A “Fast” Localizer of Component Processes in Reading

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Introduction

Background
- Obtaining a snapshot of the reading circuit is highly useful
- Individual differences in neurobiology related to performance
- Limitations of previous localizers:
  - Many involve metacognitive judgments
  - Associated with long administration times

Aim
- To develop a localizer of the reading circuit that:
  - Isolates regions involved in component processes
  - Orthography, phonology, semantics
  - Is sensitive to individual differences
  - Requires little imaging time
  - Is appropriate for different populations of readers

Methods

Subjects
- 18 adult monolingual English speakers (mean age 24; 11 F)
- Typical scores on standardized reading tests:
  - Test of Word Reading Efficiency (TOWRE)
  - Nelson-Denny reading comprehension

Procedure
- Rapid sequential presentation of sets of four items
- Six trial types:
  1. Unrelated (UNREL): CLAY / LAWN / FLEA / VASE
  2. O+P−: BEST / NEST / PEST / VEST
  3. O−P+: BOMB / TOMB / COMB / WOMB
  4. Semantically Related (SEM): FISH / BEEF / PORK / MEAT
  5. Pseudowords (PSW): JALL / PULE / TALM / WIBS
  6. False Font (FF): 0.02
- Event-related design; four runs each 5:16 in length
- Administered a recognition memory test following each run
- Ensured subjects attended to the stimuli

Results: Groupwise Contrasts

Key reading-related regions showed a main effect of stimulus type
- Pairwise post-hoc t-tests revealed regions sensitive to component processes

Key Findings from a Group of Skilled Adult Readers
- Reliable isolation of brain regions sensitive to component processes of reading
- The VWFA was sensitive to lexicality
- Bilateral IFG and left SMG were sensitive to phonological consistency
- Sensitivity to individual differences
- Individuals with lower comprehension scores were more taxed by semantic similarity

Broader Significance
- The “fast” localizer offers several advantages over many previous protocols:
  - Relatively brief amount of imaging time (~21 minutes)
  - Does not require trial-wise responses
  - Useful for individuals who may have deficits in response inhibition
  - e.g., children with reading disability and/or ADHD (Willcutt et al., 2005, Dev. Neuropsych)

Results: Brain-Behavior Correlations

Differences in activation between semantically related and unrelated words were negatively correlated with reading comprehension scores

Conclusions

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