

# Individual differences in ERP responses to visual statistical learning

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## Introduction

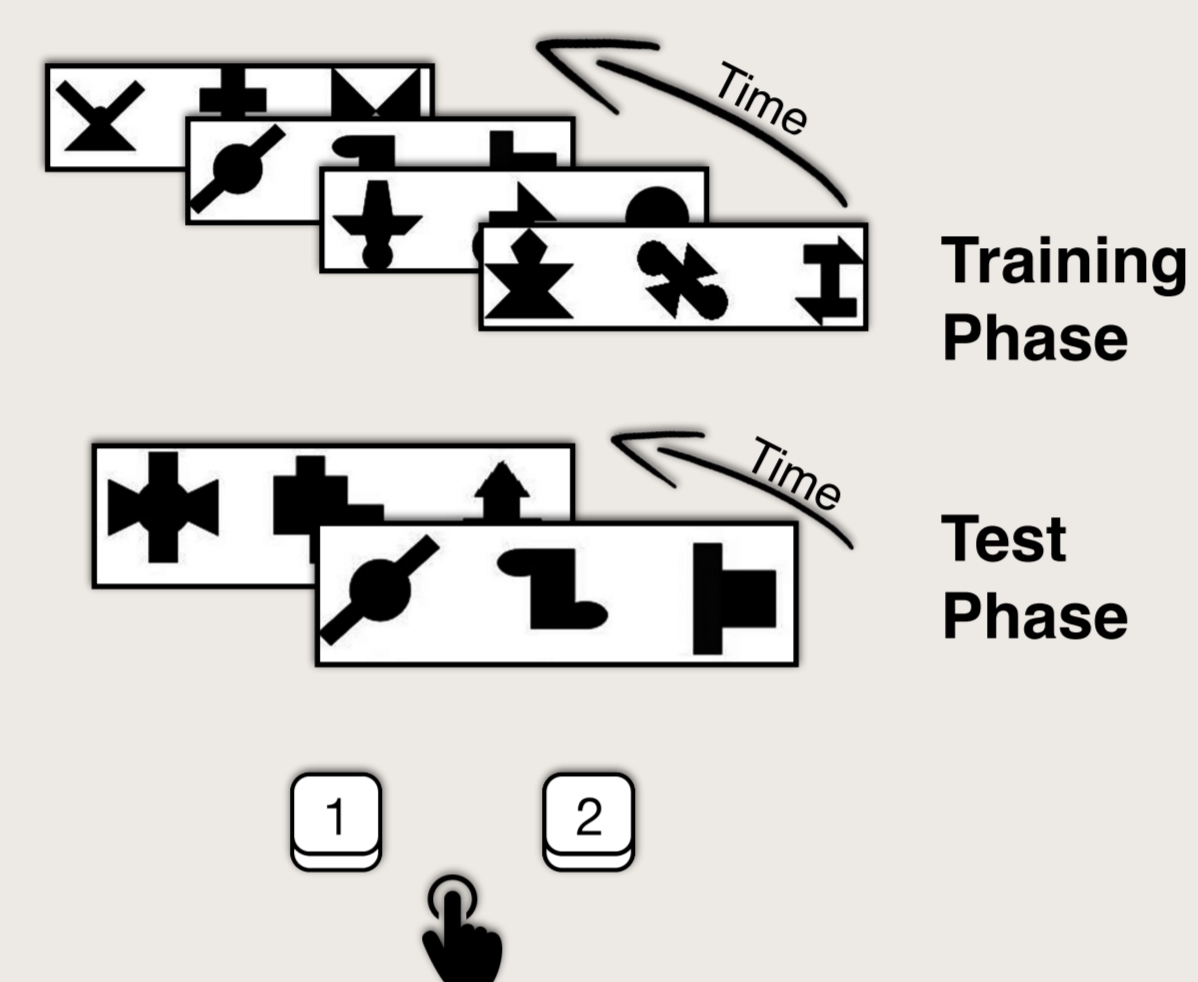
Recognising visual patterns is a key component of many cognitive activities. Statistical learning refers to the mechanism by which we extract repeated patterns, or regularities, from our sensory environment. When this is done without conscious awareness it is known as **implicit statistical learning**. In the visual domain it is known as **visual statistical learning** or **VSL**.

- Reading words requires individuals to recognize letters patterns that frequently co-occur, e.g. 'the', 'ing', 'er'. This recognition may involve visual statistical learning.
- Do **individual differences** in mechanisms of implicit learning play a role in reading? Answering this question will allow us to make more informed choices in terms of reading pedagogy.
- This research will also help us understand the extent to which implicit statistical learning, a domain general cognitive process that applies to many different kinds of information, plays a role in word reading.

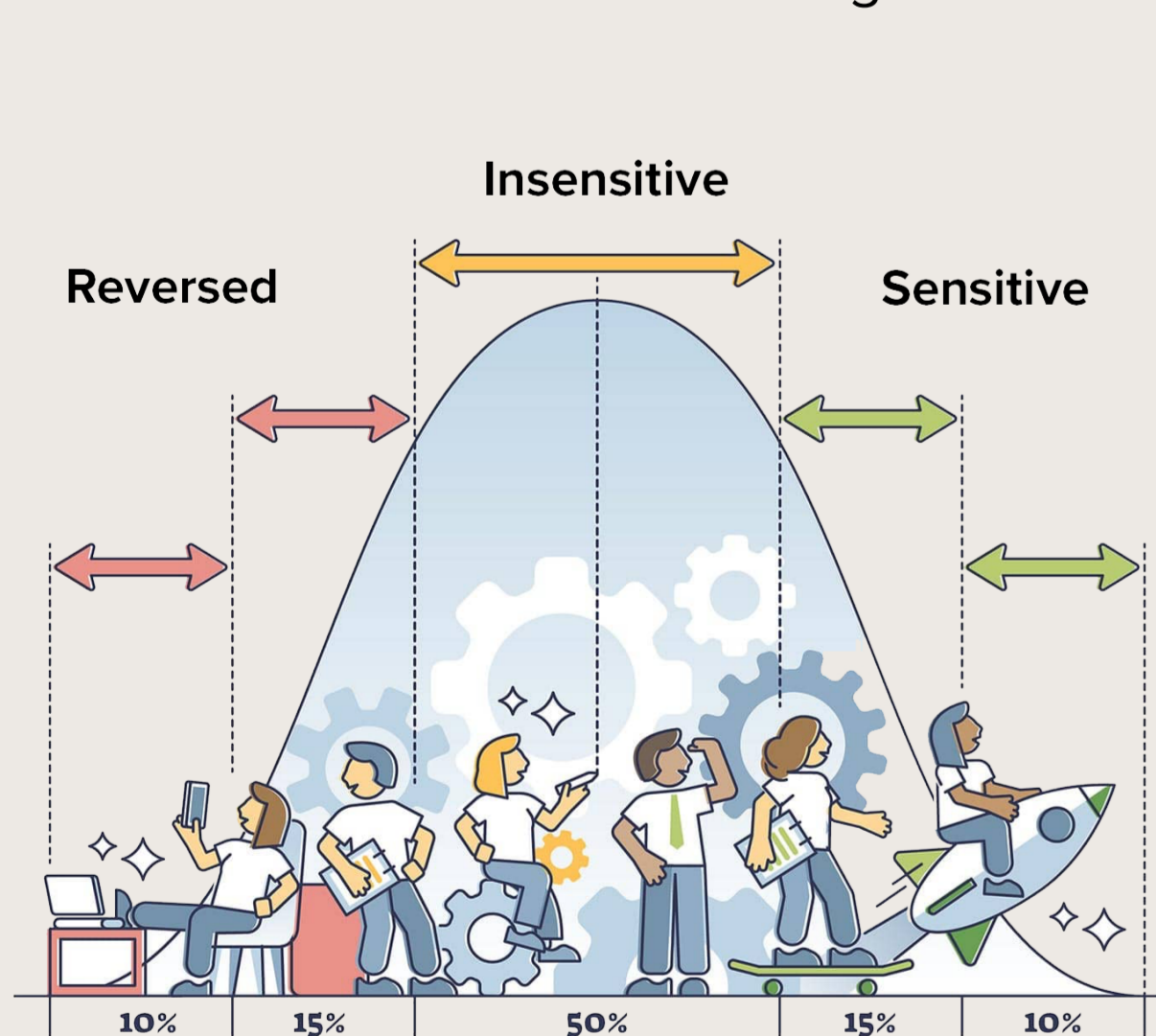
Objectives: The goal of this study was to measure people's sensitivity to the statistical patterns in visual sequences, and correlate this sensitivity with the amplitude of the N400 event-related potential component.

## Methods

- In an initial **training phase**, participants viewed a series of unfamiliar shapes organized into triplets. Each triplet was presented 24 times during training.
- In a subsequent **testing phase**, on each trial participants saw two triplets, one that had been presented in the training phase and one unfamiliar triplet.
- On each trial, they indicated whether the familiar triplet was presented first or second by pressing button one or two, respectively.
- As they completed the task we measured we measured the amplitude of the **N400 component**.



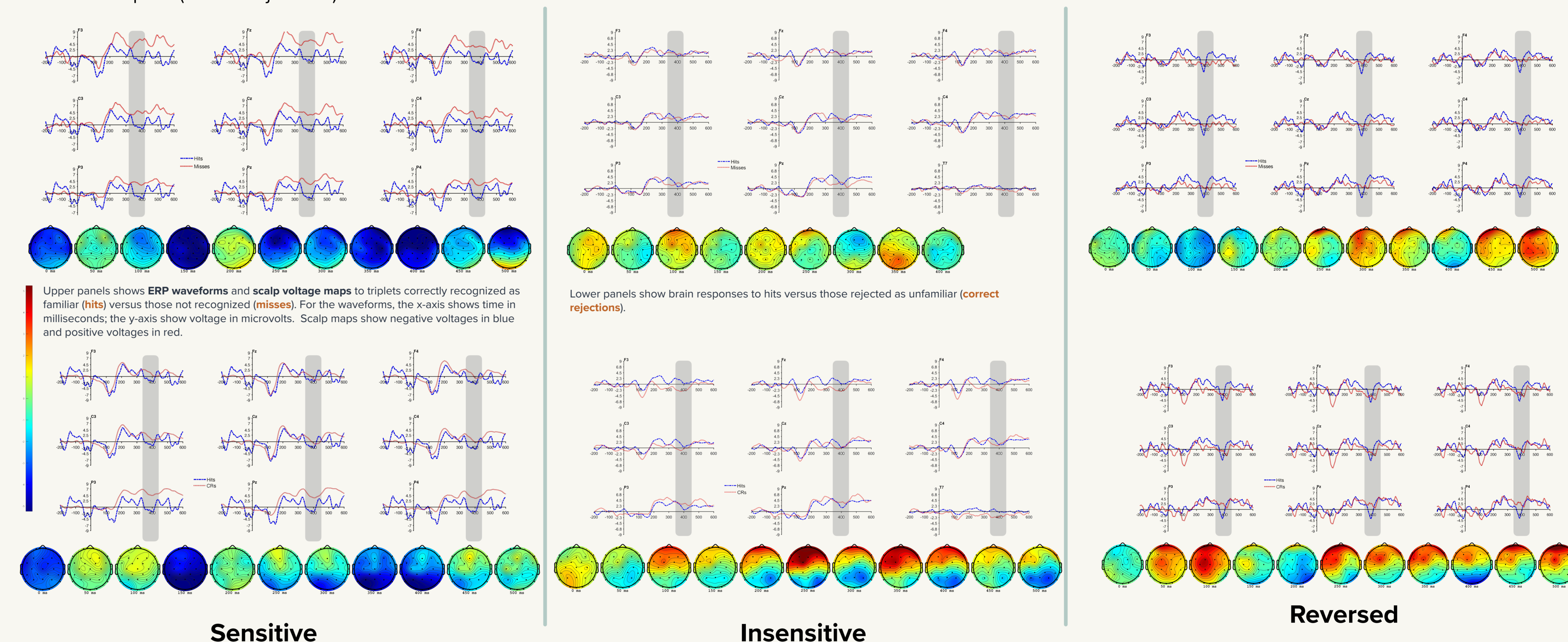
- The N400 is **relative voltage negativity** linked to processing **meaningful stimuli**. It is typically examined by comparing the response to a **target** stimulus that of a **control** stimulus via a **difference wave** created by point-by-point subtraction of the responses.
- This difference in the amplitude of the N400 between target and control conditions is known as the **N400 effect**.
- Abia and colleagues (Abia et al., 2008; Abia & Okanoya, 2009) have suggested that the N400 reflects statistical learning.



Participants were sixteen right-handed PC students between the ages of 18 and 26, who were classified as "**Sensitive**", "**Insensitive**" or "**Sensitive (Reversed)**" as determined by the percentile rank of their **d-prime scores** on the VSL task.

## Results

- We found that the **amplitude of the N400 component** was positively correlated with participants' ability to detect statistical regularities in visual sequences.
- For **sensitive** participants, correctly identified familiar triplets (**hits**) elicited greater N400 amplitudes than familiar triplets that were not recognised as such (**misses**) or unfamiliar triplets (**correct rejections**).
- These differences were less pronounced or absent for insensitive participants or those with reversed sensitivity.



- Interestingly, there were also differences between groups in the N1 component, which has been shown to reflect familiarity with different kinds of visual objects, including written words (Maurer et al., 2006; Maurer et al., 2008).
- Both **insensitive** and **reversed sensitivity** participants showed a small **positive deflection** for **hits** relative to **correct rejections**. **Sensitive** participants and **reversed sensitivity** participants showed a negativity for **hits** relative to **misses** in this time window.

## Discussion

- In this study, our aim was to determine whether brain activity reflects differences in sensitivity to **visual statistical learning**.
- We measured participants' sensitivity to the statistical patterns in visual sequences; we then correlated this sensitivity with the amplitude of the N400 event-related potential component.
- **Sensitive** participants showed **greater N400 amplitudes to hits** relative to misses and correct rejections.
- Participants with low sensitivity did not show these differences.

- The findings suggest that individual differences in mechanisms of implicit learning play a role in reading.
- The next step of this study is to examine the data collected from the lexical decision task (LDT). From there, we can combine the findings of the N400 effect from both tests (LDT and VSL) to look directly at the impact of individual differences in implicit statistical learning on reading.
- These findings will give us a better understanding of how the human brain processes visual language. This can be used to better inform educators in how they approach teaching children to read.

## References

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