

The influence of tens and units inversion in a two-digit number matching task in German and French monolinguals and bilinguals

Bilingual number matching

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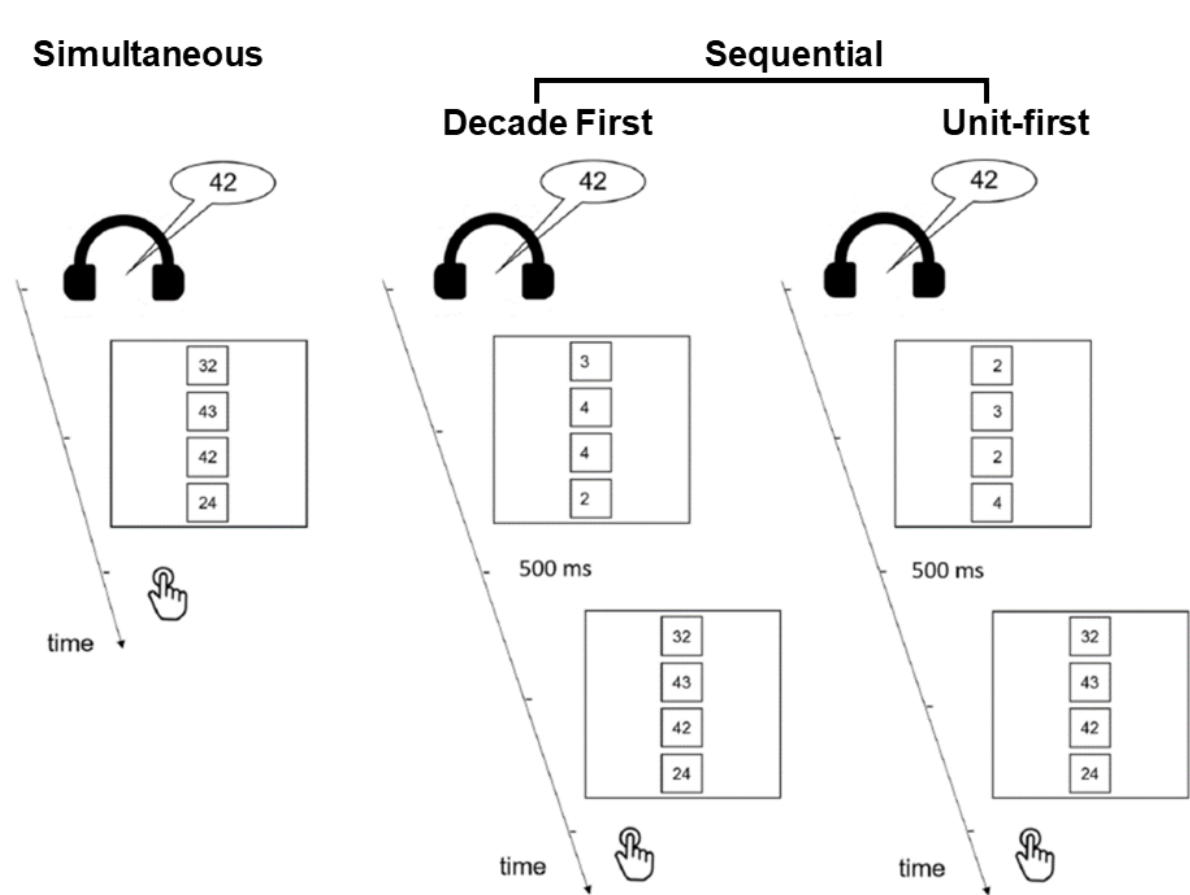
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Introduction

The verbal representations of numbers might be influenced by (A) language profiles (bilinguals vs. monolinguals) (Van Rinsveld et al. 2016a, 2016b; Poncin, Van Rinsveld, and Schiltz 2020) (B) Language of learning mathematics (i.e. LM2 cost) (Bernardo 2001) and (C) languages themselves (i.e. German vs. French) (Clayton et al. 2020; Steiner et al. 2021; Finke et al. 2021). For example, in comparison to Arabic digits writing system (i.e. 42: Decade Unit (DU)), German number words are inverted (i.e. Vier und Zwanzig: UD) while French number words are not (i.e. Quarante-deux: DU).

Task

We used an auditory-visual number matching task. The participant heard a number word and had then to click on the visually presented matching number. There were one simultaneous condition, where both numbers appear at the same time and two sequential conditions: decade first to mimic the French's DU system: decades were presented 500 ms, unit first to mimic the German's UD inversion: The unit was presented for 500 ms, followed by the full number.



In addition the participant solved a math fluency task (De Vos 1992). The task was implemented online on Labvanced (Finger et al. 2017). Monolingual participants were recruited in prolific [www.prolific.co], and bilinguals through the university of Luxembourg.

Stimuli

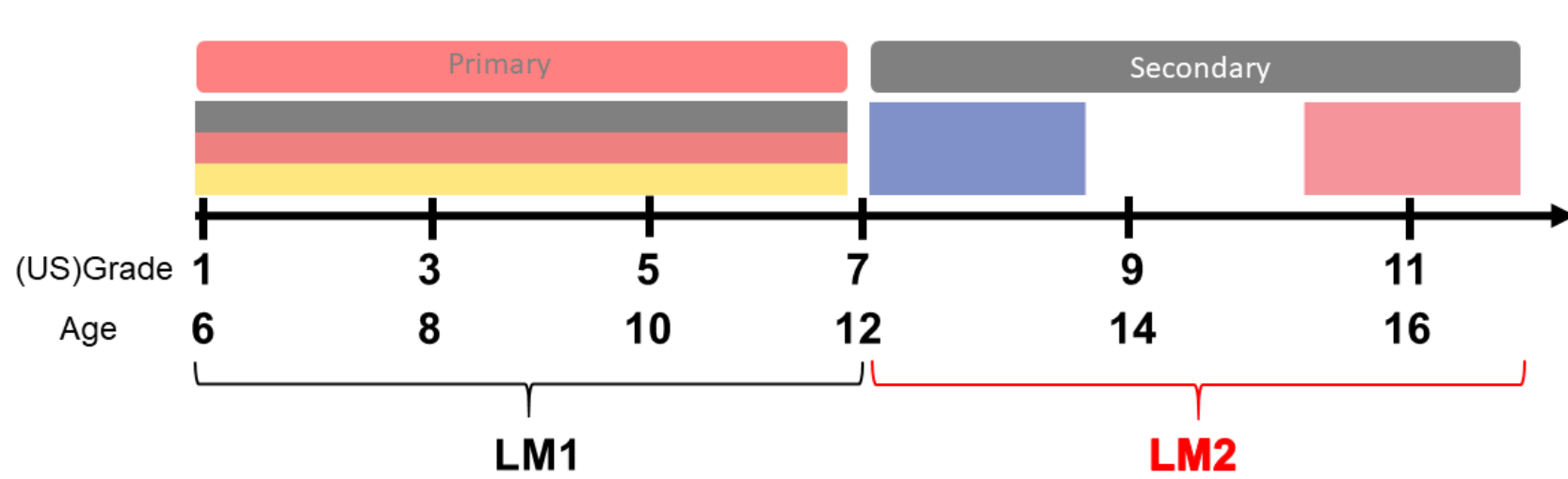
Decades (i.e. 20, 30), ties (i.e. 22, 33), 1 and 9 unit numbers (i.e. 21, 29), were excluded from numbers ranging between 20 and 70. Distractor numbers were generated by adding or removing +/- 1 of the target. Recordings were standardized over intensity.

Population

The groups had comparable TTR scores ($F(2, 135) = 2.5, p = .09$). There were overall 1.17% errors for the matching task.

Group	n	men	Age	TTR	TTRsd	NumberOfLang
Bil	23	9	22.96	105.70	23.23	4.61
MonoDE	59	29	22.36	114.19	19.98	2.88
MonoFR	56	32	22.88	106.11	21.88	2.73

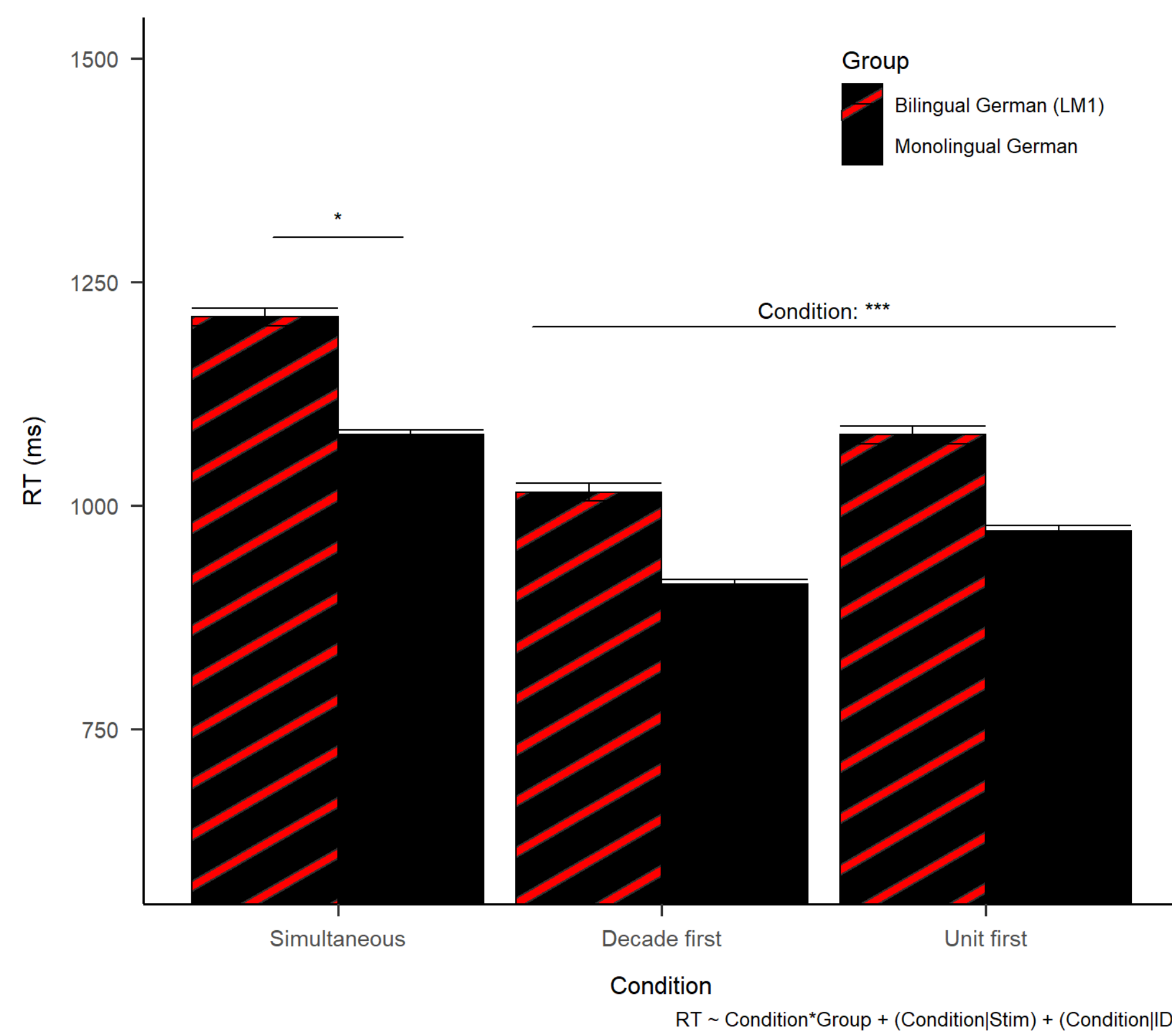
Bilinguals were highly proficient and learned mathematics first in German (LM1) and then in French (LM2)



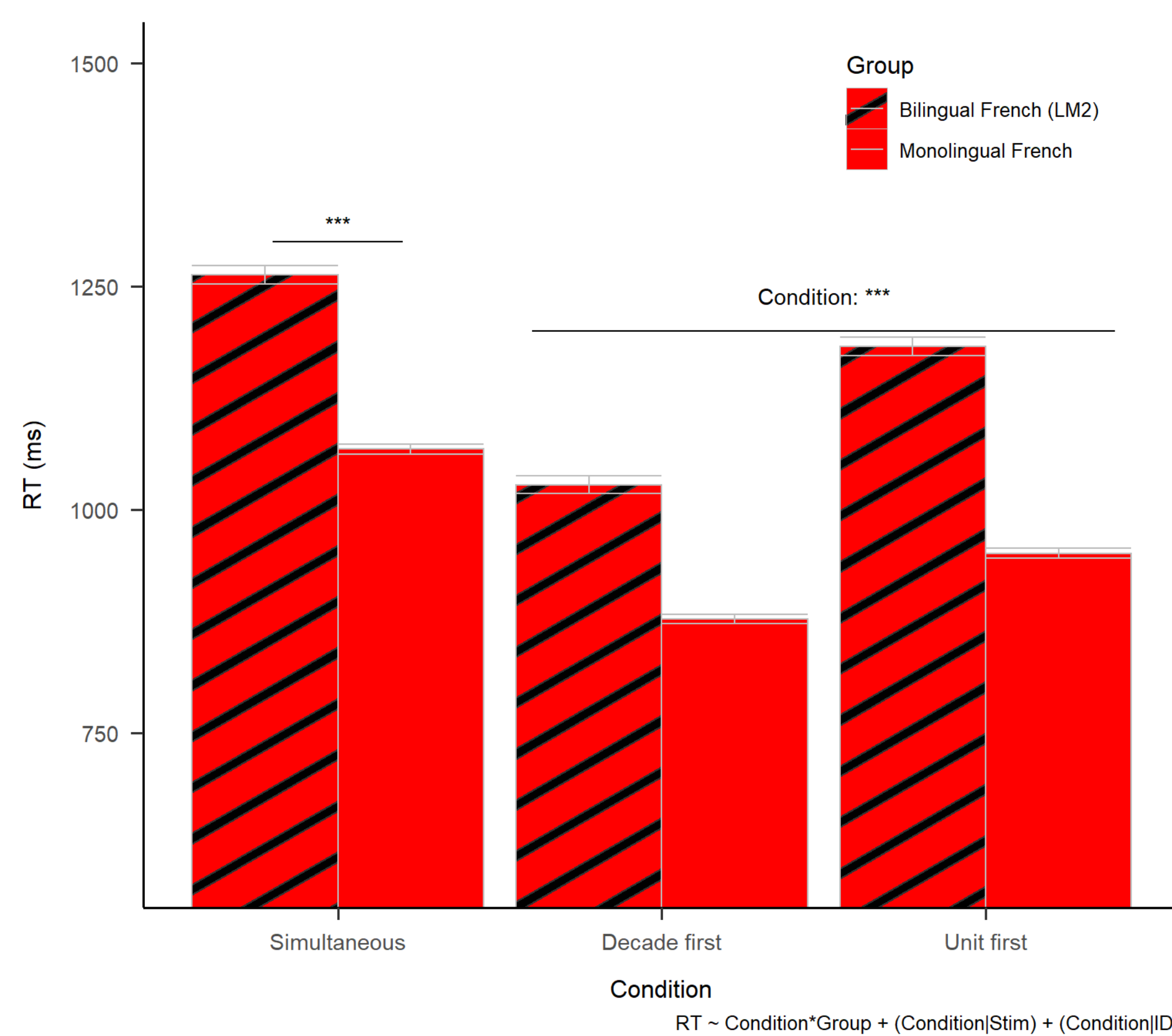
Results

Linear mixed models were fit using afex (Singmann et al. 2022). We pre-registered the models and hypothesis <https://osf.io/b4p2z/>. We first compared the simultaneous condition for differences between monolinguals and bilinguals and then the sequential conditions for the impact of the number word structures.

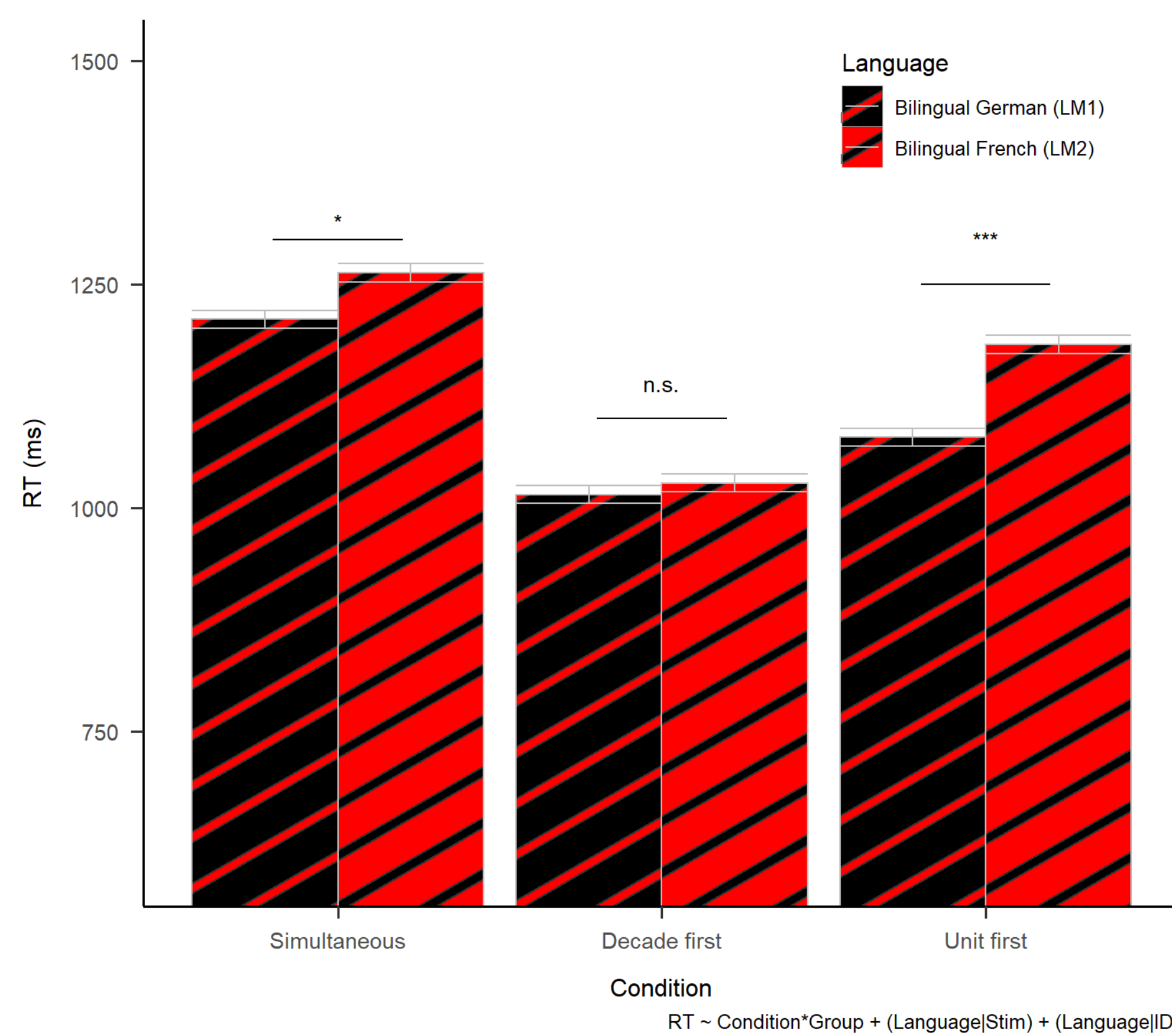
In German



In French



For Bilinguals



Discussion

Summary:

Monolinguals vs bilinguals:

- Bilinguals are slower than monolinguals
- Bilinguals benefit similarly from the sequential conditions than monolinguals

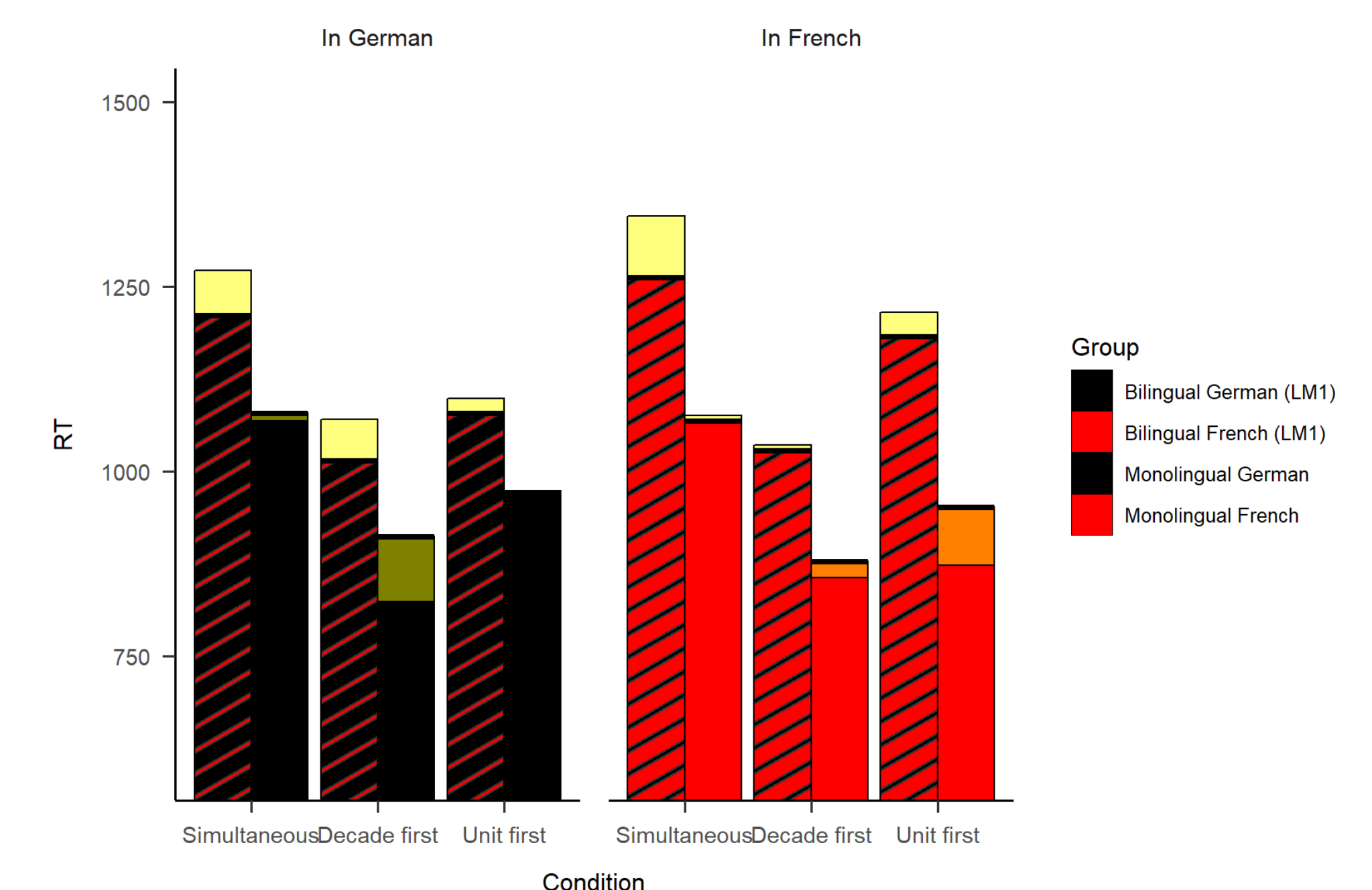
Bilinguals: German (LM1) vs french (LM2):

- Bilinguals are slower in the LM2 than LM1 (LM2 cost)
- Bilinguals benefit from the unit first condition in German (LM1)
- Bilinguals do not benefit from the decade first condition in French (LM2)

We could compare the data with our pre-registered predictions. Since different effects might overshadow each others, the prediction were made for each condition in each group.

Predictions

In the following we plot the data against the predicted effects (added transparency). The hypothesis baseline was adjusted by 160 ms.



Error bars represent the difference between the data and the predictions. Our predictions mainly underestimated the LM2 cost and overestimated the benefice of the decade first condition in French and unit first in German.

References

Note:

This is a reproducible poster, made using: (Thorne 2019)

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Pre-registration & Reproducible poster



<https://osf.io/b4p2z/>