Neural Correlates of Rapid Automatized Naming

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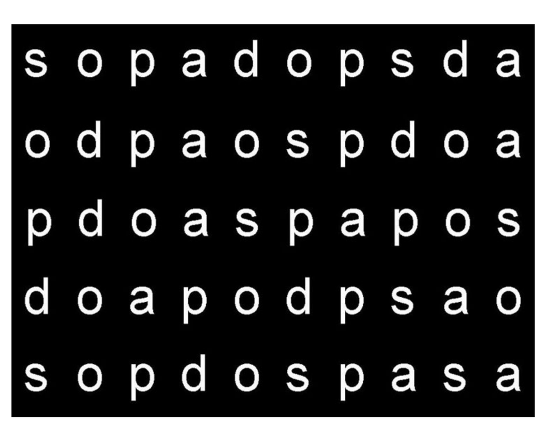
Abstract

Performance on rapid automatized naming (RAN), the ability to automatically and correctly retrieve labels for abstract visual stimuli, predicts reading ability and underlies reading fluency[1]. However, only one paper has been published on the neural correlates of rapid naming, using letter and object naming tasks in typically reading adults[2]. We further investigated the neural correlates of rapid naming in two ways. First, given the relevance of alphanumeric stimuli for readers in late elementary school years and beyond[1], we used letter and number tasks. Second, we compared brain activations for readers with dyslexia to a matched sample of typically-reading adults. Comparisons of these two groups revealed that the typically reading group recruited posterior networks significantly more than the readers with dyslexia, while readers with dyslexia relied on distributed networks in frontal and parietal areas.

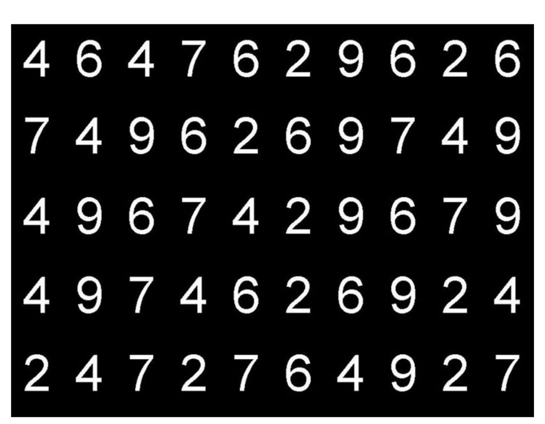
Background

Rapid automatized naming (RAN) is the ability to automatically and correctly retrieve labels for abstract visual stimuli. Performance predicts reading ability and underlies reading fluency[1]. Previous work has identified the neural correlates of letter and object rapid naming tasks in typically reading adults[2]. However, given the importance of RAN for readers with developmental dyslexia, we sought to **compare performance between adult readers with and without dyslexia to understand how behavioral differences may relate to brain differences.**

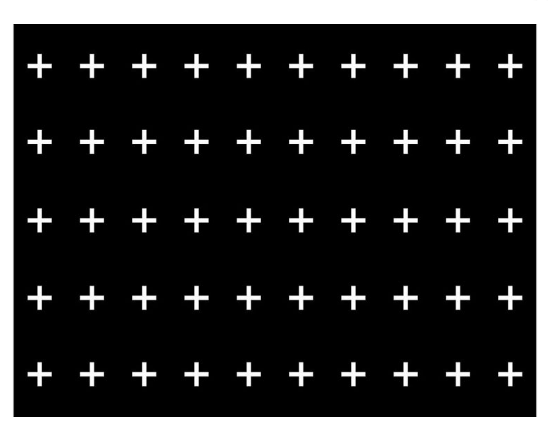
fMRI Task: Rapid Automatized Naming



Letters



Numbers



Fixation

Directions: ***Name each item silently and as quickly as you can. After completing each line, press a button.***

Paradigm: Block design, each item presented for 16 seconds

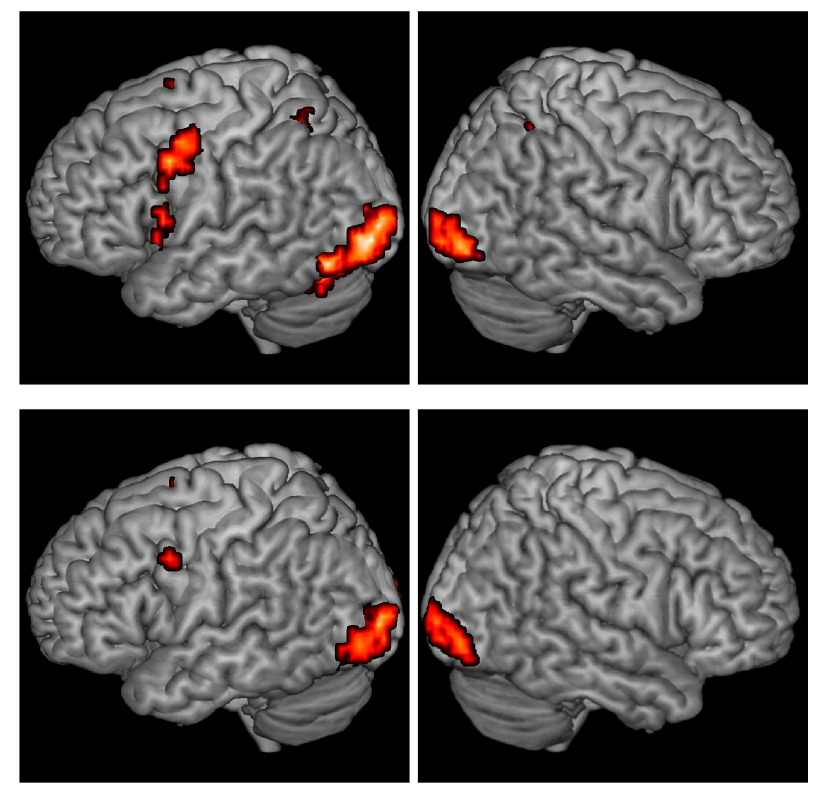
Results

Typically Reading Adults Show Robust Frontal & Occipital Activations for RAN Tasks

n=18, *p*<.05 FWE *k*=10

Letters vs. Fixation

Numbers vs. Fixation

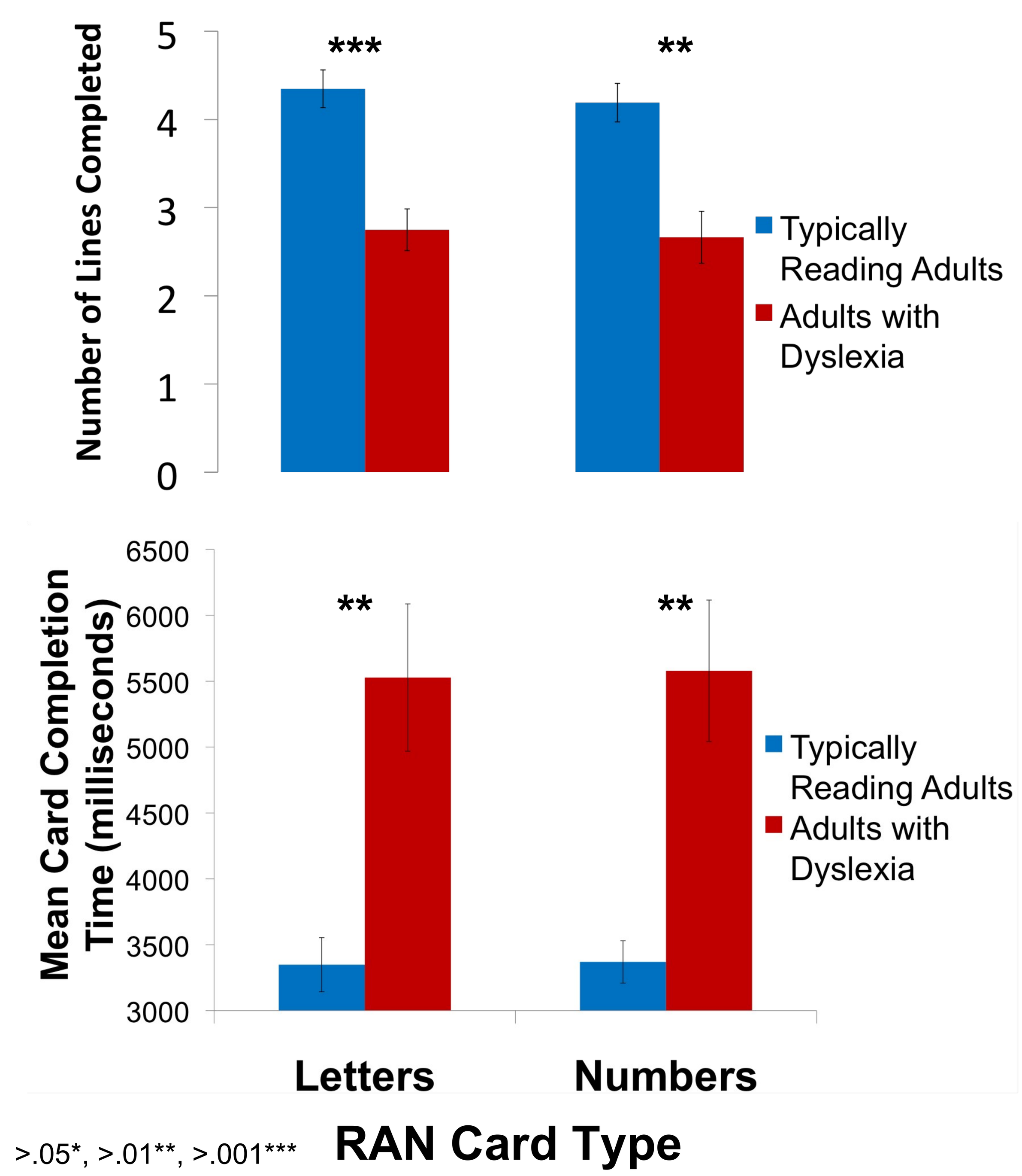


In-Scanner RAN Correlates with Standardized Measures

Correlations (*n*=18)

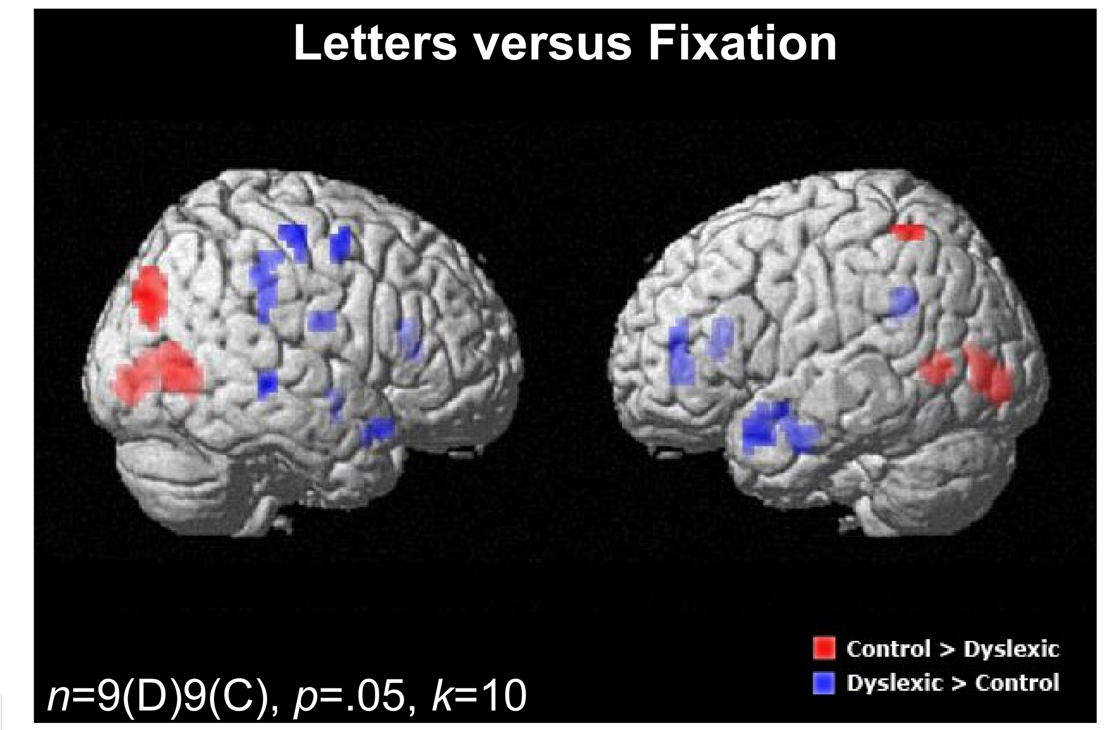
- **RAN Letters**
  - **Pro-Ed RAN Letters raw (.754**, .000)**
  - **CTOPP RAN Letters raw (.757**, .000)**
- **RAN Numbers**
  - **Pro-Ed RAN Numbers raw (.801**, .000)**
  - **CTOPP RAN Numbers raw (.631**, .005)**

In-Scanner: Lower Performance for Readers with Dyslexia

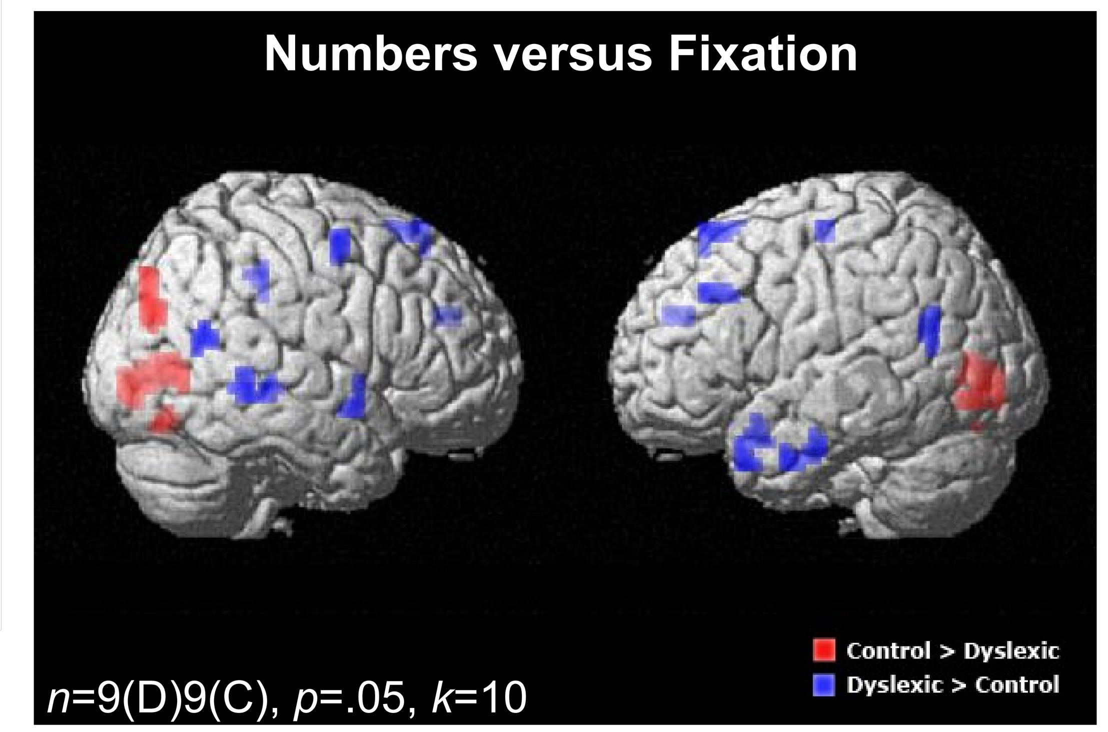


>.05*, >.01**, >.001***

Typical Readers vs Readers with Dyslexia > Posterior >Distributed

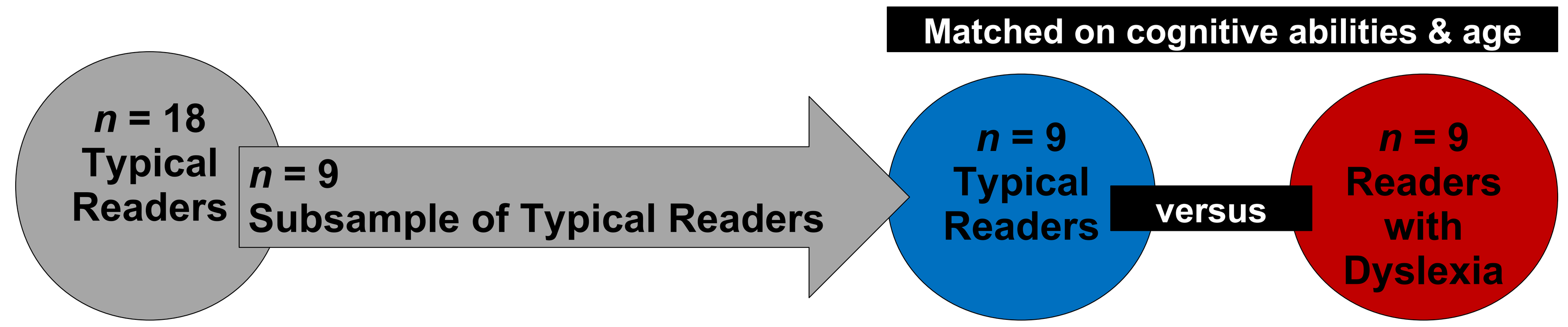


n=9(D)9(C), *p*=.05, *k*=10



n=9(D)9(C), *p*=.05, *k*=10

Participants and Methods



fMRI Acquisition Parameters: Siemens Trio 3T MRI scanner, 12-channel head coil, TR = 2, 32 axial slices, whole head coverage, 3.1x3.1x4.0 mm voxels.

Data Preprocessing: Functional timeseries data were realigned to correct for subject movement, submitted to motion and intensity artifact rejection, coregistered and normalized to an anatomical template, spatially smoothed at 6mm FWHM.

Conclusions

Typically reading adults showed robust activations in frontal and occipital regions for both letters and numbers RAN tasks. A comparison of typically reading adults and readers with dyslexia matched for cognitive abilities and age revealed notable group differences. Typically reading adults showed more activation in posterior regions, associated with the earliest processing of visual stimuli. Readers with dyslexia showed more distributed activations in frontal and parietal areas, suggesting a compensatory system for translating visual to verbal tokens that parallels compromised behavioral performance on RAN tasks, both in-scanner and on standardized measures. Hypoactivation of posterior networks required for reading, as shown here, is consistent with activation patterns found for readers with dyslexia[3,4].

References

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