

# The Hands Have It: Neural Activity During Beat Gesture-Speech Integration in ASD

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## Background

### Beat gesture

- Beat gestures are **simple rhythmic gestures** that reflect intonation and pitch accenting in speech, conveying prosody visually
- Beat gesture and speech are **closely temporally synched**, and discrepancies of a half second or less in either direction are detectable

### Gesture-speech integration in autism spectrum disorder

- In autism spectrum disorder (ASD), gesture may be processed **more slowly** than speech and neural signatures may be different
- Gesture and speech production are **temporally asynchronous**, possibly contributing to the social communication impairments in ASD

### Current study

- Purpose:** Examine the neural substrates of integration of beat gesture and speech using temporally-sensitive **event-related potentials (ERPs)**
- Inspired by previous magnetoencephalography (MEG) study showing that neural activation **differs** by beat gesture-speech temporal congruency
- Hypothesis:** More robust ERPs are associated with **incongruent** beat gesture-speech processing and are **negatively correlated** with ASD traits

## Methods

### Stimuli

- Example sentence: On Sunday afternoon, Arthur read a **newspaper** for relaxation.
- Critical word (**bolded**) always pitch accented; presence of gesture with critical word varied

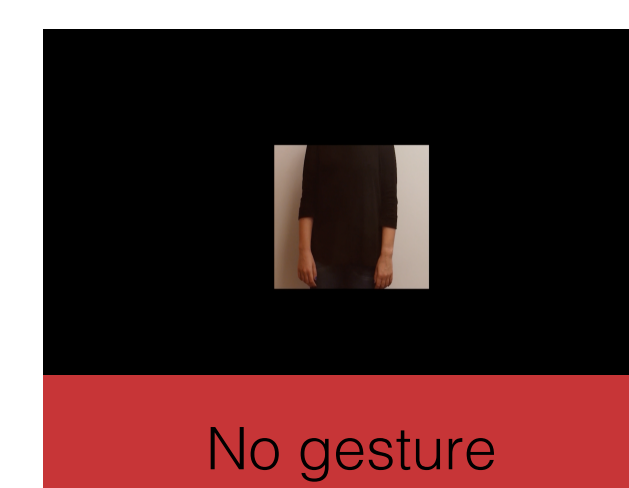
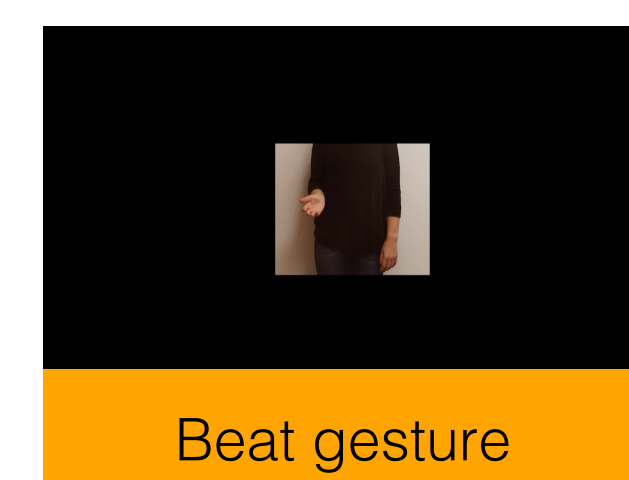
### Participants

- 15 typically-developing (TD) adults
- Subclinical ASD traits measured using **AQ**, **BAP-Q**, and **SRS-2** questionnaires

### ERP data recording

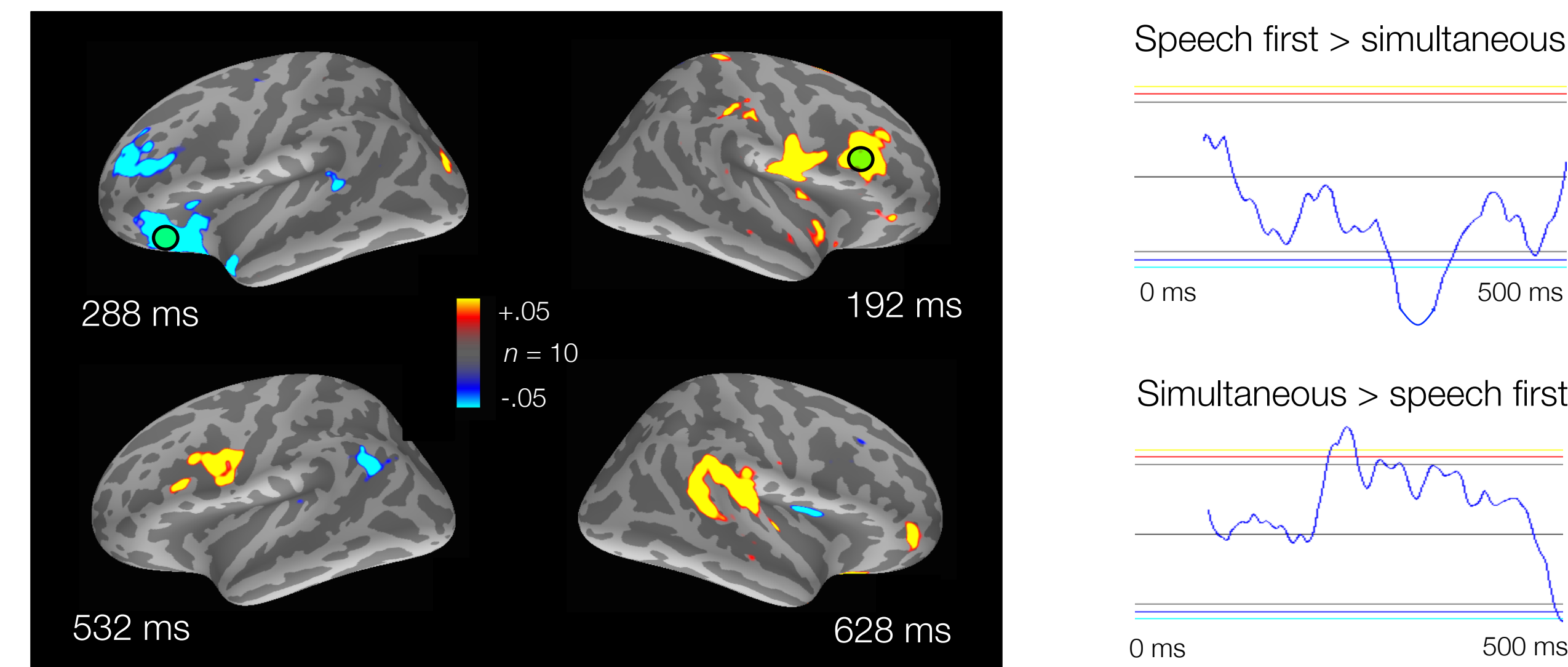
- Recorded at 1000 Hz with **128-channel** EGI Hydrocel Geodesic sensor net
- Preprocessing: filtered from 0.1-30 Hz, re-referenced to online average (Cz), baseline corrected (-400 to -300 ms), artifact detected (moving window)
- Epochs: -300 to 1200 ms relative to critical word onset (0 ms), with analyses conducted on the **N400**, an ERP reflecting semantic integration

### Conditions



## Previous MEG Findings

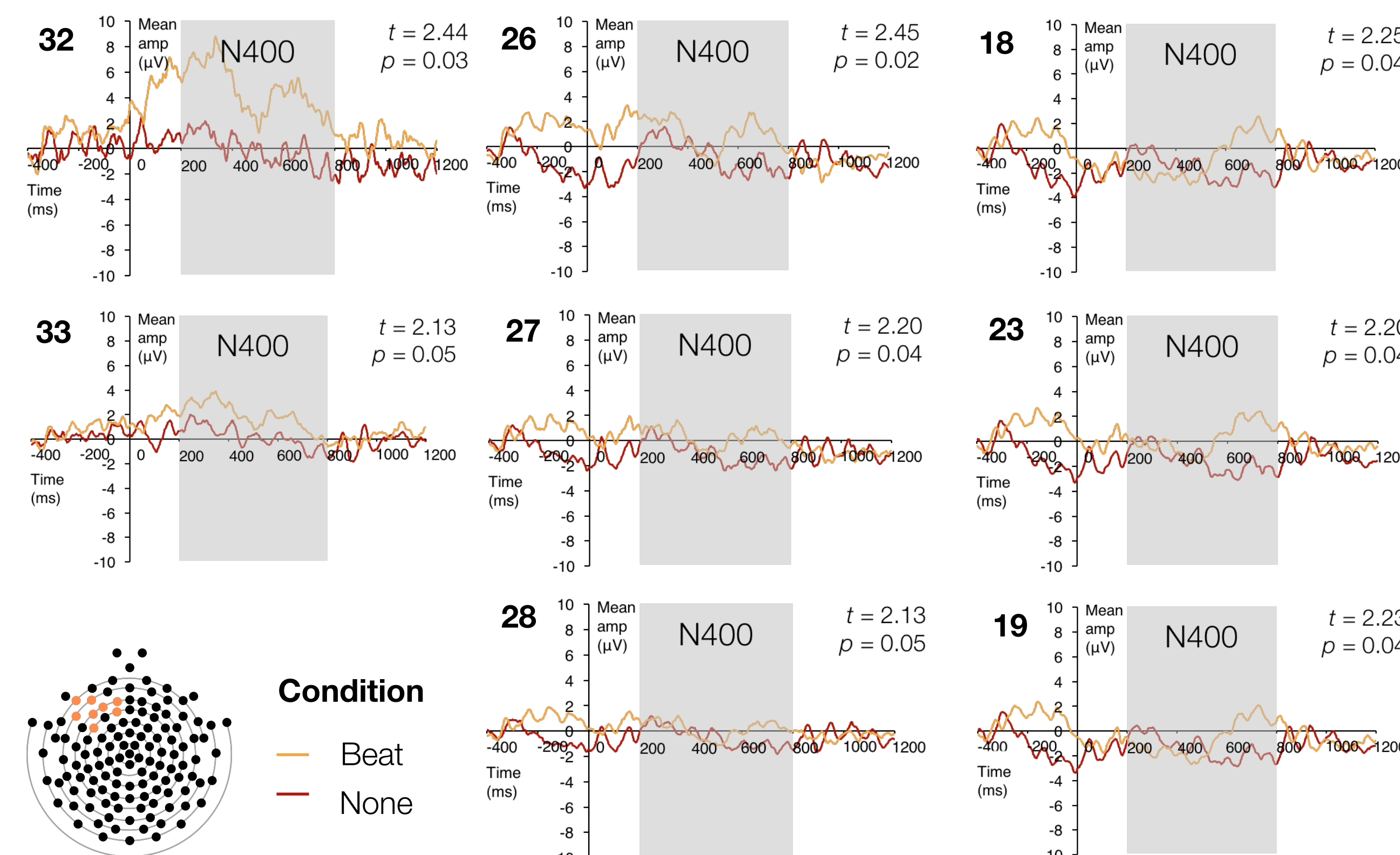
### Spatial localization of magnetic event-related potential (M-ERP)



- In **left** hemisphere, inferior frontal gyrus (IFG) and posterior superior temporal sulcus (pSTS) more active when **speech precedes gesture**
- In **right** hemisphere, IFG and pSTS more active when speech and gesture are produced **simultaneously**
- IFG active **earlier** in right hemisphere than left hemisphere, suggesting that processing is more **effortful** in left hemisphere than right hemisphere

## ERP Results

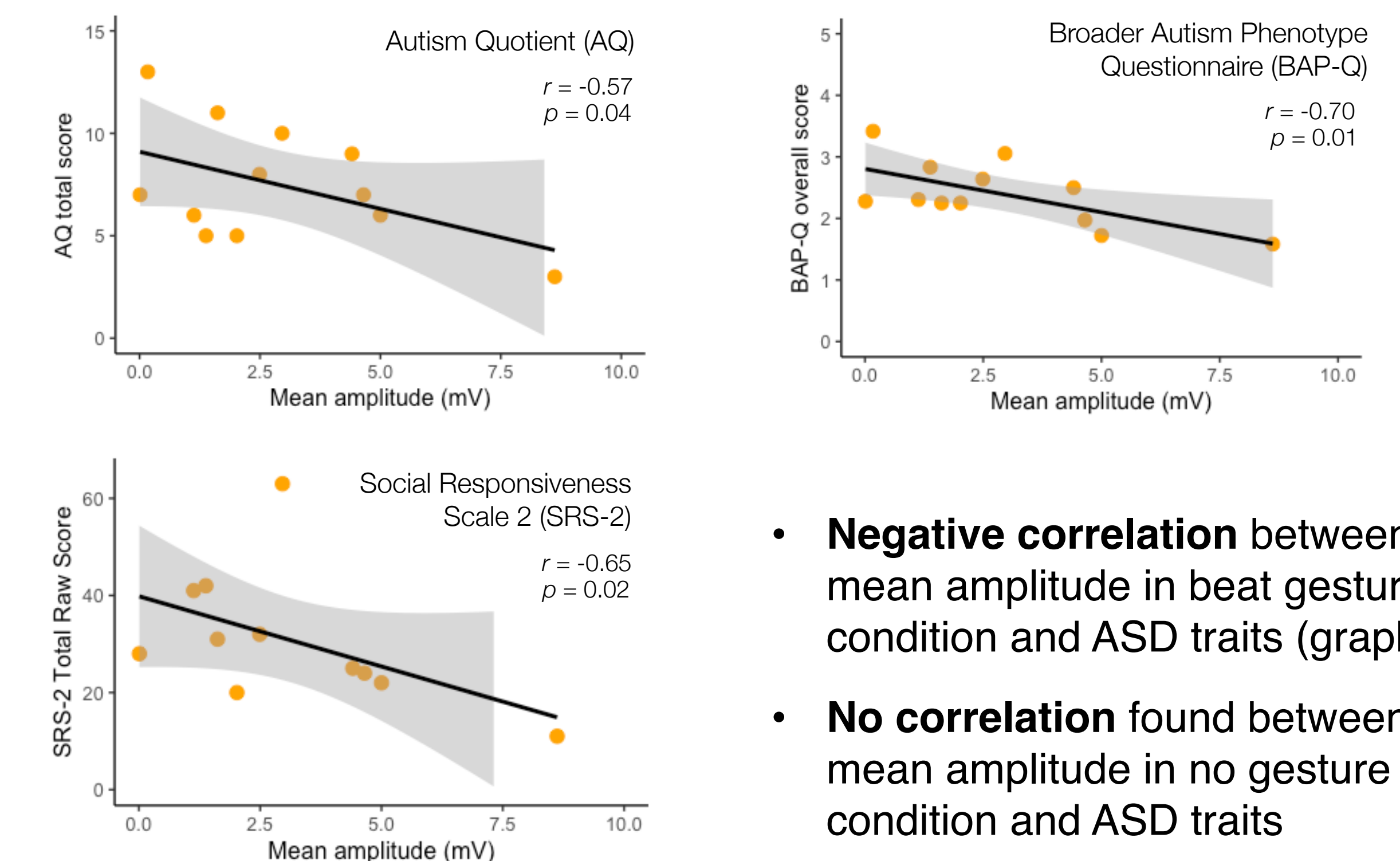
### Mean amplitude of N400 ERP



## ERP Results

- N400 effect found when critical word with pitch accent had **no gesture**
- N400 effect observed **500 – 900 ms** after critical word onset (later than usual)
- N400 effect observed in **left frontal** electrodes, suggesting that cognitive control plays a key role in integration of pitch accenting and beat gesture

### Correlations between ERP mean amplitude and ASD traits



- Negative correlation** between mean amplitude in beat gesture condition and ASD traits (graphs)
- No correlation** found between mean amplitude in no gesture condition and ASD traits

## Conclusions

### Neural correlates of beat gesture-speech integration

- The **N400** is sensitive to discrepancies between pitch accenting and beat gesture, revealing the time course of gesture-speech integration
- The timing and directionality of activity in **IFG** and **pSTS** also reflect sensitivity to discrepancies in the timing of beat gesture and speech

### Beat gesture-speech integration and ASD

- When beat gesture and pitch accenting are both present, ERPs in the beat gesture condition are **weaker** in individuals with more ASD traits
- Future work will investigate the **latency** and **variability** of the N400 and its positive counterpart for beat gesture-speech integration in ASD

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