

# LOCUS OF GENDER RESOLUTION: ON GOAL OR ON PROBE?

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**AGREEMENT IN MULTIVALUATION CONSTRUCTIONS (AMC 2021)**

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## OVERVIEW

- ▶ CONJUNCT AGREEMENT IN (SOUTH) SLAVIC
  - ▶ Single-Conjunct Agreement and ConjP Agreement
- ▶ THEORETICAL LANDSCAPE
  - ▶ Gender Resolution in (South) Slavic
    - ▶ Locus of Gender Resolution: on Probe or on Goal?
- ▶ EXPERIMENTALLY SOURCED DATA
  - ▶ Self-paced reading experiments (EXP1-3)



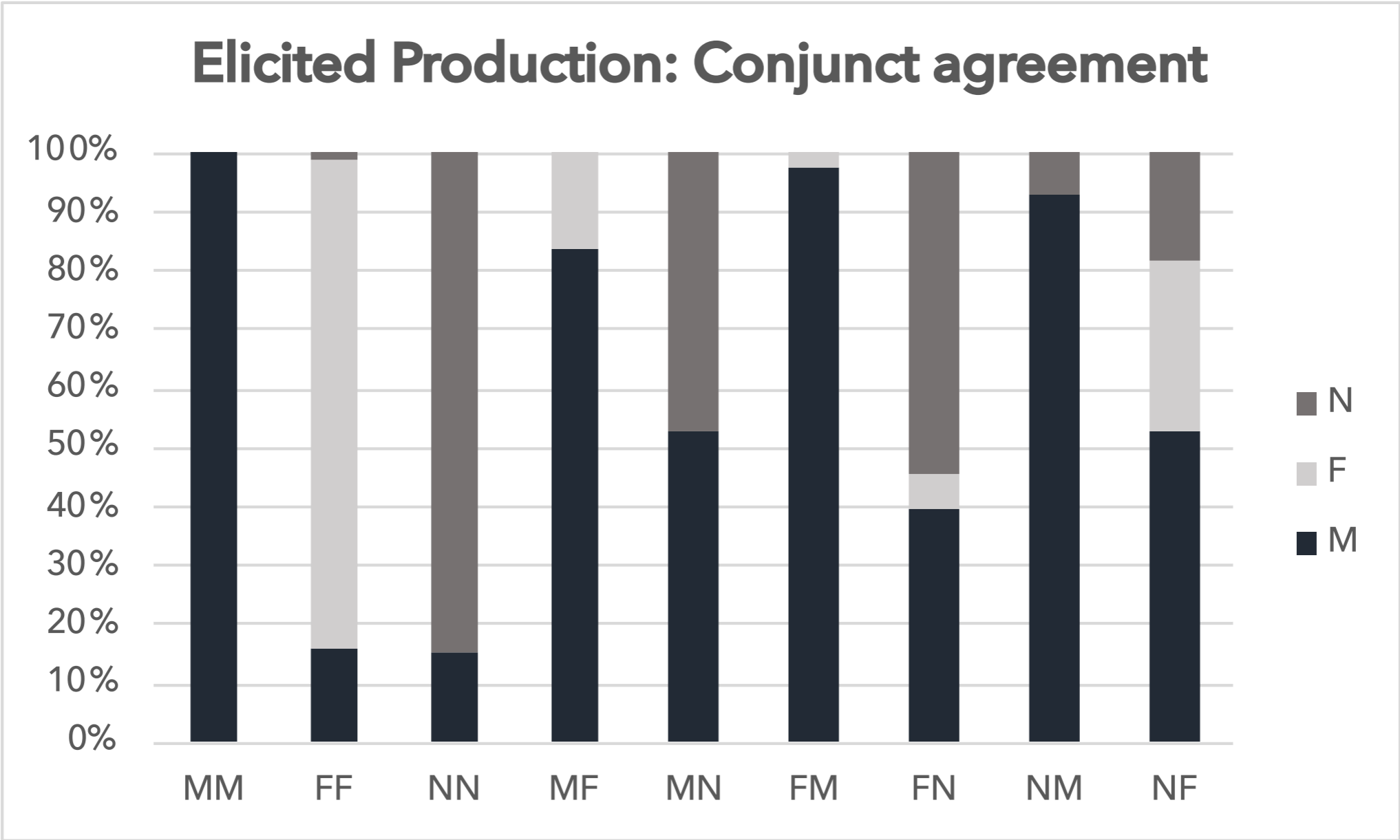
# EXPERIMENTAL DATA: SINGLE-CONJUNCT AGREEMENT

- ▶ Closest conjunct agreement is a preferred agreement strategy pre- and post-verbally (Elicited production studies - Marušič et al. 2015, Willer-Gold et al. 2016/2018)
- ▶ Closest conjunct agreement is a stable agreement strategy unlike the low rate production (attraction) errors (Elicited production studies - Marušič et al. 2015, Willer-Gold et al. 2016/2018)
- ▶ Closest conjunct agreement in gender is facilitated by number feature (plural conjuncts), morpho-phonology (syncretism) and semantics (animacy, agentivity and collective interpretation) (Elicited production studies - Marušič et al. 2015, Arsenijević and Mitić 2016a,b, Mitić and Arsenijević 2019, pseudo-words Peti-Stantić et al. 2015)
- ▶ Closest conjunct agreement post-verbally is unlikely derived only from reduced clausal conjunction, its more likely source is phrasal conjunction (Sentence picture matching task, Forced choice picture task - Arsenijević et al. 2019; Forced-choice switch agreement task - Arsenijević et al. 2019)

# EXPERIMENTAL DATA: CONJP AGREEMENT

- ▶ Word order effects - asymmetry wrt to *default masculine plural*, as no *default masculine plural* is produced in post-verbal order (Elicited production and acceptability judgment study Willer-Gold et al. 2016/18) (a.o. Corbett 1983, Smith 2013)
- ▶ Uniform gender conjuncts show preference for same-gender agreement over *default masculine plural* (FF/NN=M:15%) (Elicited production and acceptability judgment Willer-Gold et al. 2016/18) (a.o. Corbett 1983)
- ▶ Mixed gender conjuncts rely on *default masculine plural* as a 'fill-in' strategy relative to markedness of NP2's gender (FN=M:38% or NF=M:52%) (Elicited production and acceptability judgment Willer-Gold et al. 2016/18)

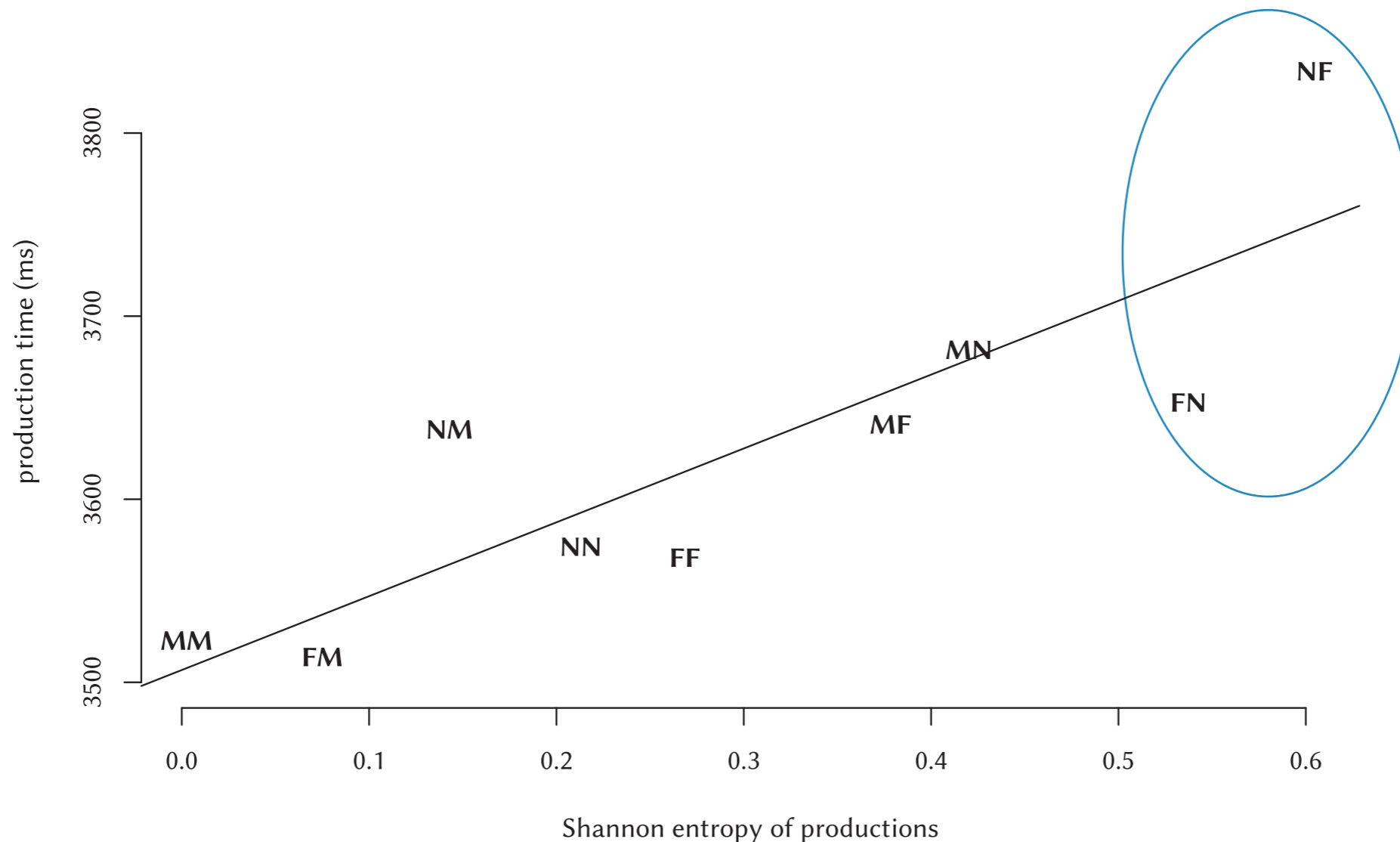
# EXPERIMENTAL DATA: CONJNP AGREEMENT



# EXPERIMENTAL DATA: CONJP AGREEMENT

- ▶ Production times of produced sentences (ConjP-Aux-Part-Adv) for the nine gender combinations in preverbal order show strong correlation with uniformity of agreement exponents (Elicited production study Willer-Gold et al. 2018).
- ▶ Shortest production times were recorded for [MM=M,M,M] and longest for [FN/NF=F,N,M].
- ▶ This data suggest that parallel activation of conjunct agreement strategies is resolved by competition at the level of morphological exponents, i.e. selection of a morphological form for a gender value to be produced on the participle. Caveat: Production times are a gross measure in need of further examination.
  - ▶ Taken together these data warrant further experimental investigation into processing of ConjP Agreement especially considering the existing theoretical landscape on the agreement with the entire ConjP.

# EXPERIMENTAL DATA: CONJNP AGREEMENT

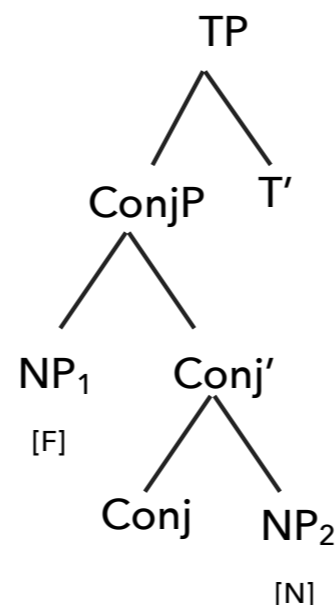


**Fig. 5.** Production time is significantly correlated with uniformity of productions for the nine gender combinations in the SV condition (where highest and closest agreement diverge),  $n = 180$ . In a fully crossed mixed-effects regression, Shannon entropy of responses significantly predicts production time,  $\beta = 86$ ,  $t = 4.10$ ,  $P < 0.0001$ .



# THEORETICAL LANDSCAPE: CONJP AGREEMENT

- ▶ Agreement is standardly defined as a syntactic operation of feature valuation where the feature values of the Goal are copied onto the Probe.
- ▶ Interesting puzzle arises in environments where there is more than one Goal, and hence more than one feature; as well as in the environments where there are no features on a single Goal.
- ▶ Conjunction Phrase (ConjP) can be taken as a prime example of these multiple Goal+no feature environments with gender feature given on the two conjunct NPs but not necessarily readily available on ConjP.



# LOCUS OF RESOLUTION: ON PROBE OR GOAL?

- ▶ Two main mechanisms have been proposed to *resolve* the (mis)match in features in multiple Goals and to *prevent* failure of agreement in no feature environments: *resolution rules* (e.g. percolation) - syntactic rules that interact with semantics; and, *default insertion rules*, which inserts default feature value (at PF) (Nevins and Weisser 2019, Franks and Willer-Gold 2014, Marušič et al. 2015 a.o.).
- ▶ While it has standardly been assumed that *resolution rules* and *default insertion rules* take place in the Goal domain, on Conj(P), there is no a priori reason why there should be a bias for these mechanisms to act on the Goal (Franks & Willer-Gold 2014, Murphy and Puškar 2018, Marušič et al. 2015).
- ▶ With valuation taking place on the Probe (by the Goal), a valid line of research assumes that the mechanisms calculating those feature values in multiple Goal+no feature environments to be either those valuing the Probe or the Probe itself (Citko 2018, Bošković 2009; Shen 2018).
  - ▶ Locus of resolution determines locus of resolved gender....

# LOCUS OF GENDER: GENDER ON GOAL

- ▶ ConjP is endowed with a full set of  $\varphi$ -features including gender.
  - ▶ Gender feature is obtained by resolution or default masculine gender insertion and is later copied onto a single probe (Franks and Willer-Gold 2014).
  - ▶ ConjP obtains gender values by percolation of gender features from Conj-head which has merged and agreed with the two conjuncts and hence obtained their gender features. In addition, Conj-head itself can be valued with masculine gender (if this variant of Conj-head is selected from the lexicon), which leads to percolation of three gender values onto ConjP. These values are then copied onto the Probe where impoverishment based resolution takes place (Murphy and Puškar 2018).

# LOCUS OF GENDER: NO GENDER ON GOAL

- ▶ ConjP is specified for number but not gender.
  - ▶ ConjP obtains gender value by insertion of default masculine gender ([- singular → +masc]) in *No-Peeking* grammar where number is valued before gender. In the next step of the derivation, this default value is copied onto the participle Probe (Marušič et al. 2015).
  - ▶ A single probe can agree with two goals - number on ConjP and gender on NP1, which leads to a pied-piping ambiguity, a conflict in need of resolution to avoid agreement failure. This is achieved by deletion of the gender value on probe and replacement by default masculine value (Bošković 2009).

# LOCUS OF GENDER: GENDER ON PROBE

- ▶ ConjP (nor Conj-head) is *not* specified for gender.
  - ▶ Single finite probe undergoes Multiple Agree with two conjuncts followed by feature resolution on the probe. Feature resolution proceeds according to language specific gender feature resolution rules (masculine personal & masculine/feminine/ neuter = virile/masculine personal, *Elsewhere*: nonvirile/nonmasculine personal) (Citko 2018)

## THEORETICAL HYPOTHESIS SPACE

		F&WG 2014	M&P 2018	Metal 2015	Bosković 2019	Citko 2018
Gender on ConjP/Goal		✓	✓	✓	X	X
Goal	Default insertion	✓		✓		
	Resolution	✓				
Probe	Default insertion				✓	
	Resolution		✓			✓

# TOWARDS AN EXPERIMENTAL STUDY

- ▶ The aim is to experimentally explore and evaluate existing theories of gender agreement in order to validate the possibility of *probe* computing resolution.
- ▶ For the purposes of the experimental study, the focus is on gender resolution which is taken to be marked by the *masculine plural* form on the agreeing participle.

# EXPERIMENTAL STUDY: LOCUS OF RESOLUTION?

- ▶ Experimental studies of prediction have shown gender feature to be highly predictable (for Russian Sekerina 2012, Akhutina et al. 1999; for Slovak Badecker and Kuminiak 2007; for Spanish Wicha, Moreno, and Kutas, 2003, 2004; for Dutch van Berkum et al. 2005, a.o.).
- ▶ Contextually constrained gender feature is often used in experimental paradigms to form predictions about upcoming noun. Violations of that prediction by intervening modifier (determiner, adjective etc.) with morphologically expressed but *unexpected* gender value has been shown to cause disruption to gender agreement processing. This disruption is quickly picked up even before the target noun has been presented (verbally or visually) in eye-tracking studies by increase in reaction times, and in ERP studies by larger N-400.
  - ▶ Assuming that gender feature is computed on ConjP, we would expect it to be used to predict the gender value on the upcoming agreeing participle and, hence, facilitate processing of the target participle matched in gender value. BUT equally impede processing of the target participle when *mismatched* in gender value is detected.
  - ▶ M vs N: Resolution of *default masculine plural* on the Goal should facilitate processing of a Probe with matching *masculine plural* value. BUT impede processing of a Probe with *mismatched* neuter plural value.



## EXPERIMENTAL STUDY: HYPOTHESIS

- ▶ Hypothesis1: If gender (*masculine plural*) is computed on ConjP, prediction-inconsistent/mismatching gender feature on the agreeing participle (*neuter plural*) will (signal violation and) impede processing. => [MM=\*N]
- ▶ Hypothesis2: If gender is computed on ConjP, prediction-consistent/matched (*masculine plural*) and prediction-inconsistent/mismatched (*neuter plural*) value on the agreeing participle will have an equal effect on processing. => [NN/MN/FN=M,N]
  - ▶ Baseline: Computation of *masculine plural* on ConjP facilitates processing of upcoming participle with prediction-consistent/matching gender (and number) value (*masculine plural*). => [MM=M]
  - ▶ [Adv NP1 & NP2 Aux Adv PTCP-be<sub>G</sub> PTCP-v<sub>G</sub> Adv]

## EXPERIMENTAL STUDY: DESIGN

- ▶ **Experimental design:** 4(MM, NN, MN, FN)\*2 factorial design \* 12 items
- ▶ **Stimuli ( $n=48$ ):**
  - ▶ [Adv NP1 & NP2 Aux Adv PTCP-be PTCP-v Adv]
    - ▶ EXP1: 4 (ConjP: Num [PL]) \* 2 (Ptcp: Gend [M, N])
    - ▶ EXP2: 4 (ConjP: Num [SG]) \* 2 (Ptcp Gend [M, N])
    - ▶ EXP3: 4 (ConjP: Num [Sg,PL]) \* 2 (Ptcp Gend [M])
    - ▶ NP1 and NP2: inanimate, concrete (grammatical gender)
- ▶ **Fillers ( $n=60$ ):**
  - ▶ Random selection of sentences + follow-up comprehension questions

## EXPERIMENTALLY SOURCED DATA

# EXPERIMENTAL STUDY: MATERIALS

		R1	R2	R3	R4	R5	R6	R7	
	Adv	NP1	and	NP2	aux	adv	ptcp-be	ptcp-v	adv
EXP1	In spite of a heavy storm	airplane.M.PL	and	ferry.M.PL	were	properly	being.M/N.PL	driving.M/N.PL	according to the schedule
EXP2	In spite of a heavy storm	airplane.M.SG	and	ferry.M.SG	were	properly	being.M/N.PL	driving.M/N.PL	according to the schedule
EXP3	In spite of a heavy storm	airplane.M.SG/PL	and	ferry.M.SG/PL	were	properly	being.M.PL	driving.M.PL	according to the schedule
	Usprkos snažnom nevremenu	avioni	i	trajekti	su	uredno	bili	vozili	po rasporedu.

# EXPERIMENTAL STUDY: PREDICTIONS: LING DATA

CONDITIONS	EXP1		EXP2		EXP3	
	PL		SG		SG	PL
Ptcp	M	N	M	N	M	
MM	✓	<b>X</b>	✓	<b>X</b>	✓	✓
NN	✓	✓	✓	<b>X</b>	✓	✓
MN	✓	✓	✓	<b>X</b>	✓	✓
FN	✓	✓	✓	<b>X</b>	✓	✓

✓-grammatical [match], X-ungrammatical [mismatch]

# EXPERIMENTAL STUDY: PROCEDURE

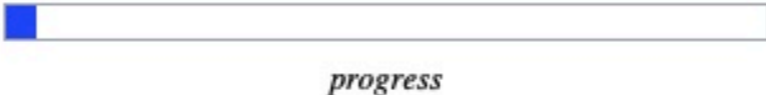
## ▶ Participants

- ▶ University students (n=28/Exp1, 36/Exp2, 35/Exp3), Native speakers of Croatian (data collected at Zadar and Zagreb)
- ▶ Age (mean= 22), Sex (female= 81, male= 18)

## ▶ Self-paced reading experiment

- ▶ **Procedure:** Participants were presented with a masked sentence. Their task was to read the sentence word by word. They would open each word by pressing on the space bar. They were instructed to read the words at a natural pace and to make sure they have understood the sentence as some would be followed by comprehension questions. Items were randomised per participants using IbexFarm.
- ▶ **Measures:** Mean reading times for each region and condition averaged across items and participants. RT<120ms and >10000 were excluded (0.09%).

# EXPERIMENTAL STUDY: IBEXFARM EXAMPLE



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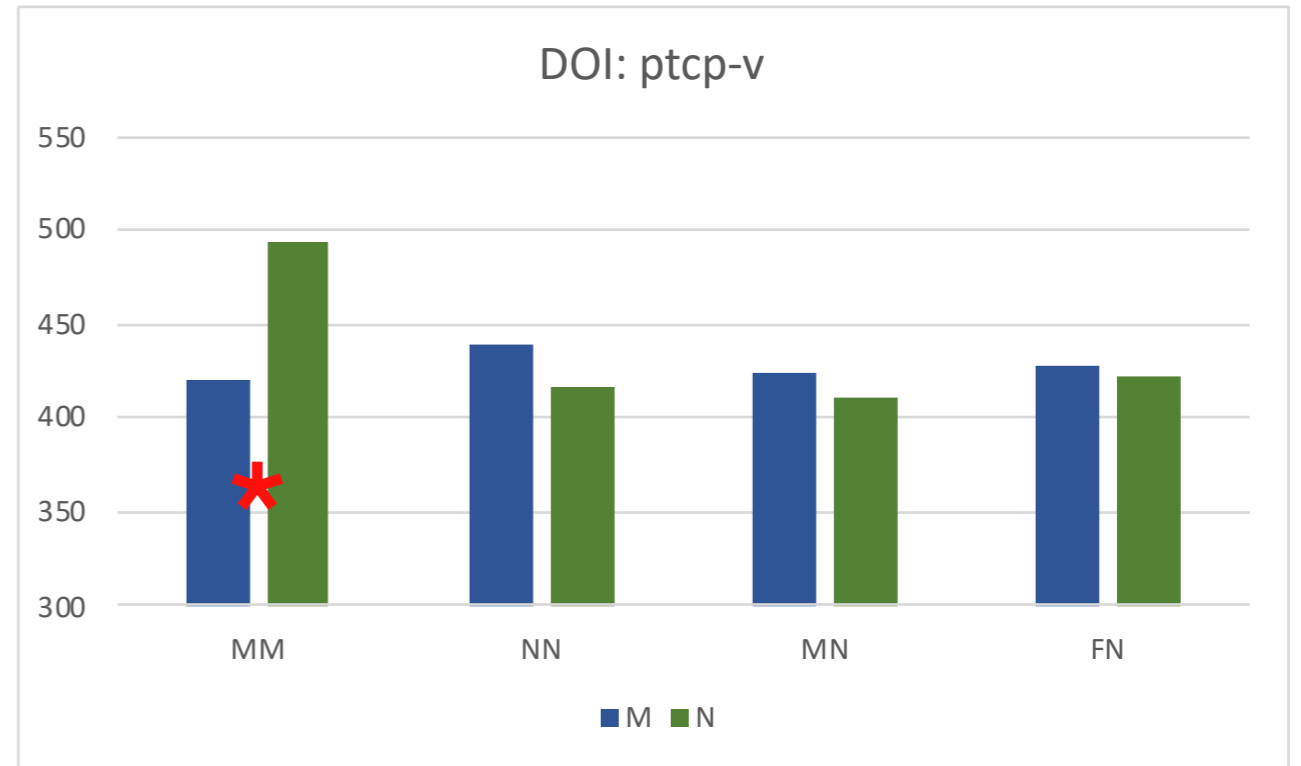
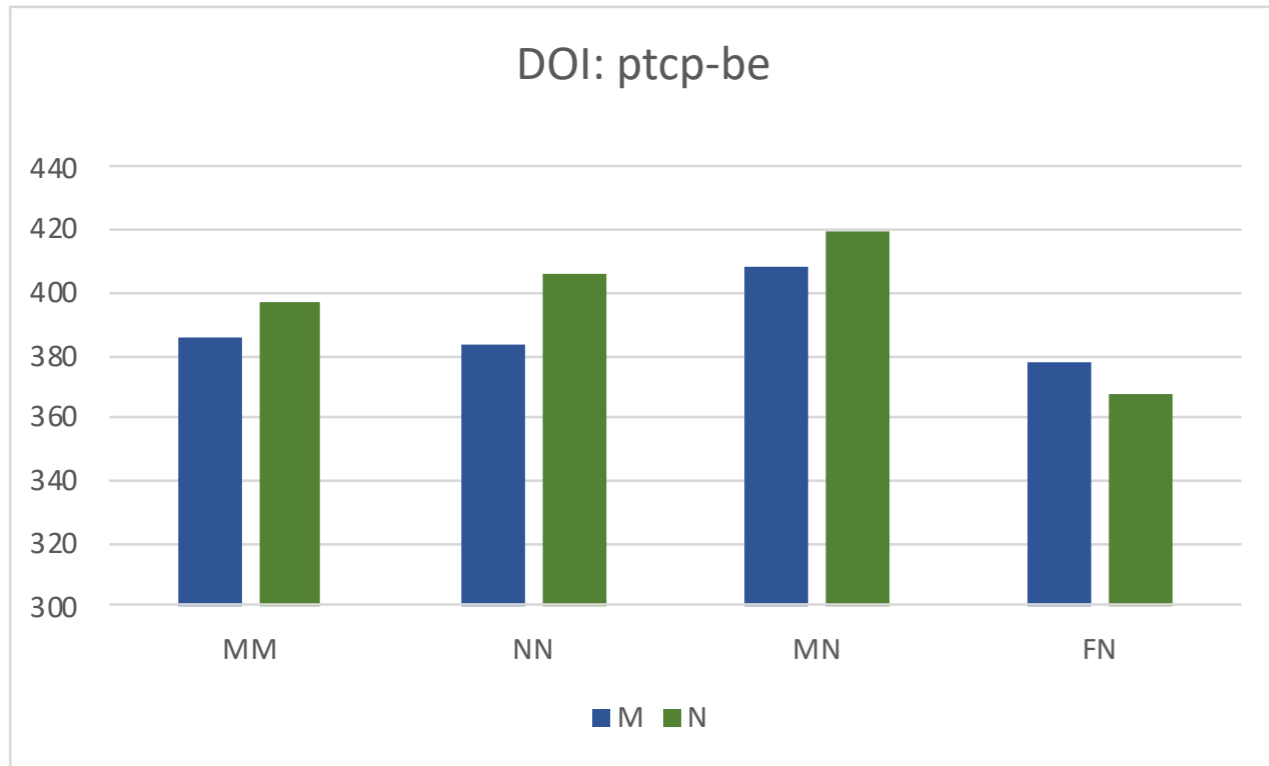
# EXPERIMENTAL STUDY: ANALYSIS

- ▶ **Analysis:** Critical regions R6 (ptcp-be) and R7 (ptcp-v)
  - ▶ **EXP1[PL]:** *Two-way ANOVA: RT ~ ConjP (NN, MN, MM, NF) \* Matching Gend (Match, Mismatch)*
  - ▶ **EXP2[SG]:** *Two-way ANOVA: RT ~ ConjP (NN, MN, MM, NF) \* Matching Gend (Match, Mismatch)*
  - ▶ **EXP3[M]:** *Two-way ANOVA: RT ~ ConjP (NN, MN, MM, NF) \* Matching Num (Match, Mismatch)*

CONDITION ConjP	EXP1		EXP2		EXP3	
	PL		SG		SG	PL
Ptcp	M	N	M	N	M	
MM	✓	**	✓	***	✓	✓
NN	✓	✓	✓	***	✓	✓
MN	✓	✓	✓	*	✓	✓
FN	✓	✓	✓	*	✓	✓

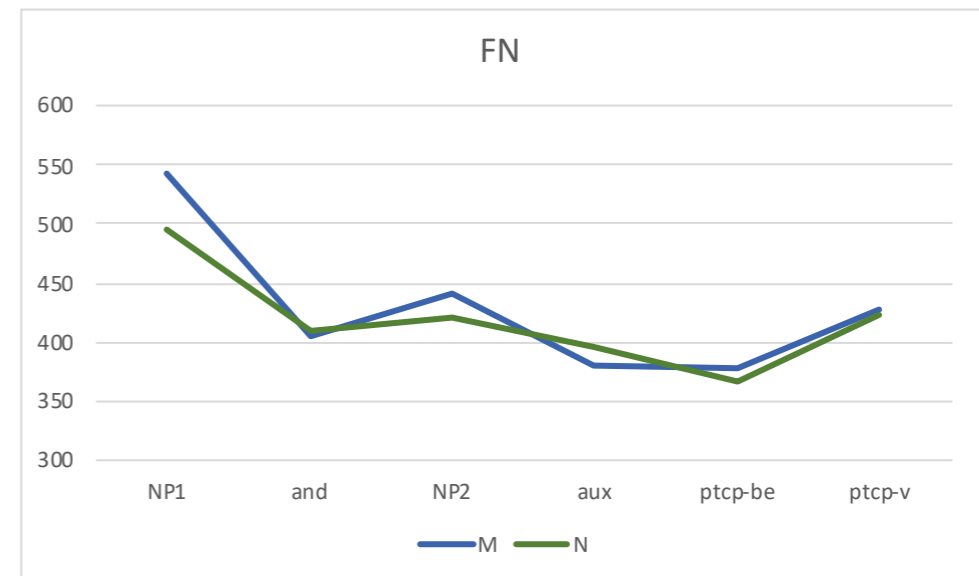
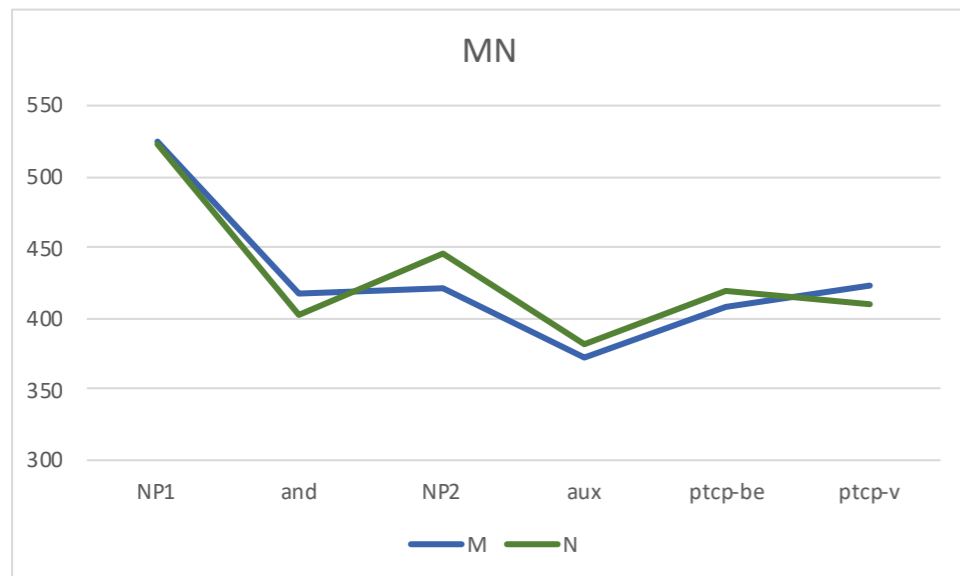
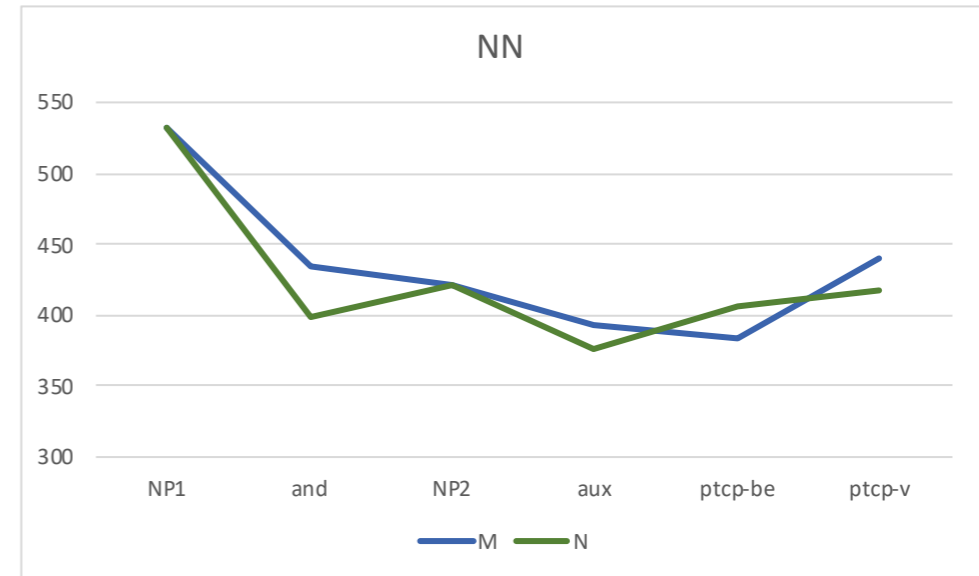
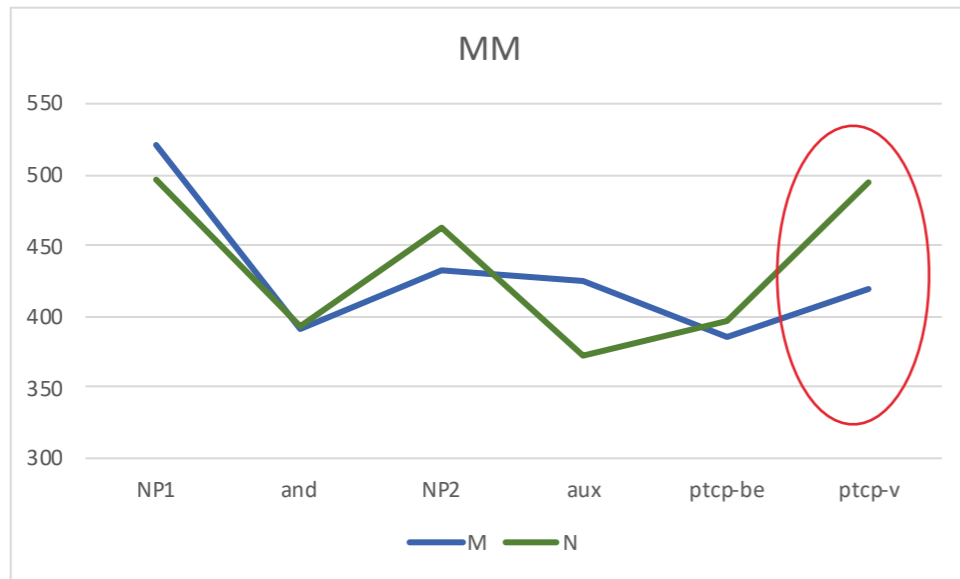
\*p < .05, \*\*p < .005, \*\*\*p < .0005

# EXP1 [PL] RESULTS

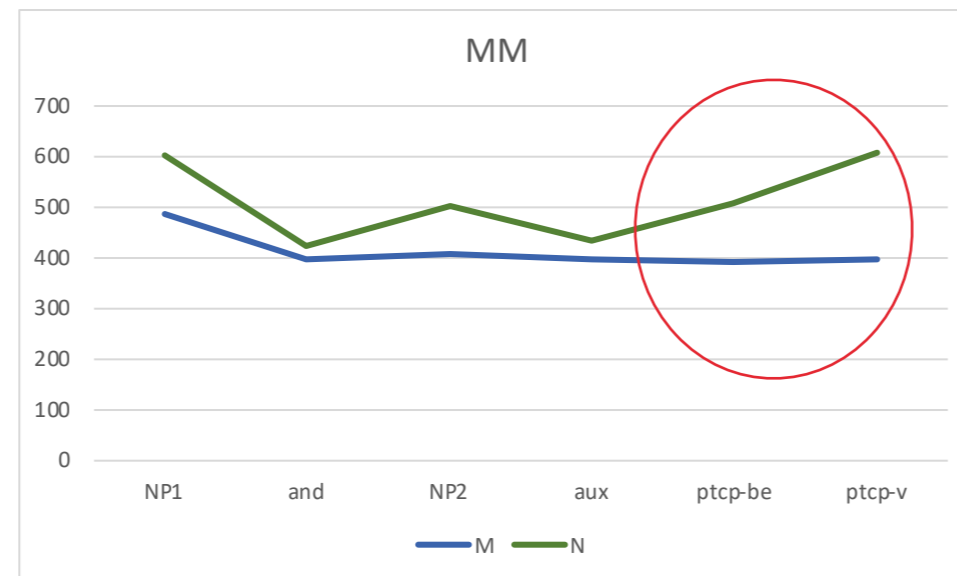
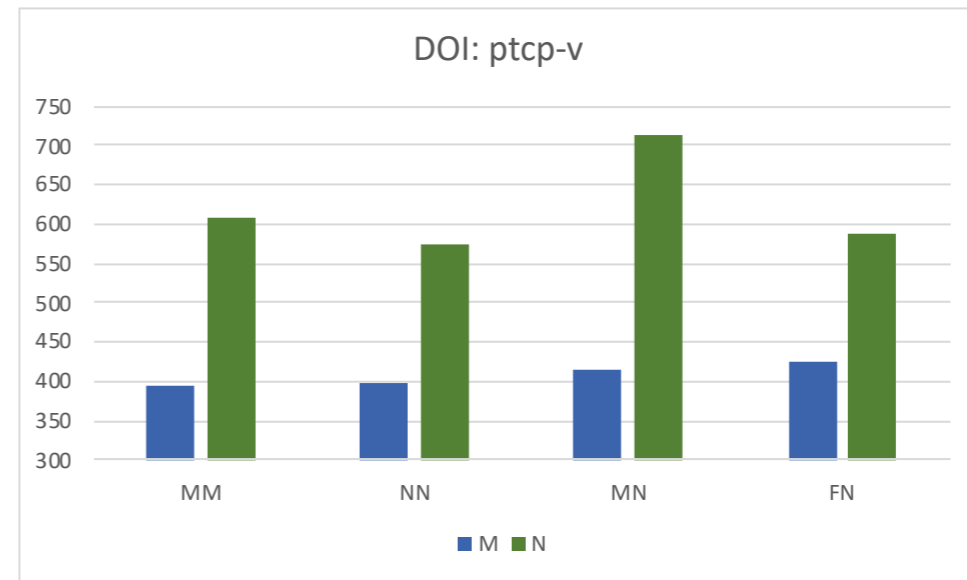
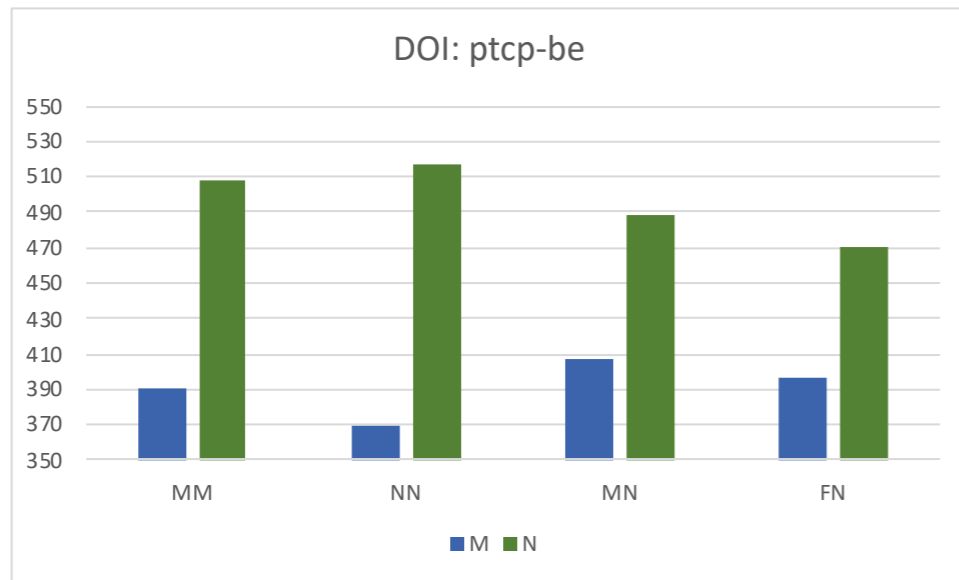




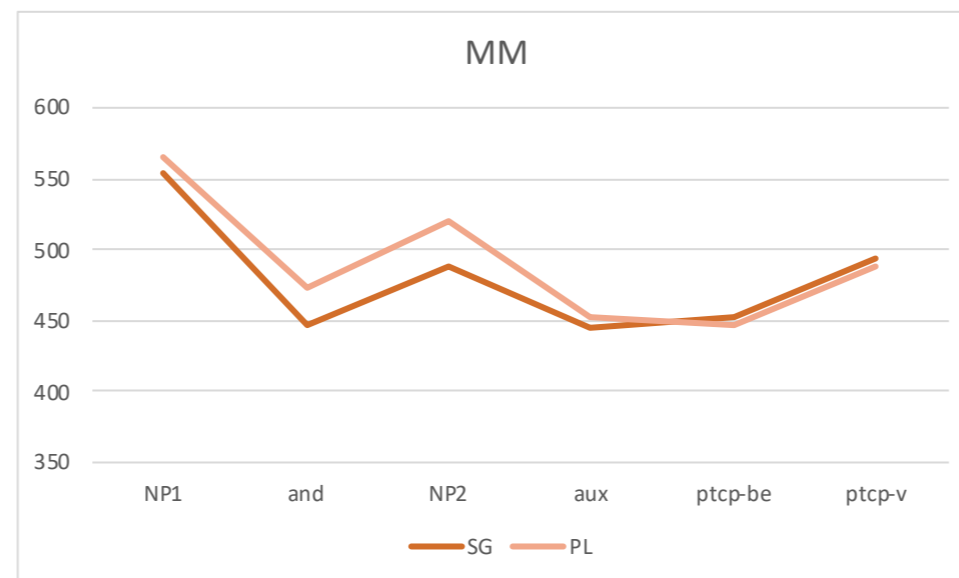
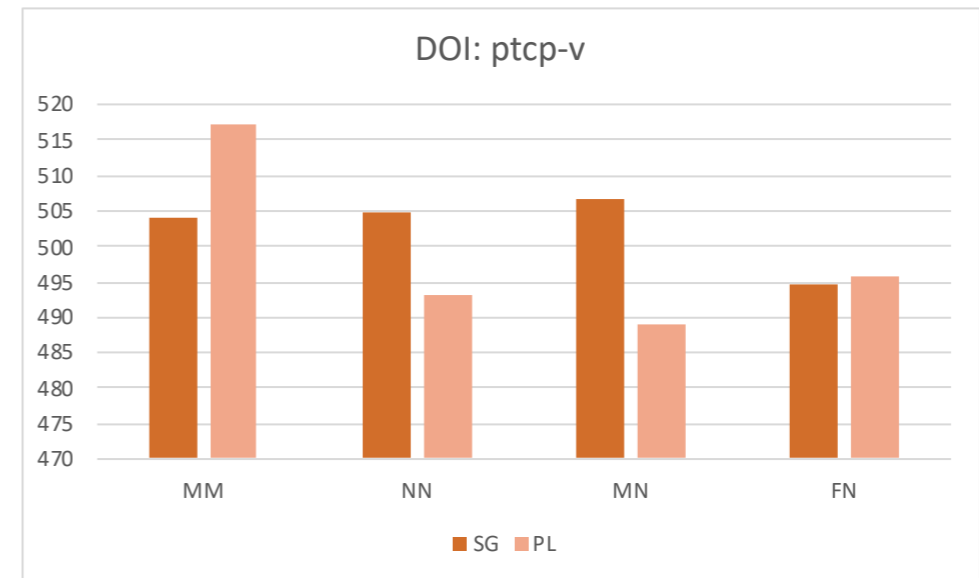
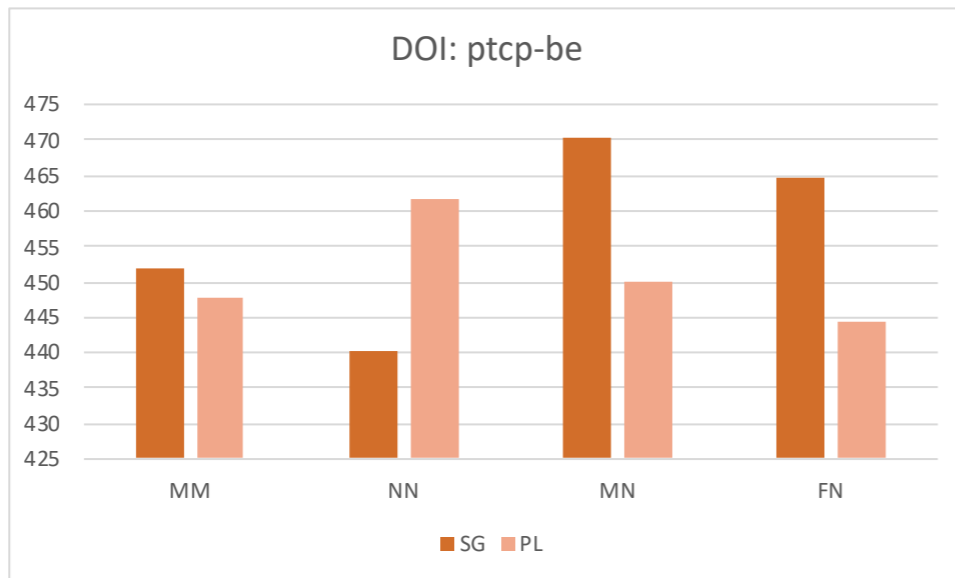
## EXP1[PL] RESULTS



## EXP2[SG]: RESULTS



## EXP3[M]: RESULTS



# EXPERIMENTAL STUDY: RESULTS

- ▶ Exp1: Late and robust ungrammaticality effects were observed in *Ptcp-v* but *not in Ptcp-be* critical region in [MM=\*N] condition. Relative to the baseline condition, these sentences with a prediction-inconsistent gender show a significant slowdown in reading times on the second encounter of the agreeing participle (Ptcp-v).
- ▶ Exp2: Early and robust ungrammaticality effects were observed in the two critical regions *Ptcp-be* and *Ptcp-v* for all [SGSG=\*N] conditions. Significant slowdown in reading times compared to the baseline is observed already at the first encounter of the mismatched gender value (neuter) on the agreeing participle (Ptcp-be) and strengthened at the second encounter (Ptcp-v). Spending longer time over the entire critical region (R6 and R7) suggests that the readers have not only detected the prediction error (unexpected agreement on the participles) but have been attempting to resolve this ungrammaticality.
- ▶ Exp3: No effect was observed. No significant slowdown in grammatical sentences suggests that the expectation of the *masculine* gender on the agreeing participle is independent of gender (and number) values of the two conjuncts.

# EXPERIMENTAL STUDY: DISCUSSION

- ▶ Late gender effects in [MM=\*N] cond - delay in detecting unexpected/mismatched agreement, is often reported for self-paced reading experiments (3 words delay in prediction studies van Berkum et al. 2005, V+1,2 in attraction Tucker et al. 2021, a.o.)
  - ▶ Illusory licensing in attraction studies - involves low-level feature checking without a contribution to or having impact on semantic processing, i.e. interpretation of a sentence (Schlueter et al. 2018). Note that in the case of [MM=\*N] there is no overt attractor (neuter NP) and there is a marked slowdown in RTs.
  - ▶ Prediction revision - detection of a prediction-inconsistent value can be used to promptly to revise a prediction when the unexpected target matching this value is also available (Chow and Chen 2020).
  - ▶ Ecological validity - [MM=\*N] condition is embedded in a larger paradigm where multiple agreement strategies are available (resolved (M) + CCA (N) (Palmović and Willer-Gold 2016).

# EXPERIMENTAL STUDY: CONCLUSION

- ▶ Ungrammaticality effects observed in Exp1 and Exp2 favour the *Goal* oriented approaches to ConjP agreement that argue for (masculine) gender value to be readily available on ConjP.
- ▶ In a multiple agreement experimental paradigm, the *masculine gender* prediction is open to quick revision and accommodation of other plausible gender values (neuter) derived by the availability of other gender agreement strategies (CCA).
- ▶ Conflicting data from comprehension (self-paced reading) and production (elicited production) study favouring *Goal* and *Probe* approaches, respectively, could find its grounding in the production-comprehension asymmetry observed in gender attraction studies (for French Villata and Franck 2019; for Russian Slioussar and Malko 2016)

## EXPERIMENTAL STUDY: FUTURE DIRECTIONS

- ▶ These tentative conclusion about predictions in ConjP agreement based on self-paced reading task should be subjected to replication and further experimental verification by time sensitive methods (ERP and Eye-tracking), and on other languages with a default and CCA.

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THANK YOU AMC2021 VIEWERS!



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