

Czech 20-month-olds interpret gender-marked adjectives without nouns: Emerging knowledge of the gender agreement system

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<https://earlygrammarlab.github.io>



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Ministry of Education,
Youth and Sports
of the Czech Republic



Institute of Psychology
The Czech Academy of Sciences



<https://earlygrammarlab.github.io/people.html>



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Martina Abbondanza

Gender trouble (another intro on gender)

- thousands of languages encode gender (Corbett, 1991)
- semantic core, structural functions
- varying degrees of complexity and transparency
- grammatical gender knowledge is essential for interpreting and producing sentences correctly
- sooner or later, children manage to learn it

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→ How children learn noun gender?

→ What are the very first steps?

→ What information do they use?

Gender and (mor)phonology

- mapping onto some (mor)phonological features of words
- e.g., Spanish (Bull, 1965)
 - nouns ending with *-a*, *-d*, *ción*, *-sis*, and *-itis* x 98% of the time feminine
 - nouns ending in in any other grapheme x 96% of the time masculine

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 - nouns ending in any other grapheme x 96% of the time masculine
- such a level of systematicity is rare (Kupisch et al., 2022)

<i>Spanish</i>	<i>Italian</i>	<i>Russian</i>	<i>French</i>	<i>German</i>	<i>Danish, Dutch, Norwegian, Swedish</i>
HIGH	Transparency				LOW

Determiners and gender agreement

- obligatory articles (e.g., German)
 - if not obligatory, gender agreement as the main cue

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- gender agreement (e.g., Czech)

- adjectives

velk-ý_{masc} nákladák

‘big truck’

velk-á_{fem} motorka

‘big bike’

velk-é_{neut} vozidlo

‘big vehicle’

- verbs

Nákladák zastavil-o_{masc}

‘The truck stopped’

Motorka zastavil-a_{fem}

‘The bike stopped’

Vozidlo zastavil-o_{neut}

‘The vehicle stopped’

Gender in language acquisition

Production

- determiners, adjectives and other elements often delayed, hardly ever show before 2
- gender agreement often nowhere to show in production

Gender in language acquisition

Production

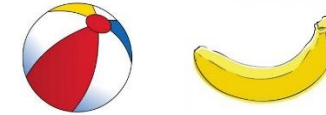
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Comprehension

- Nouns identified faster if preceded by an informative determiner
 - in French 25-mo. olds (Van Heugten & Shi, 2009)
 - in Dutch 28-mo. olds (Johnson, 2005)
 - in Spanish 3-yr.-olds (Lew-Williams & Fernald, 2007)

target

Regarde, le ballon/la banane!



control condition

Regarde, le ballon/le bateau

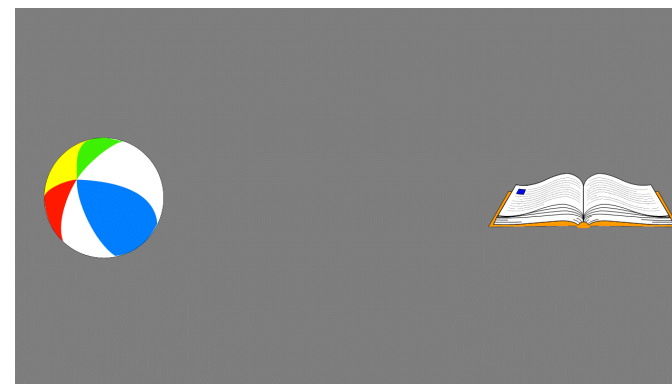


agrammatical

... *la ballon/*le banana

Anticipation from bound morphemes

- e.g., in Czech (Smolík, Bláhová, 2018)
 - Matching condition
Taková_{fem} veliká_{fem} kniha_{fem} / Takový_{masc} veliký_{masc} míč_{masc}
such_{fem} big_{fem} book_{fem} / such_{masc} big_{masc} ball_{masc}
 - Mismatching condition
Takový_{masc} veliký_{masc} kniha_{fem} / Taková_{fem} veliká_{fem} míč_{masc}



- 21- to 24-month-olds looked at the picture based on adjective gender
 - Only those with better offline sentence scores

Gender category or morpheme association?

1. French toddler hears *le*.
2. It looks toward the ball (*ballon*_{masc}) and not the banana (*banane*_{fem}).
3. It does it with a few other words.

- a) Does it mean they have categories of feminine and masculine?
- b) Does it just mean they know that ball is *le* and banana is *la*?

→ How can we tell?

- What about testing the semantic (category) interpretation?
- Do children have this knowledge?

Gender interpretation in infants

Ferry et al. (2020)

- Italian 12, 18, 24-month-olds
- noun pairs such as
il ragazzo vs. *la ragazza*
il nonno vs. *la nonna*
- Even 12-month-olds looked at the correct picture



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- 4 noun pairs such as
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il nonno vs. *la nonna*
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a) Knowledge of gender?

b) Knowledge of specific nouns?



The questions

- Can we show interpretation of gendered forms in Czech toddlers?
- Can we do it without noun labels?
- Do Czech children use gender information from adjectival inflections?
- Do they associate it with gender as a semantic category?

Adjectival system in Czech

- adjectives agree with their head nouns in gender, number, case

velk-ý_{masc} nákladák

‘big truck’

velk-á_{fem} motorka

‘big bike’

velk-é_{neut} vozidlo

‘big vehicle’

- one minor adjective class does not distinguish genders

posledn-í_{masc} nákladák

‘last truck’

posledn-í_{fem} motorka

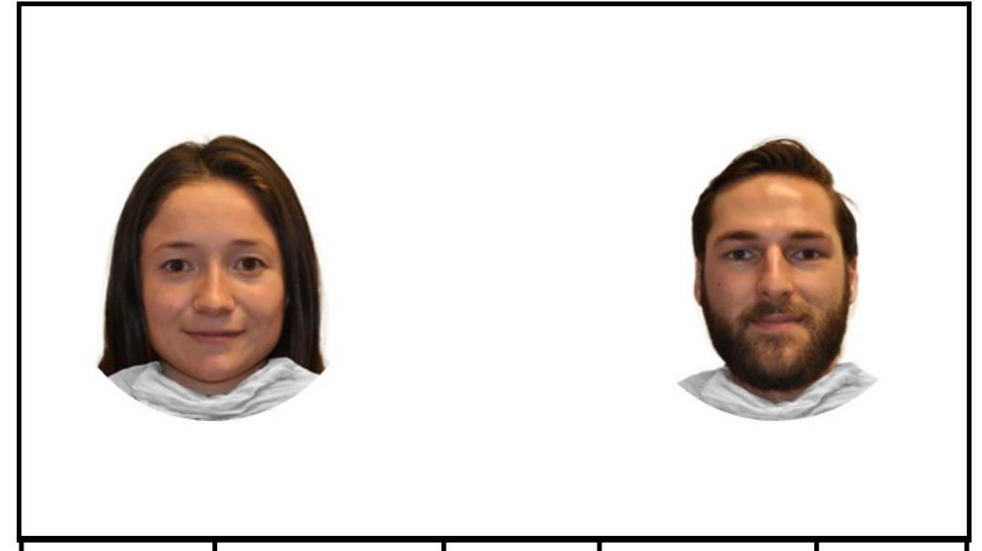
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The experiment

- Screen with a male and a female face
 - 4 yoked pairs of different faces (Conley et al., 2018)



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- Passage with two instances of an adjective

Jéé, hele! Koukej, jak je [chytrý/chytrá]! Je fakt [chytrý/chytrá]!

‘Yay, see! Look how smart_{m/f} (s/he) is? (S/he) is really smart_{m/f}!’

				
Familiarization (2000ms)	Start of phrase 1 (1150–1700ms)	Adjective 1 (2000ms)	Start of phrase 2 (470–900ms)	Adjective 2 (3000ms)
Jůů, koukej! Oh, look!	Vidíš, jak je hezký/hezká? Can you see how nice s/he is?	Je moc hezký/hezká. S/he is really nice.		

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 - *chytrý/á* (‘clever’), *veselý/á* (‘happy’), *smutný/á* (‘sad’), *hezký/á* (‘pretty’)

				
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- 16 trials, 8 per gender condition
 - each adjective 2 x per condition, counterbalancing female/male face location

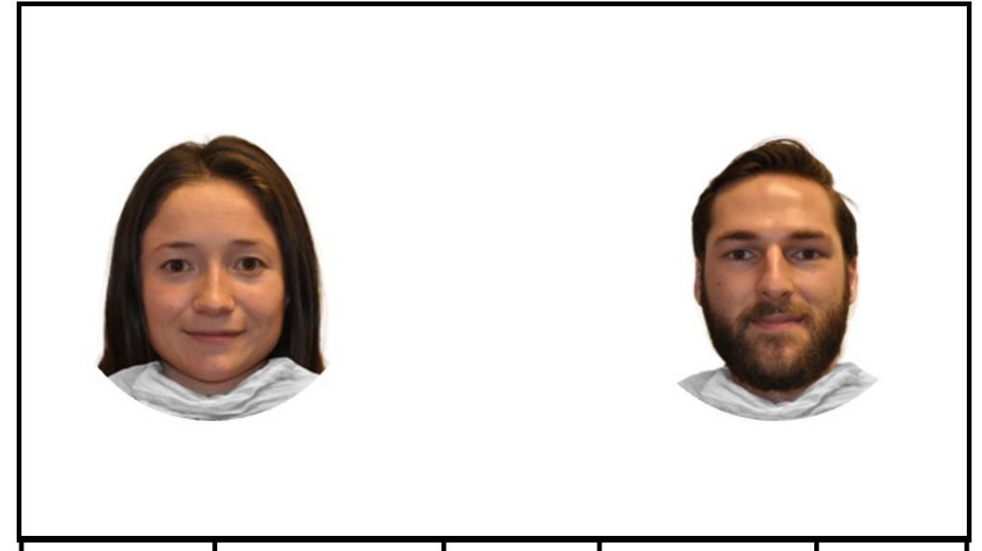
				
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The baseline

- Can children reliably distinguish between men and women?
- Two initial trials labelling *paní* (lady, woman) and *pán* (gentleman)

Jů, koukej! Tady je [nějaká/ý] [paní/pán]! Vidíš [tu/toho] [paní/pána]?

‘Hey, look! Here is some lady/man! Do you see the lady/man?’



Participants and procedure

- Eyelink 1000+ (SR Research) with a 25mm lens
 - Target sticker on the child's forehead, faces approx. 55 cm from the lens
- Created and presented in SR Research Experiment Builder 2.44.7
 - Pictures presented on a 22-inch screen
 - Children sitting on parent's lap
 - Video animation with music played after the baseline trials and then after each set of 4 trials

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 - Video animation with music played after the baseline trials and then after each set of 4 trials
- 53 children aged 18 to 24 months visited the lab
- data collected from 46
- between 31 and 40 children analyzed (depending on cleaning criteria)

Analyses

1. Time windows

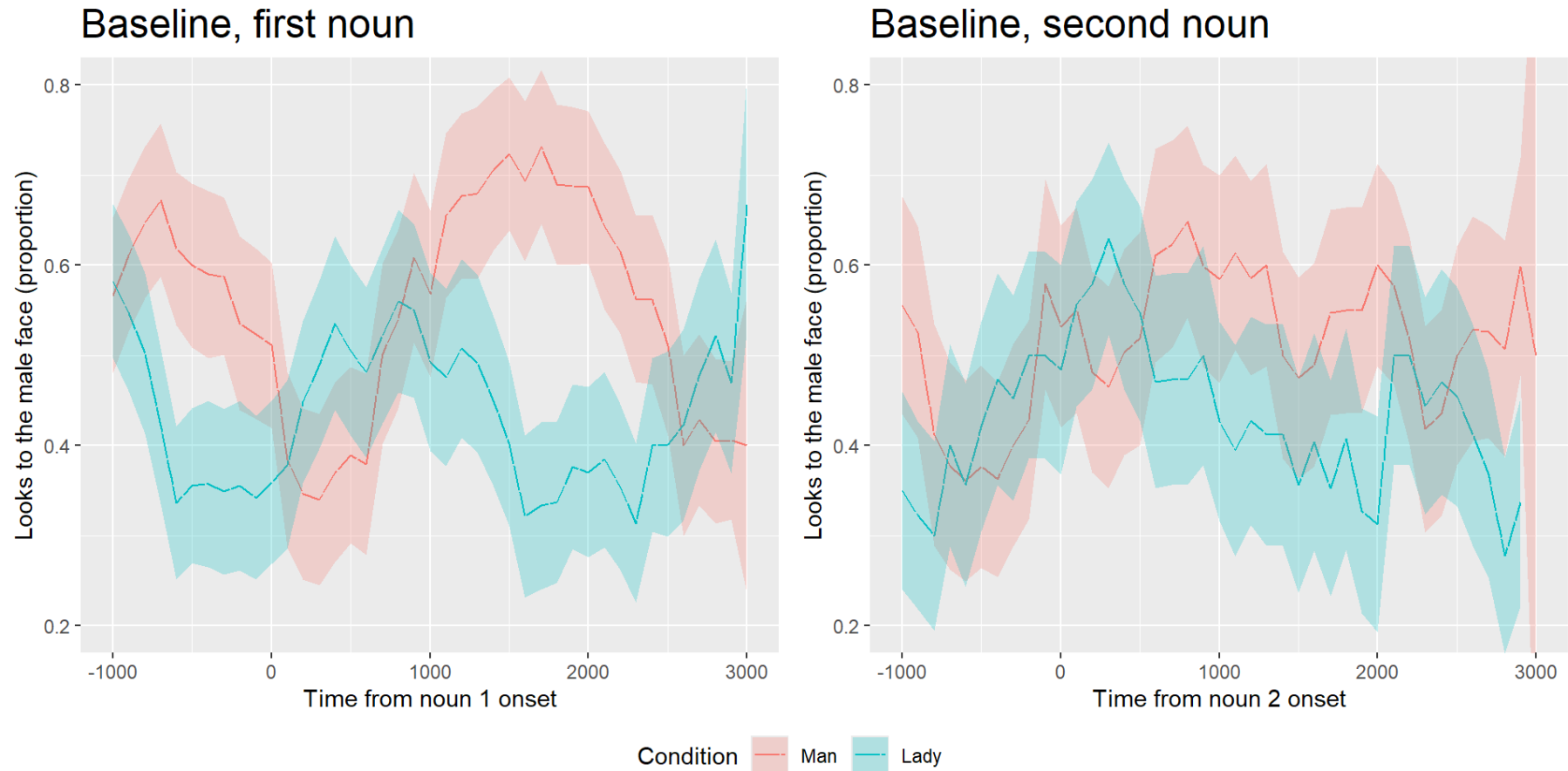
- Pre-adjective: 1500 ms, from 1000 ms before to 500 ms after the adjective onset
- Post-adjective: 500 to 3000 ms after the adjective onset
- Mixed model: effects of time window and condition on the proportion of looks (straight or logit)

$$\text{Prop} \sim \text{expcond} * \text{window} + (\text{window} \mid \text{pic/trial}) + (\text{window} * \text{condition} \mid \text{child})$$

2. Permutation analysis

- Running a glmm on each 4-ms time slice with participant and trial random intercepts
- Examining sequences (clusters) of significant results

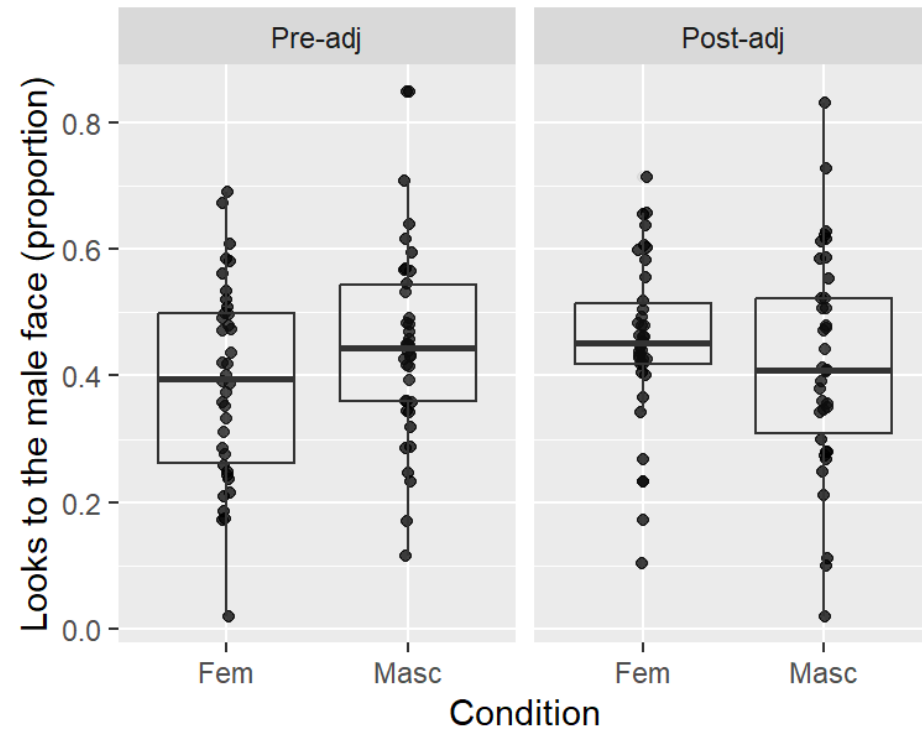
Results: baseline



Clear differentiation on the first noun. Nothing on the second noun.

Results for Adjective 1

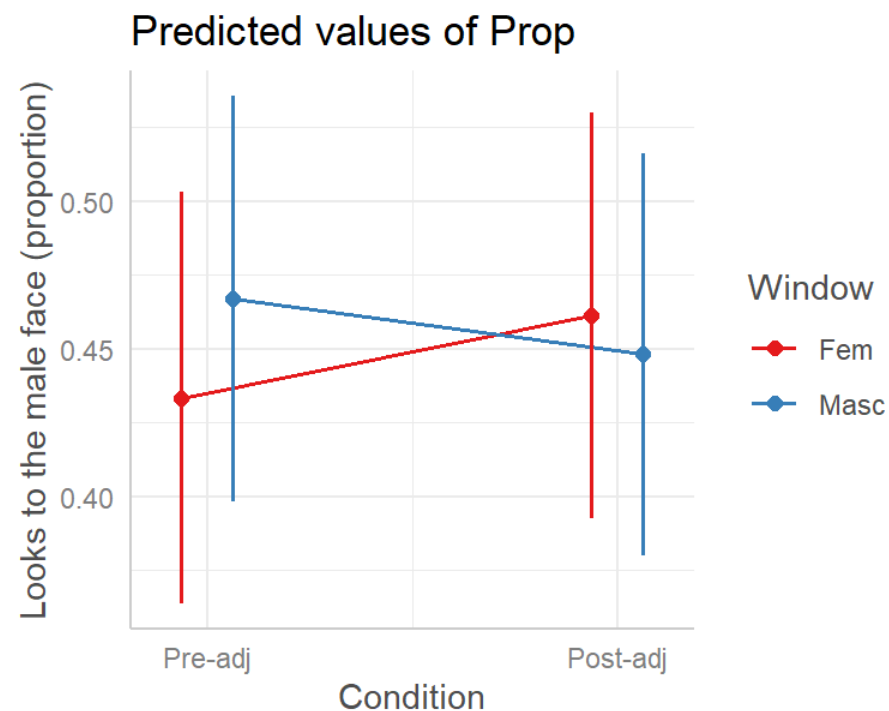
1. Time windows



Results for Adjective 1

1. Time windows

No significant interaction

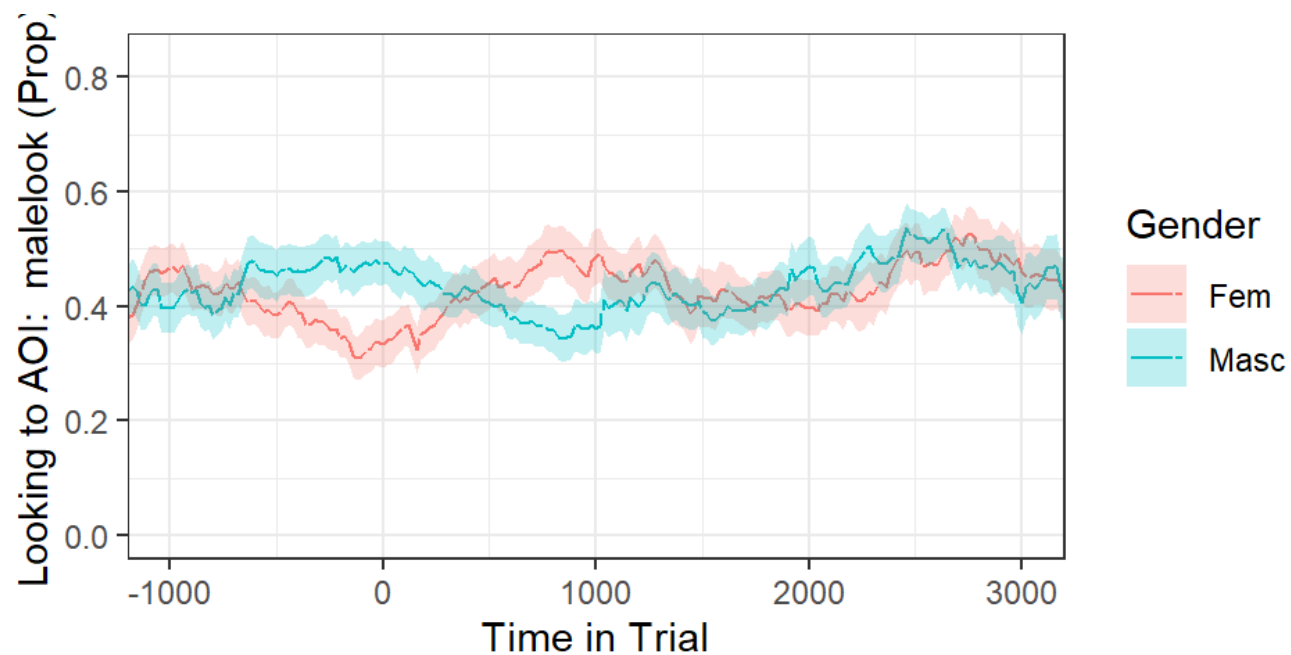


Predictors	Prop			LogitAdjusted		
	Estimates	Statistic	p	Estimates	Statistic	p
(Intercept)	0.43	12.19	<0.001	-0.67	-1.62	0.106
Condition	0.03	1.03	0.305	0.20	0.56	0.576
Window	0.03	0.86	0.393	0.32	0.90	0.370
Condition x Window	-0.05	-1.03	0.305	-0.32	-0.64	0.523
Random Effects						
σ^2	0.12			14.02		
T_{00}	0.00	Session_Name_		0.07	Session_Name_	
	0.00	identifier:pic		0.00	identifier:pic	
	0.01	pic		0.81	pic	
N	16	identifier		16	identifier	
	8	pic		8	pic	
	38	Session_Name_		38	Session_Name_	
Observations	903			903		
Marginal R ² / Conditional R ²	0.001 / NA			0.001 / NA		

Results for Adjective 1

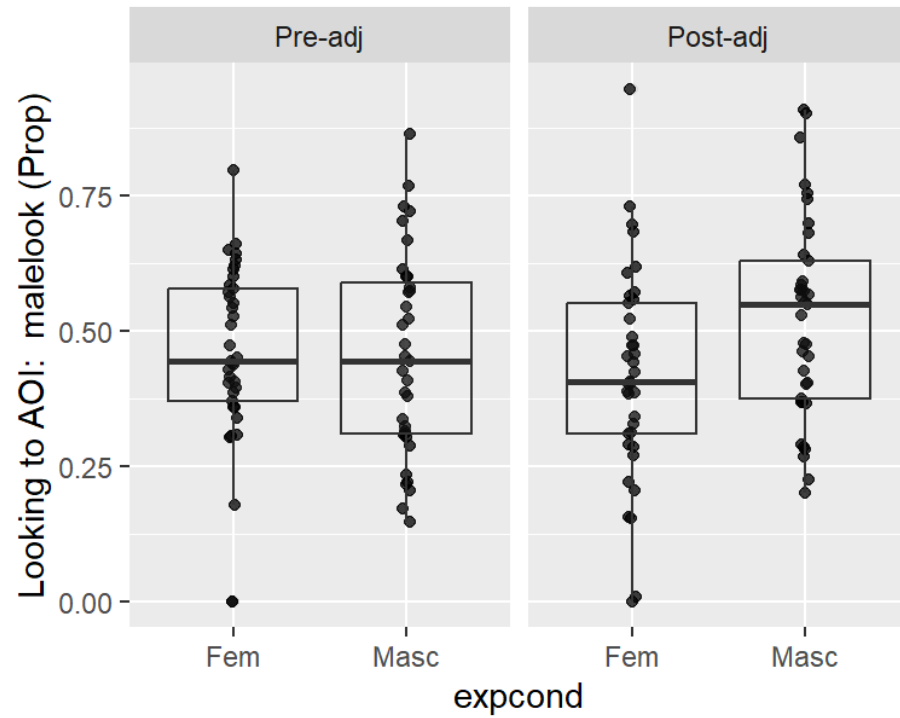
2. Permutation analysis

No significant results



Results for Adjective 2

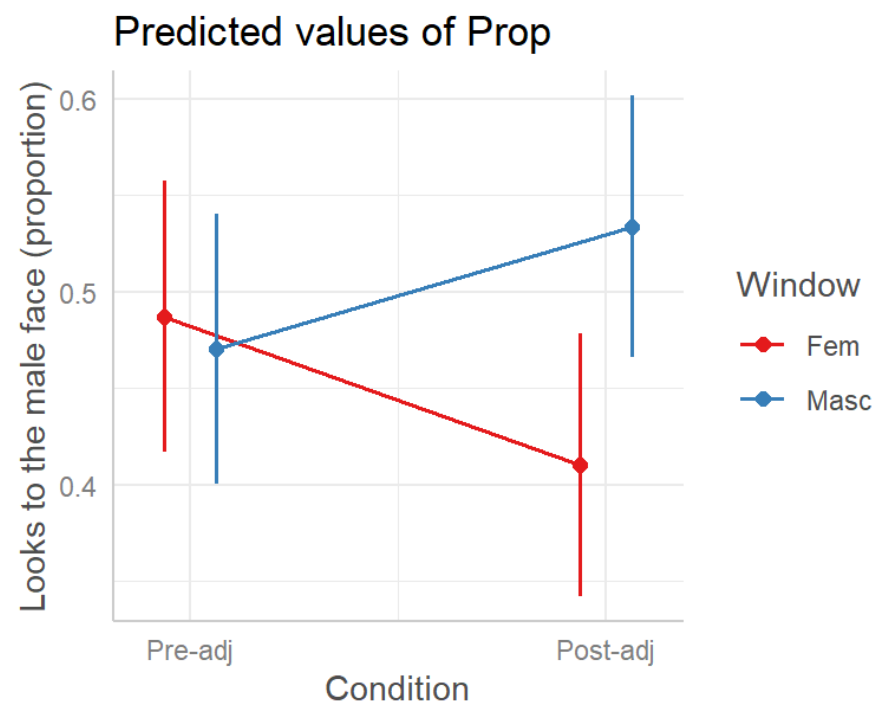
1. Time windows



Results for Adjective 2

1. Time windows

Significant interaction

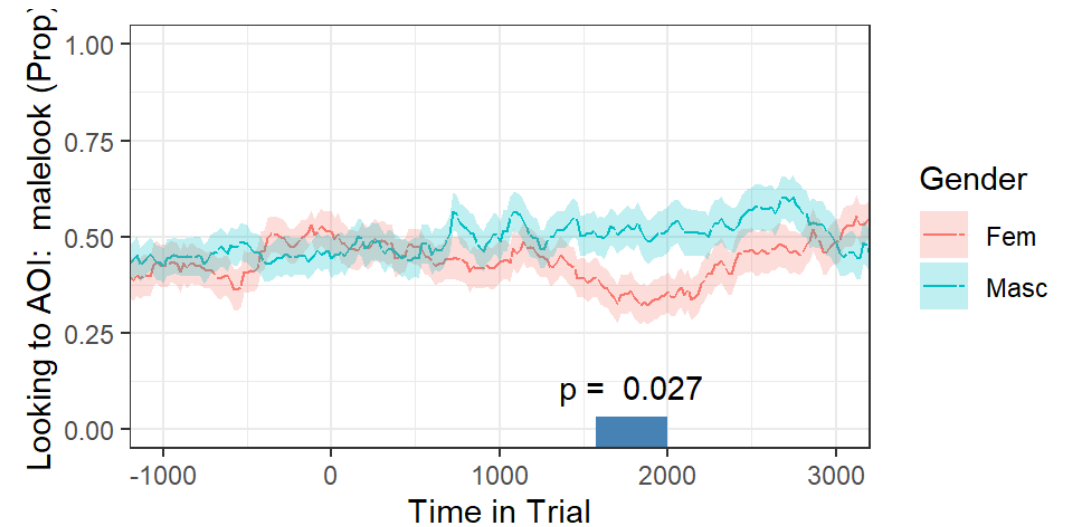


Predictors	Prop			LogitAdjusted		
	Estimates	Statistic	p	Estimates	Statistic	p
(Intercept)	0.49	13.61	<0.001	-0.11	-0.23	0.815
Condition	-0.02	-0.41	0.680	-0.36	-0.72	0.472
Window	-0.08	-2.11	0.035	-1.07	-2.44	0.015
Condition x Window	0.14	2.74	0.006	1.74	2.82	0.005
Random Effects						
σ^2	0.13			18.13		
T_{00}	0.00	Session_Name_		0.28	Session_Name_	
	0.00	identifier:pic		0.19	identifier:pic	
	0.00	pic		0.56	pic	
ICC	0.05			0.05		
N	16	identifier		16	identifier	
	8	pic		8	pic	
	37	Session_Name_		37	Session_Name_	
Observations	763			763		
Marginal R ² / Conditional R ²	0.015 / 0.065			0.014 / 0.067		

Results for Adjective 2

2. Permutation analyses

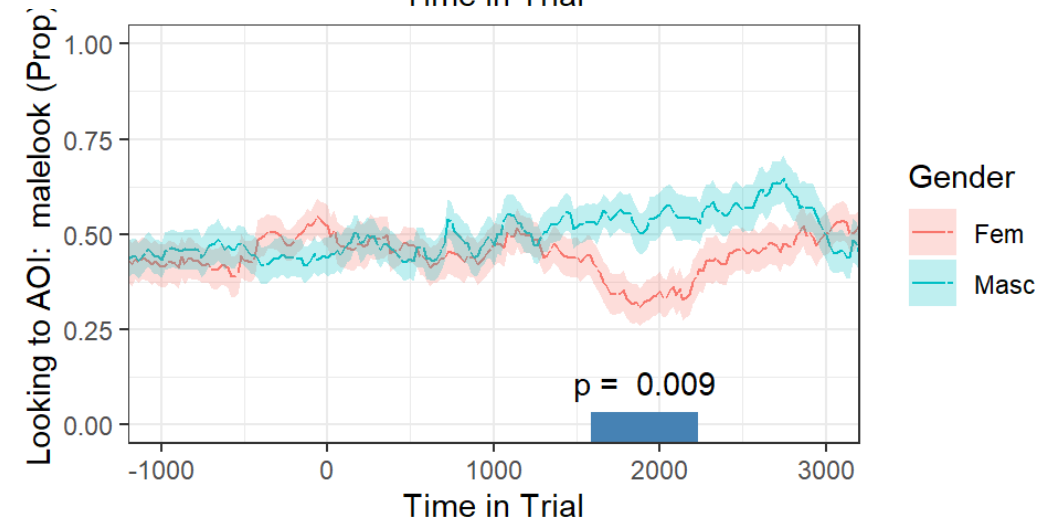
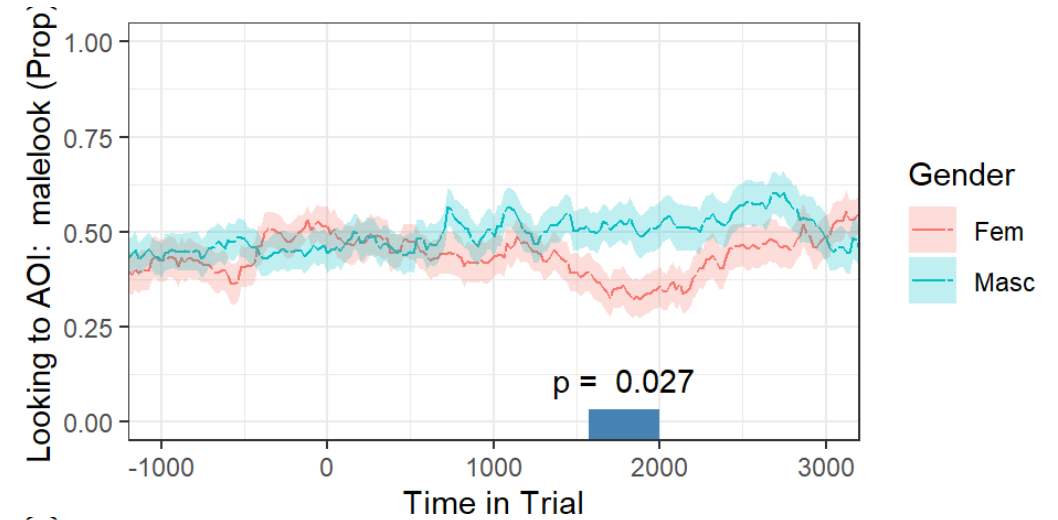
- Significant cluster identified
- $p=0.027$, with 37 kids with min. 2 trials/condition



Results for Adjective 2

2. Permutation analyses

- Significant cluster identified
- $p=0.027$, with 37 kids with min. 2 trials/condition
- $p=0.009$, with 31 kids with min. 3 trials/condition



Discussion

- Czech 18- to 24-month-olds have emerging knowledge of adjective inflections
- They associate inflections with a semantic/social category
 - specific lexical association less likely
- Why only the second adjective?
 - Children are slow
 - difficult to make the connection between grammar and social category (x baseline)
- Asymmetry between the effect of feminine and masculine adjective?
 - stronger in feminines
 - masculine form (*hezký*) is standard (not colloquial), feminine form (*velká*) is universal
- What about non-nominative forms?

Thank you!

Conley, M. I., Dellarco, D. V., Rubien-Thomas, E., Cohen, A. O., Cervera, A., Tottenham, N., & Casey, B. J. (2018). The racially diverse affective expression (RADIATE) face stimulus set. *Psychiatry research*, 270, 1059-1067.

Corbett, Greville G. (2013). *Number of genders*. In Dryer, Matthew S. & Haspelmath, Martin (Eds.), *WALS Online* (v2020.4) [Data set]. Zenodo.

Johnson, E.K., & Diks, M. (2005). On-line processing of grammatical gender in Dutch-learning toddlers. Paper presented at the Xth International Congress for the Study of Child Language, Berlin, Germany.

Kupisch, T., Mitrofanova, N., & Westergaard, M. (2022). Phonological vs. natural gender cues in the acquisition of German by simultaneous and sequential bilinguals (German–Russian). *Journal of Child Language*, 49(4), 661-683.

Lew-Williams, C., & Fernald, A. (2007). Young children learning Spanish make rapid use of grammatical gender in spoken word recognition. *Psychological science*, 18(3), 193-198.

Smolíková, F., & Bláhová, V. (2019). Czech 23-month-olds use gender agreement to anticipate upcoming nouns. *Journal of Experimental Child Psychology*, 178, 251-265.

Van Heugten, M., & Shi, R. (2009). French-learning toddlers use gender information on determiners during word recognition. *Developmental Science*, 12(3), 419-425.



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