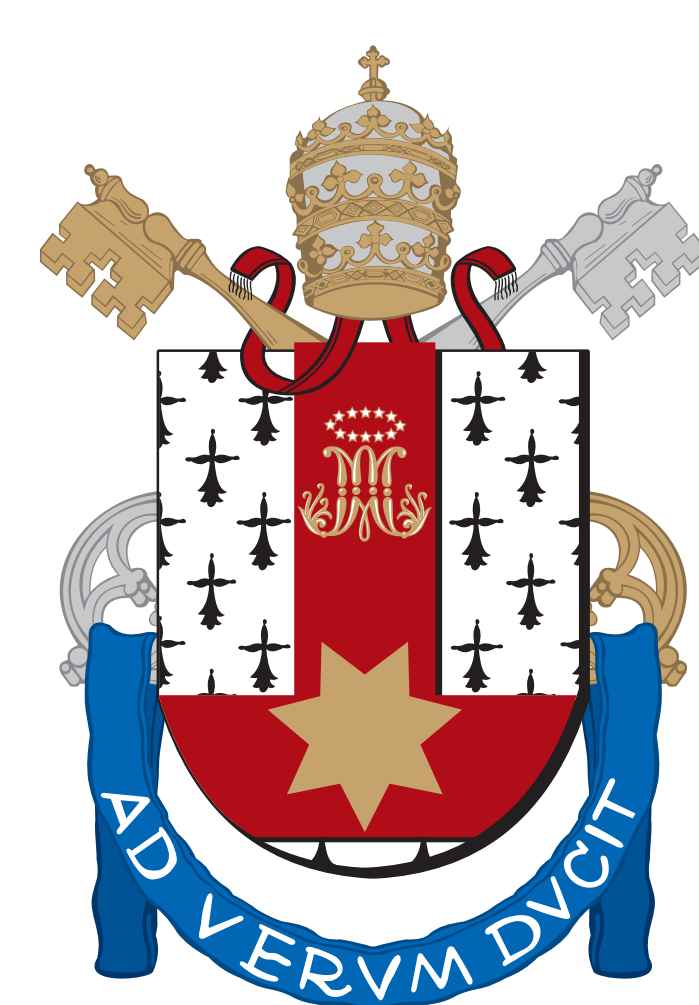# Identifying the neural representation of word reading in children diagnosed with dyslexia

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Motivation and Goals

The aim of our study is to:

- Identify cognitive states in dyslexic readers based solely on their brain activation using fMRI data (functional Magnetic Resonance Imaging).
- Apply machine-learning algorithms to identify whether a participant is reading a specific type of word while performing a word-reading task inside a fMRI scanner.

Experiment design

- The study has 10 participants (4 female) diagnosed with dyslexia or identified as having reading difficulties (poor readers).
- Subject age ranges from 8 to 13 years (Mean = 10.2; SD = 1.68).
- An event-related experiment was conducted with patients using a word and pseudoword reading task.
  - 20 regular words, 20 irregular words, and 20 pseudowords.
  - Words and pseudowords were presented in separate trials on the screen, for seven seconds.
  - A question was presented to participants together with each word (is this a real word?) to which they had to select Yes or No by pressing response buttons.
  - The baseline condition was presented twice and consists of the presentation of a crosshair in the middle of the screen for 30 seconds.

Feature Selection

- The input data for the feature selection are contrast images relative to the task conditions.
- We use a parcellation approach that divides the contrast images in 190 functional regions.
- Classifier examples were generated by calculating the average activation of all voxels within a region (contrast image transformed into an example with 190 features).
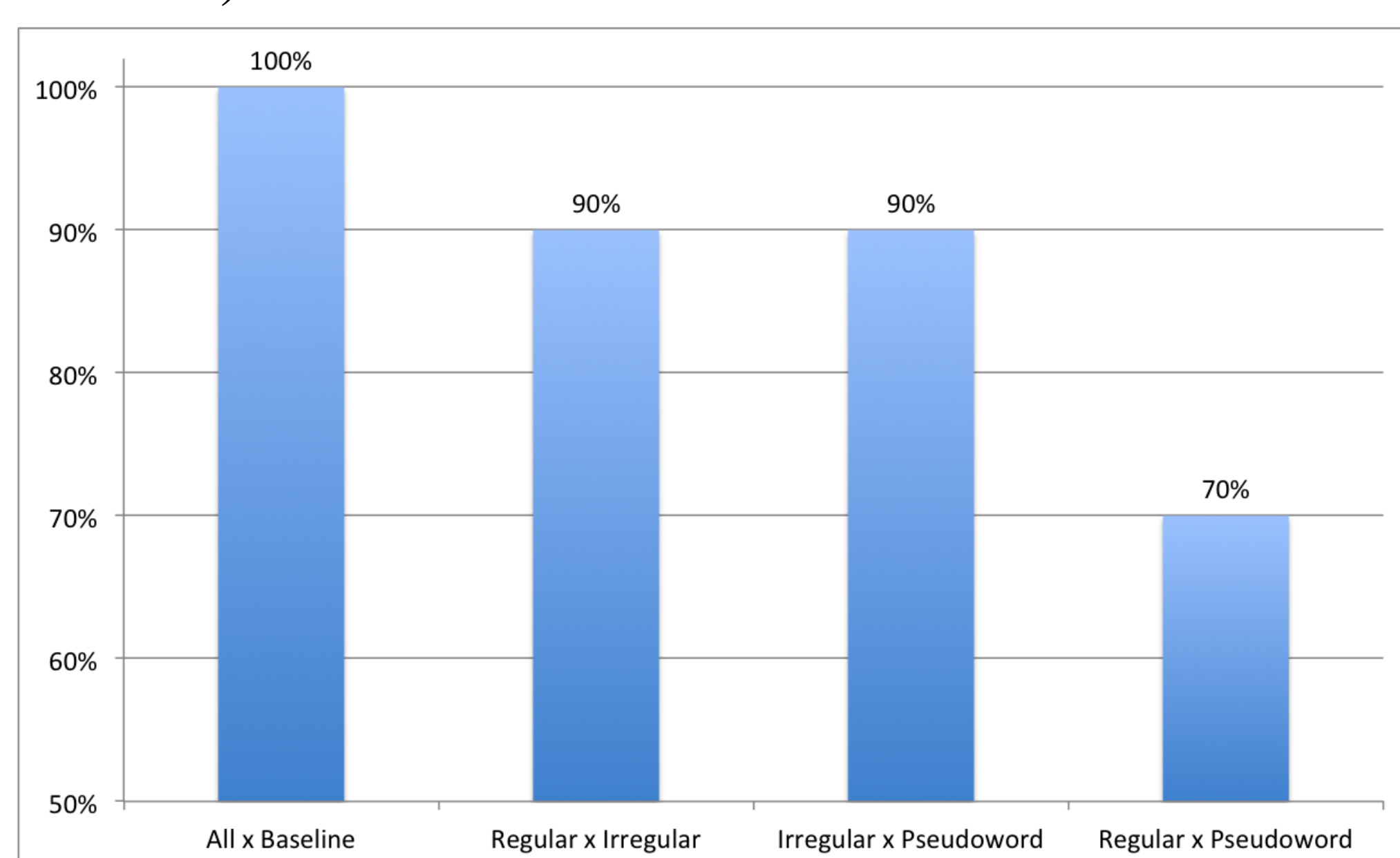

Figure 1: Classification results according to type of words.

Classification

- Classifiers were trained to distinguish types of word being read. We first used a test classifier to distinguish if children were reading any word (all) or resting (baseline). Then, we used 3 binary classifiers that distinguish which type of word children were reading, (regular x irregular, regular x pseudo-word, irregular x pseudo-word)
- Classifiers were trained and tested across-subjects using leave one subject out cross validation
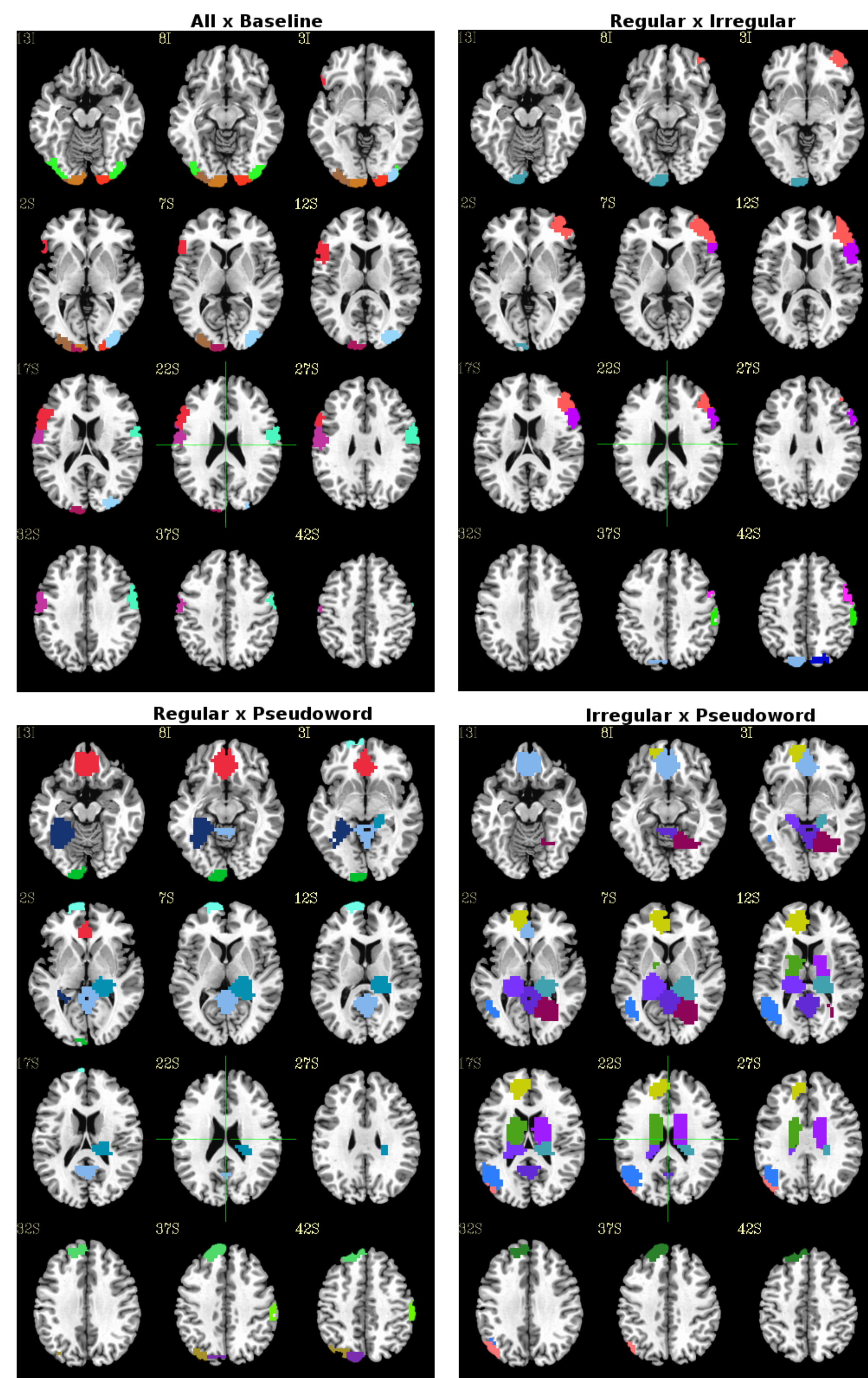- We used linear support vector machine (SVM) classifier

Figure 2: Location of the parcellations that contribute the most to classification from the 190 parcellations

Contributions and Conclusions

- Results show reliable classification of the type of word being read by the participants: average classification accuracy 87.5% for type of word being read by the dyslexic children, as shown in Figure 2.
- The areas that contributed the most for classification are illustrated in Figure 2. We can draw some conclusions about them:
  - all words x baseline included traditional, left hemisphere language areas
  - regular words x irregular words, right-hemisphere language homologues;
  - Classification of irregular and regular words x pseudowords relied on areas in the left inferior parietal lobe and anterior frontal lobe areas.