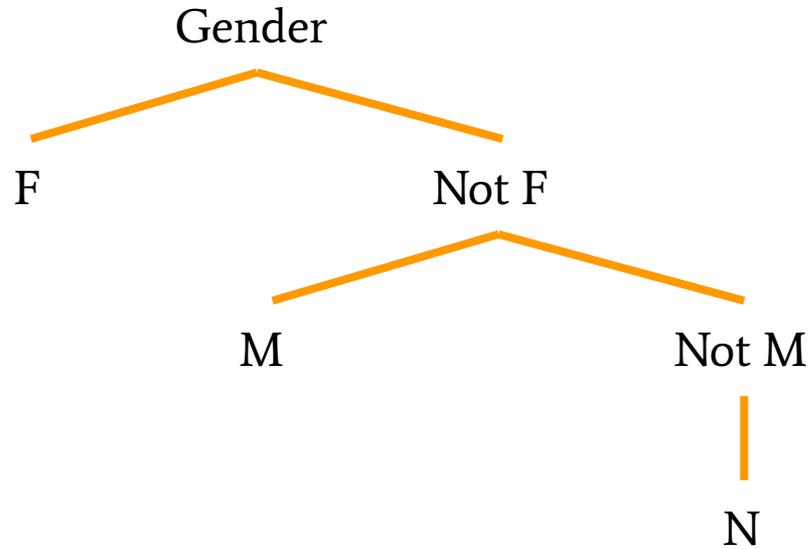
# Hierarchical geometry of Polish gender



Children acquire initial gender distinctions by age 2;0 (Smoczyńska 1985).

At initial stages of acquisition, children have 3 global genders (Krajewski 2005) but F vs M acquired earlier, N takes longer (Dąbrowska 2006).

# Hierarchical geometry of Polish gender



Recall neuter is the default gender. Does this alone explain the asymmetries?

No, it would predict patterns we do not see here, in particular, the interference between F and N.

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# Summary

- Polish monolingual speakers can use gender on prenominal adjectives to facilitate lexical retrieval.
- Asymmetrical interference between M and N gives psycholinguistic evidence for notion that Polish genders are organized hierarchically, not as a flat set of categories.
- This brings Polish gender closer to two-gender systems like in Spanish.

# Further questions

- Internal structure of gender in the bilingual grammar?
  - How a system performs under pressure from reduced input can inform our understanding of the system itself.
- How does hierarchical relationship between M and N interplay with subgenders?
  - In other words, what happens in the other (non-nominative) cases?

Thank you!

