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Psychophysiological Correlates of Geometric Visual Illusions: A Comparative Study of the Ponzo and Müller-Lyer Effects.

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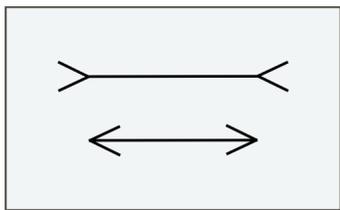
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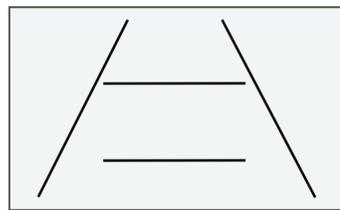
INTRODUCTION & AIM

- Ponzo and Müller-Lyer distort perceived line length in similar ways but are thought to rely on different visual-processing mechanisms (Gregory, 2009; Coren et al., 1978).
- We compared their **psychophysiological signatures** using **EEG (N200)** and **eye movements** during judgments of equal central line segments.



Mueller-Lyer illusion.

Refers to a low-level processing mechanism of frequency filtering.



Ponzo illusion.

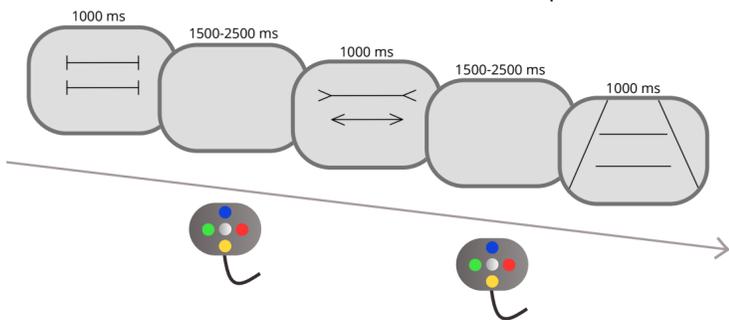
Relate to the high-level processing mechanisms of size constancy.

METHOD

- **40 people** (18–45 years, M = 24.7); **simultaneous EEG (64-ch ActiChamp) + Eye tracking (EyeLink 1000).**
- **Stimuli:** equal/unequal segments across control, Ponzo, Müller-Lyer conditions.
- **Metrics:** ERP N200 (270–320 ms), fixation and saccade durations, accuracy;
- **Stats:** repeated-measures ANOVA + Friedman tests.

PROCEDURE

100 presentations in 6 blocks
total of 600 presentations.



Subjects were tasked with judging whether the segments were equal or different and pressing the appropriate button on the joystick. Thus, participants pressed one of the two buttons.

EXPERIMENTAL SETUP

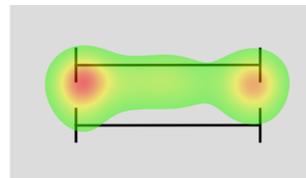


The EEG and the recording of eye tracking were recorded synchronously in one experimental setup.

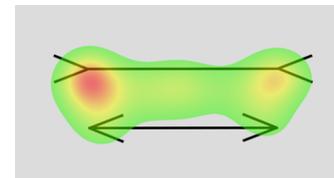
RESULTS & DISCUSSION

- **Accuracy:** control > both illusions ($p < .0001$).
- **EEG:** N2 amplitudes (F1, F3, FC1, FC3) higher in Ponzo vs Müller-Lyer ($p < 0.0001$); at FC3, control > Müller-Lyer ($p < 0.05$).
- **Eye movements:** fixation durations differed vs both illusion conditions (control–Müller-Lyer $p = 0.0097$; control–Ponzo $p < 0.0001$); saccades shorter in Ponzo.
- **Heat maps** showed distinct viewing patterns across conditions.

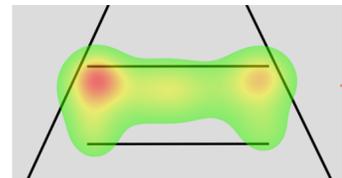
HEAT MAPS



in the control condition,
13818 fixations with an
average duration of
196.29 ms.

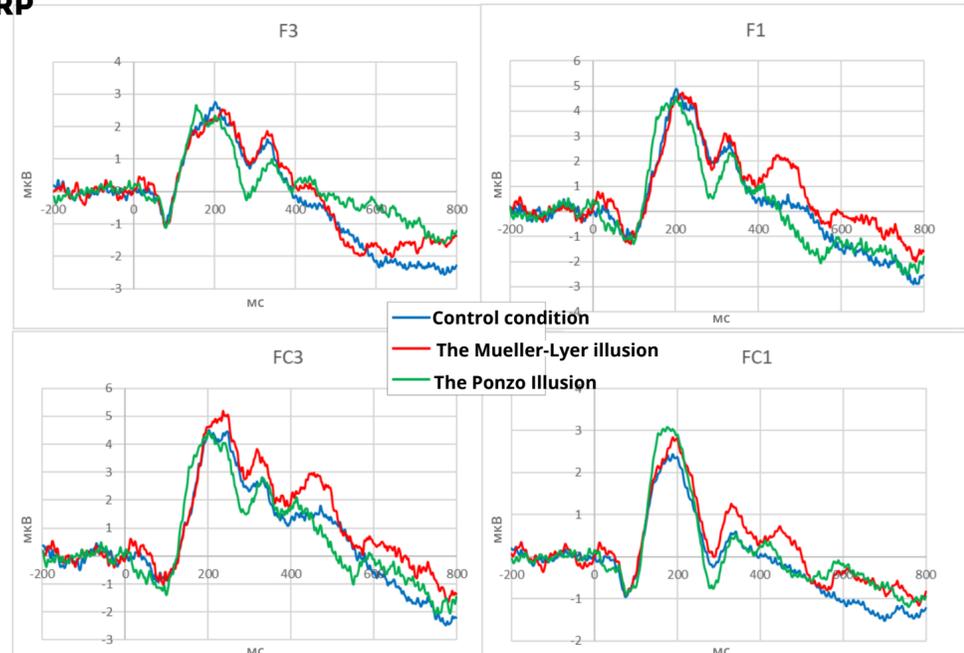


in the Müller-Lyer illusion
condition, 14495 fixations
with a mean duration of
176.04 ms.



in the Ponzo illusion
condition, 14829 fixations
with a mean duration of
147.24 ms.

ERP



CONCLUSION

- Ponzo and Müller-Lyer recruit **partly distinct intermediate-stage visual mechanisms** (consistent with N200 as an intermediate processing marker).
- Behavioral differences were minimal, suggesting compensatory higher-level cognitive processing.
- Combining EEG + oculomotor metrics gives a sharper read on where geometric illusions diverge in processing.

Further experiments on visual perception of geometric illusions are planned.

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