

How do expectations modulate perception?

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Background

- The information entering our senses is inherently incomplete, and to varying degrees, noisy, ambiguous.
- One strategy of our perceptual system to overcome this perceptual problem is to analyse regularities in the past to make predictions about the immediate future².
- Recently, we found differences in amplitudes of the P400 event-related potential and in reaction times to and the same stimulus as a function of one differences in the perceptual past and expectations about the immediate perceptual future ("temporal context effects^{")1}.

Participants:

• 23 participants (7 males); mean age: 24 (range: 19-31 years) with normal or corrected-to-normal visual acuity

Paradigm:

- Stimuli were presented in blocks of three pairs S1S2 S1S2 **S1S2.** Each block alternated with an unrelated experiment.
- Two separate experimental conditions, S1 ambiguous and S2 ambiguous (Condition AA) or S1 ambiguous and S2 unambiguous (Condition AU). All three pairs within blocks were identical.

AU

AA

- Cognitive announcement (CA) of the condition of the upcoming block to increase predictability
- Task 1: Is the orientation of S1 'left' or 'right'?
- Task 2: Is the orientation of S2 'same' or 'reverse' compared to S1?

Peak Detection:

Methods

• Maximum positive amplitude within time window 300-600 ms (P400) detected for each individual

Statistical Analysis:

Wilcoxon signed rank test ($\alpha = 0.05$) to compare differences

- S1-evoked P400 amplitudes
- Task-1 reaction times (RT) related to S1 between conditions AU and AA





Cognitive Announcement



In the present study, we investigated if an abstract cognitive knowledge about the identity of future stimuli is equally effective in generating the temporal context effects as the direct experience of regularities in the perceptual history.



EEG:

- Sampling rate = 1000 Hz
- Impedance < 10 k Ω
- Artefact threshold = $\pm 100 \,\mu V$
- Reference: average mastoids
- Baseline: -60 ms before to 40 ms after stimulus onset

Data Processing:

- EEG trials sorted for stimulus(S1, S2), condition(AA, AU), pair(1, 2, 3), channel and averaged to ERPs
- Analysis of identical S1 in different experimental conditions

Results

Fig 1. A-C: ERPs for S1 of AA and AU, pair wise. D: Joos et al (2016) S1 results and voltage map.









Fig 2⁴. Larger P400 amplitudes in S1 from the first pair compared to S1 from other pairs. A trend for P400 amplitude differences is apparent by the third pair. AA: S1 and S2 ambiguous. AU: S1 ambiguous S2 unambiguous. Difference = AU amplitude – AA amplitude. Effect size: Cohen's d. Error bars indicate mean ± SEM.

Fig 3⁴.The first pair RTs are overall longer than the second and third pair. The difference in RTs between AA and AU is already comparable to the old results by the second pair. AA: S1 and S2 ambiguous. AU: S1 ambiguous S2 unambiguous. RT difference = AU RT – AA RT. Effect size: Cohen's *d*. Error bars indicate mean ± SEM.

Discussion

- Larger S1-evoked P400 amplitudes and longer Task-1-RTs for the first pair across conditions may be related to "task-switching" effects³.
- Cognitive announcements alone cannot induce temporal context effects. Possibly, the participants of this study did not learn the association between the CA and the upcoming stimuli; therefore, predictions about the upcoming stimuli were not formed.
- Direct observation of at least two repetitions of the stimulus pair are necessary for a trend of temporal context effects in P400 amplitudes.

Direct observation of one repetition of the stimulus pair is necessary for temporal context effects in RTs. Similar stimulus quality of the past, present and predicted stimuli ("perceptual continuity") in the AA condition may contribute to shorter RTs.

The presence of temporal context effects despite the irrelevance of the temporal context for the processing of S1 and execution of Task 1 suggests that perceptual predictions occur automatically. We cannot even avoid analysing the past and predicting the future.

References

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