Electrophysiological properties of the concise language paradigm (CLaP)

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INTRODUCTION

- Lack of studies investigating language comprehension and production together
- Concise Language Paradigm (CLaP): combination of language comprehension and production, tapping into processes of both within each trial by having conext-driven picture naming with meaningful auditory sentences[1-7], auditory time-reversed sentences[8] and scrambled pictures[9]
- Identical trial structure across conditions: presenting an auditory stimulus (constrained, unconstrained, or reversed sentences) followed by a visual stimulus to be named (normal or scrambled objects)
- Reduced task-related confounds between conditions

METHODS

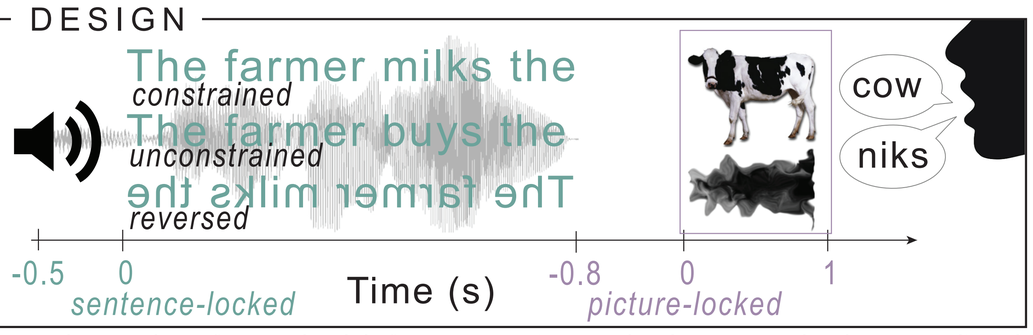
PARTICIPANTS & MATERIALS

- 21 Right-handed, healthy speakers of Dutch, 18-28 years (15 females)
- Visual stimuli: 156 normal pictures, 30 scrambled pictures[9]
- Auditory stimuli: constrained and unconstrained sentences[10] (78 each), time-reversed speech sentences[8] (78)

ANALYSIS

- Auditory responses locked to sentence onset (78 trials): ERPs and TFRs
- Context effect during pre-picture interval (48 trials): TFRs
- Visual responses locked to picture onset (30 trials): ERPs
- Statistical comparison with non-parametric cluster-based permutation tests[11]

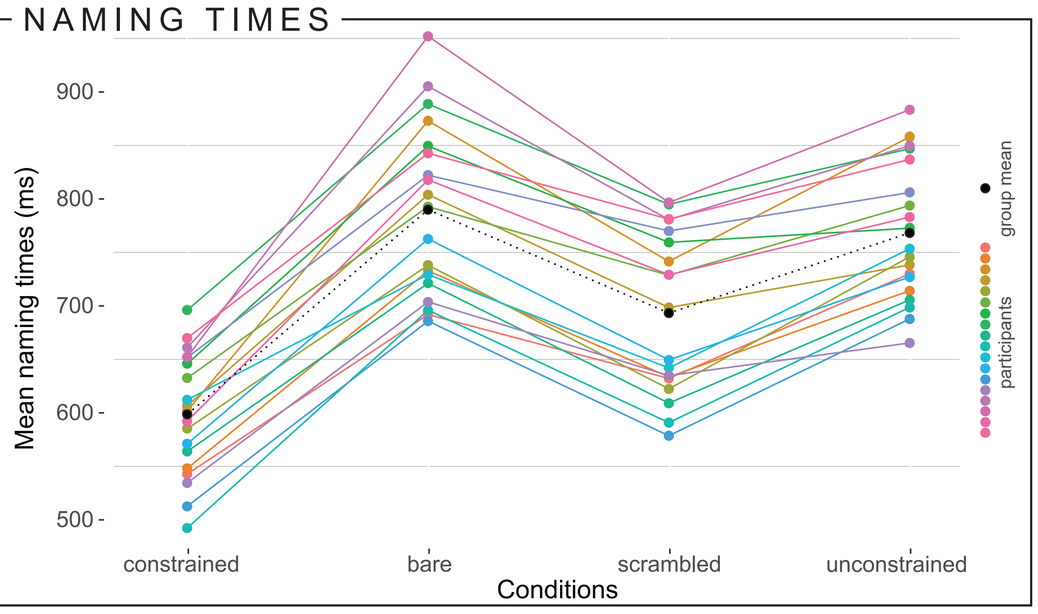
DESIGN



Schematic overview of example trials for sentence (constrained, unconstrained, reversed) and picture (normal, scrambled) conditions. Note the different time-lockings to sentence or picture. Sentence time varies per trial.

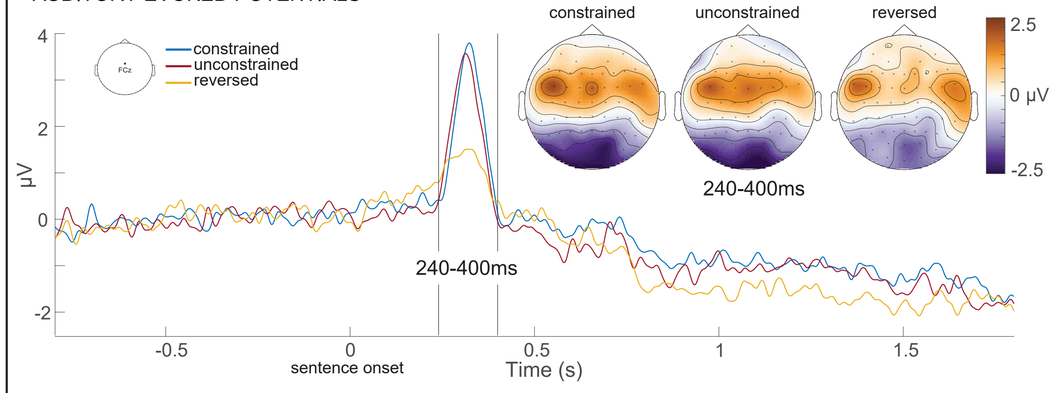
RESULTS

NAMING TIMES

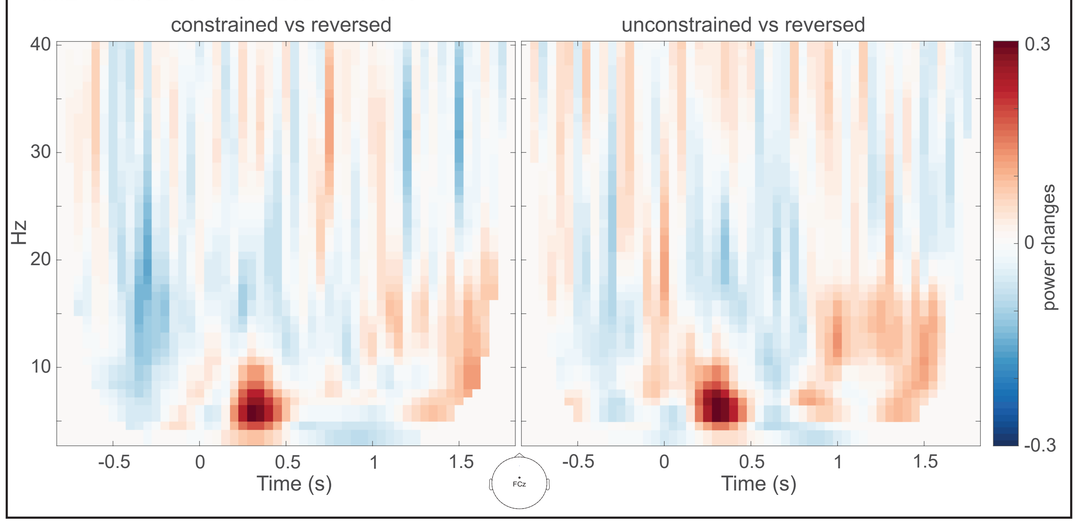


SENTENCE

AUDITORY EVOKED POTENTIALS

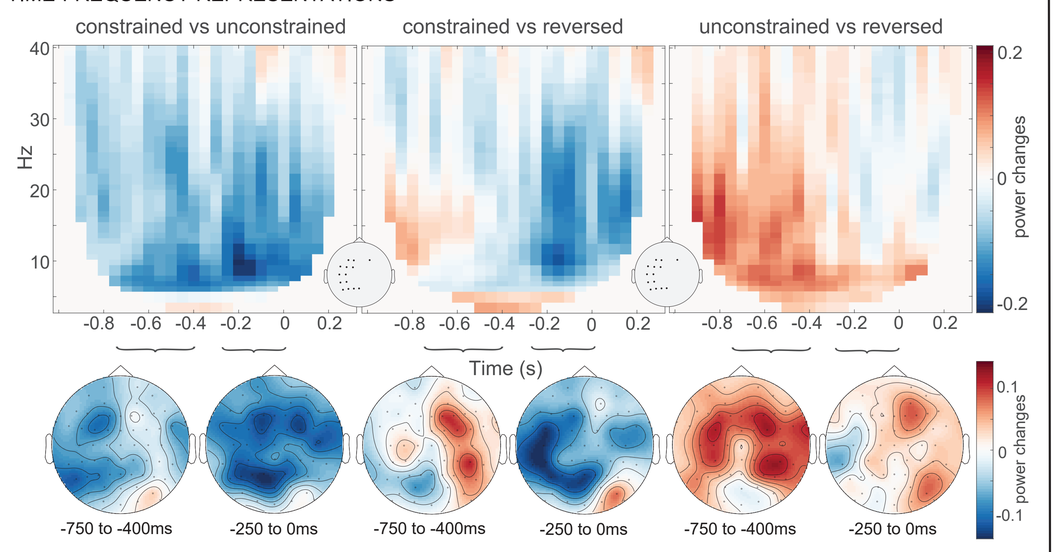


TIME-FREQUENCY REPRESENTATIONS

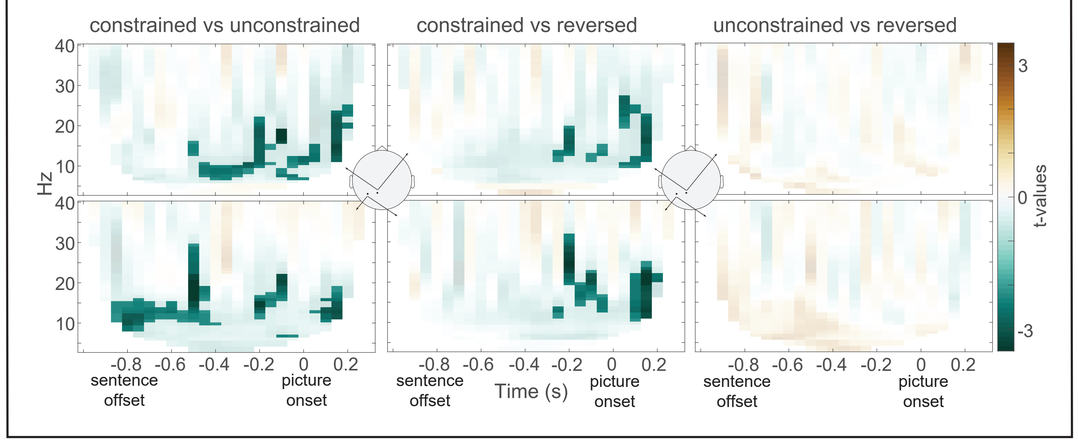


PRE-PICTURE

TIME-FREQUENCY REPRESENTATIONS

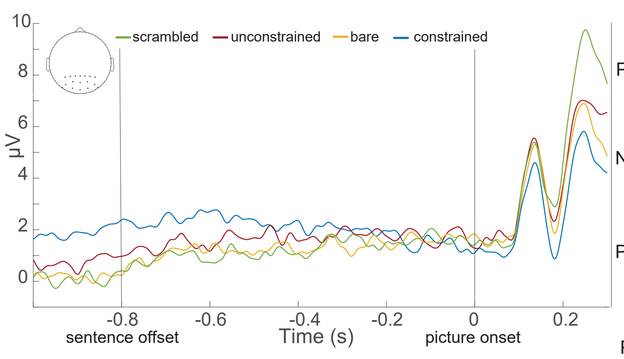


SIGNIFICANT T-VALUES

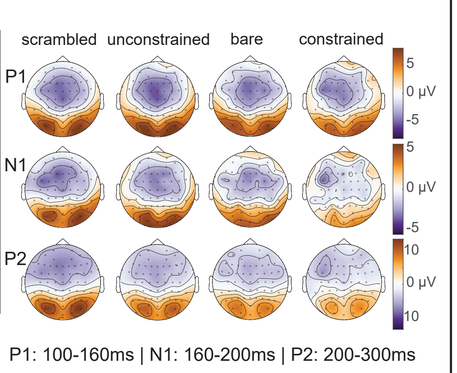


PICTURE

EVENT-RELATED POTENTIALS



VISUAL EVOKED POTENTIALS



P1: 100-160ms | N1: 160-200ms | P2: 200-300ms

DISCUSSION

- Bare and unconstrained picture naming are equally slow, fastest naming following constrained sentences
- Auditory responses differ between meaningful and reversed speech, peaking around 240-400ms (in ERPs and TFRs)
- Context effect due to power decreases in constrained trials (rather than increase in unconstrained trials), also present in constrained over reversed trials
- Visual responses following constrained sentences have lowest amplitude (similar to repetition priming[12-15]), scrambled pictures evoke highest amplitude[14] (especially P2 component), unconstrained and bare have similar amplitude[10]
- Findings provide benchmarking for future studies in different populations

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