The neural dynamics of letter perception in blind and sighted readers
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Introduction

Auditory control: Spoken letters

Sighted and blind participants were run in the visual and auditory conditions. Blind people were run in the tactile (Braille) and auditory conditions.

Stimuli & Task

Sighted and blind participants were presented with single letters during MEG scanning. Visual stimuli were lower-case Roman letters, tactile stimuli were lower-case Braille letters, auditory stimuli were spoken letters.

Methods

We extracted trials for each letter condition (-200 to +1000 ms relative to stimulus onset). Button-press target trials were excluded from further analysis.

Thus, in each experiment, 10 conditions of ~100 trials each were extracted.

Results: Decoding letter identity from MEG

Single letters were discriminated by both tactile and visual representations, with different temporal signatures: Visual letter decoding showed a more rapid onset, higher peak decodability, and more rapid fall off. Braille temporal decoding curves tended toward a slower, more sustained profile.

• When are the representations of different individuals/groups similar? Cross-correlating RDM across time points can show consistency within-group representations as well as the similarity of representations across groups.

• We found high inter-subject (within-group) correlations at ~200 ms for sighted subjects and ~600 ms for blind subjects, suggesting that visual and tactile representations of letters arise at different time scales.

• Importantly, we found that RDM correlations between blind and sighted subjects peak ~200 ms for visual and >600 ms for blind individuals, suggesting that a similar, amodal representation may exist across people who have only learned to read visually, or via Braille.

Comparing Across Time & Subjects

The neural time course of letter recognition varies with modality: visual (sighted) letter representations be attributed to group or modality differences? i.e., do the two groups represent identical stimuli similarly?

Temporal generalization: Transient or sustained representations?

• Training a classifier at each time point and testing it at all other time points yields a temporal generalization or “time-time” decoding matrix.

• Decisive and transient and mild sustained representations for visual letters (as with other visual objects), and slower, more sustained dynamics in Braille representations.

• Can disparate and common dynamic processes between Braille (blind) and visual (sighted) letter representations be attributed to group or modality differences? i.e., do the two groups represent identical stimuli similarly?

Comparing representational content across populations

Within- and between-group RDM correlations revealed disparate and common dynamic processes between blind Braille and sighted visual letter readers. This suggests some components of letter processing common across modalities.

• The neural time course of letter recognition varies with modality: visual letter perception occurs with a faster onset, higher peak, and faster offset compared to Braille reading in early-blind participants. Thus, similar components of processing may occur at different times contingent on the modality of presentation.

• Sighted subjects’ neural responses were most similar to each other (correlated most strongly) at ~200 ms, compared to ~600 ms for blind subjects. Blind and sighted subjects’ responses were most similar to one another at ~200 ms for blind and ~600 ms for sighted subjects. These results suggest dissociable communities within and between groups.

Conclusions

A similar experiment presenting auditory spoken letters to both groups showed strong similarity of responses between groups. Thus, differences in representational structures are unlikely to be inherent group differences.

References