# The Effect of Prediction on Type-1 and Type-2 Language Processing

Pratik Bhandari [1,2,3] , David Soto [4,5]

1. Department of Psychology, Saarland University, Germany. 2. Department of Language Science and Technology, Saarland University, Germany. 3. Collaborative Research Center (SFB 1102), Saarland University, Germany
4. Basque Center on Cognition, Brain and Language, Spain. 5. Iquerbasque Foundation for Science, Spain

## Introduction

- Predictive processing framework: we continuously make predictions about events based on the prior probability of such occurrence [1]
- language comprehension – shown to operate within PP framework [2]
- studies in low-level visual perception tasks – stimulus predictability modulates perceptual sensitivity and metacognitive judgment [3]
- not well-studied if such relationship extends to higher level cognitive processes like language processing

## Questions

- Does animacy judgement / object categorization for predictable trials differ than that from non-predictable trials? *type-1 sensitivity*
- Does metacognitive judgement for predictable trials differ than that from non-predictable trials? *type-2 sensitivity*

## Predictions

- Both type-1 and type-2 sensitivity should be higher for predictive trials than for non-predictive trials.

## Methods

### Participants: Group 1

- N=16 (11 female)
- Age: 20-28 years (M=22.9 yrs., SD=2)
- AoA of Spanish: 0.3 years
- AoA of Basque: 0.8 years

### Participants: Group 2

- N=16 (14 female)
- Age: 20-28 years (M=23.5 yrs., SD=2.13)
- AoA of Spanish: 0.3 years
- AoA of Basque: 0.9 years

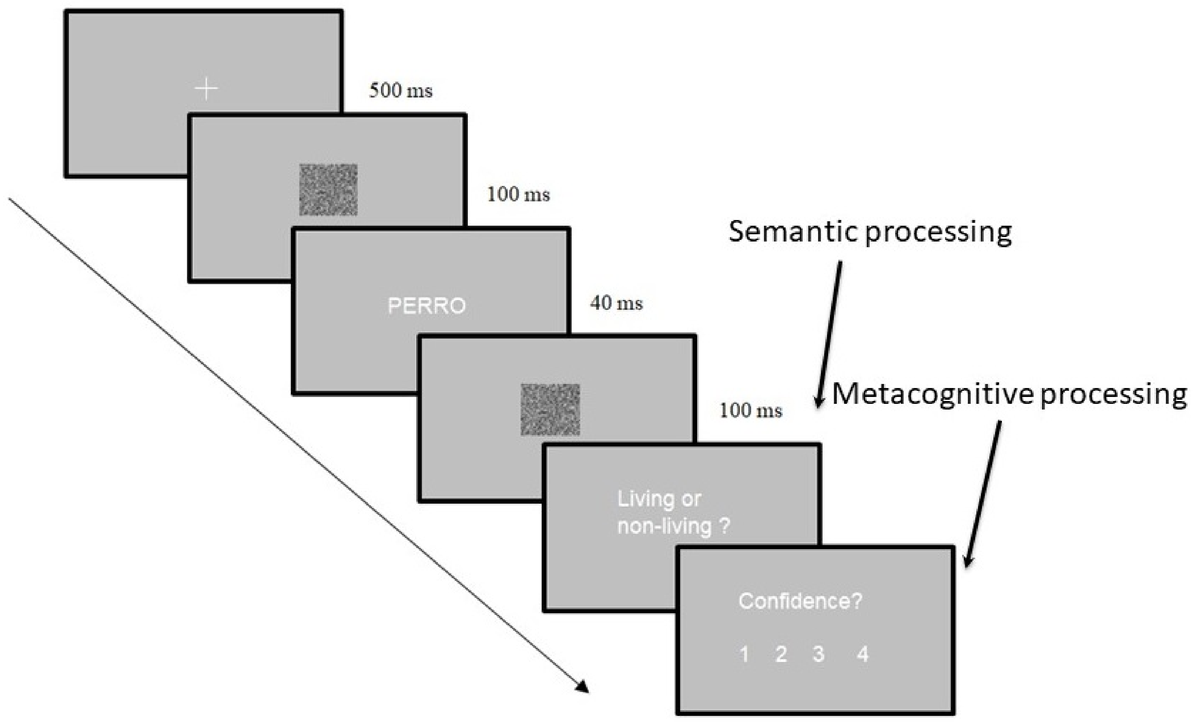


Fig.1: Sample trial

### Stimuli

640 words denoting living or non-living objects, near the threshold of awareness

- Group 1: 'ESP predictable group'
  - 80% Spanish words, 20% Basque words
- Group 2: 'EUS predictable group'
  - 80% Basque words, 20% Spanish words

### Task

- Object categorization: living or non-living
- Confidence rating: 1 to 4 ('guessing' to 'highly confident')

## Results

### Language proficiency

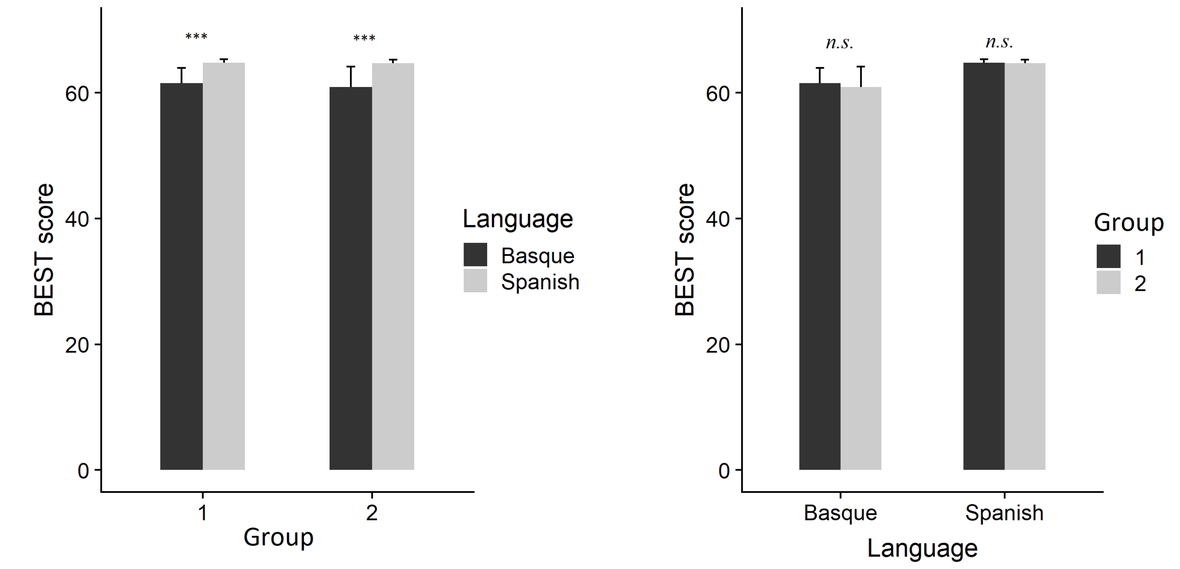


Fig.2: Barplot showing language proficiency scores in BEST [5] in Spanish and in Basque. **A.** Participants in both the groups had significantly higher language proficiency scores in Spanish than in Basque **B.** No significant difference in language proficiency scores between participants in Group 1 and Group 2 for both Spanish and Basque. *(vertical lines represent SD from the mean. ***p<0.001)*

### Type-1 and type-2 sensitivity

Signal detection theoretic analysis [5]

- For Spanish trials
  - d': t(30) = 1.151, p=0.258
  - meta-d': t(30) = -0.755, p=0.456

- For Basque trials
  - d': t(30)=3.299 , p<0.05
  - meta-d': t(30)=3.791, p<0.001

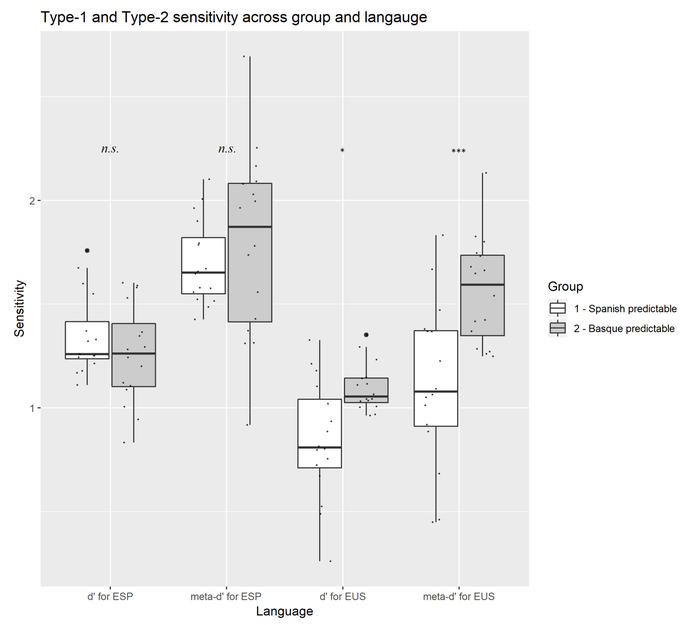


Fig.3: Boxplot showing d' and meta-d' for trials in Spanish and in Basque for Group 1 and Group 2. *(*p<0.05, ***p<0.001)*

## Conclusion

- Predictability enhances type-1 and type-2 language processing
  - but only in low proficiency language – *B*asque
- Predictability confers no processing advantage in high proficiency language *(Spanish)*

### Abbreviations used:

AoA: Age of Acquisition. ESP: Spanish. EUS: Basque
BEST: Basque, English and Spanish Tests

## References

1. Clark, A. (2013). *Behavioral and Brain Sciences*
2. Lupyan & Clark (2015). *Curr. Dir. Psychol. Sci*
3. Sherman et al. (2015). *Consciousness and Cognition*
4. de Bruin, Carreiras & Dunabeitia (2017). *Frontiers Psych.*
5. Maniscalco & Lau (2014). *Cog. Neuro. Metacog.*

### Lets chat more!

*@neurofreakPB*
pratik.bhandari.np@gmail.com