Introduction

Background

Stroop tasks are designed to elicit conflict between stimulus dimensions and/or response choices.\(^1\)\(^-\)\(^3\) - Delay in reaction time and activity in specialized neural circuits are taken as evidence for biomarkers of conflict.\(^1\)\(^-\)\(^3\)

\textbf{QUESTION:}\n
Does conflict between gesture and word engage canonical language systems, such as Wernicke’s and Broca’s areas, or is it associated with more domain-specific systems tied to social function?\(^6\)

\textbf{Subjects:}\n
- 34 healthy volunteers: 27 male, 7 female; mean age: 24

\textbf{Media:}\n
- 648.25, SfN 2014
- A pdf version of this poster is available here: http://fmri.org/publications/Yahil-et-al-SFN-Poster-2014.pdf
- You can also get the poster by scanning the QR code on the left.

Experimental Design

**Communication Conflict**

Task: Identify the gesture as “yes” or “no”

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- Subjects use button responses to indicate the meaning of thumb or head movements as “yes” or “no.”
- 6 each of congruent and incongruent-dominant blocks, alternated with 15s rest - 4 trials per block, ISI: 3.75s

**fNIRS Acquisition**

- Continuous-wave functional near-infrared spectroscopy (Shimadzu LABNIRS) sampled every 33ms.
- 30 channels registered to standard MNI coordinates using SPM-NIRS (Bioimaging and Signal Processing Lab, KAIST) and a 3D digitizing system (Polhemus Patriot)

Neuroimaging Results

**Broca’s Area:**

- Inferior frontal G
- (-50.0, 43.7, 26.5)
- (-58.0, 34.8, 16.3)

**Wernicke’s Area:**

- Superior Temporal G
- (-70.0, -37.3, 20.5)
- (-62.3, -61.8, 16.3)

**Figure 2.** Video: head shake, nod, thumbs up, thumbs down. Audio: “yes” and “no.” Gestures are congruent or incongruent with spoken word

**Figure 3.** Task design: 15s task alternates with 15s rest. 4 trials per block. Fixed ISI of 3.75s.

**fNIRS Analysis**

- fNIRS oxyhemoglobin signals were low-pass filtered, detrended, and event-trigger averaged in MATLAB
- Channel locations were converted to MNI maps with SPM-NIRS (BISPL).
- A GLM was used to obtain beta values of event-triggered signals, incongruent greater than congruent (I > C), projected onto 3D brain

**Behavioral Results**

**Within-subjects Analysis**

- The difference in reaction time for congruent and incongruent trials was significant: \( p < 0.05, \text{df: } 30, \text{two-tailed.} \)
- \( \mu: 21\text{ms} \pm 9\text{ms} \) (SEM)

**Group Analysis**

- Congruent reaction time:
  - \( \mu: 741\text{ms} \pm 28\text{ms} \) (SEM)
- Incongruent reaction time:
  - \( \mu: 762\text{ms} \pm 30\text{ms} \) (SEM)

**Figure 4.** Group-level analysis: t-test of beta values for I > C signals. MNI coordinates \((x, y, z)\) shown per active region. Yellow numbers indicate approximate channel locations.

**Figure 5.** Reaction time differences (ms) for incongruent trials larger than congruent.

Conclusions

Neuroimaging results are consistent with the hypothesis that conflict between gesture and word engages both domain-specific language regions and socially-responsive neural circuitry.

**Domain specific (blue boxes):**

- Wernicke’s Area: STG/MTG
- Receptive language
- Broca’s Area: IFG

**Socially-responsive (gray box):**

- Temporal-parietal junction: TPJ
- Social processing

References


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