Neural plasticity underlying a shift from beginning to skilled reading

Wouter Braet1,*, Joline Rediers1, Hans Op de Beeck2, Johan Wagemans1

1 Laboratory of Experimental Psychology, 2 Laboratory of Biological Psychology, University of Leuven, Belgium

* e-mail: wouter.braet@psy.kuleuven.be

**REFERENCES**


**METHODS and DESIGN**

Participants:
Fifteen right-handed Dutch-speakers participated in this study (12 females; mean age: 23 years). One participant dropped out.

Training:
- **Training Session 1:** letter identification (5 × 100 trials; either on paper or word-matching (1 × 45 trials)
- **Training Session 2:** consonant categorisation (3 × 170 trials)
- **Scan Session 1:** consonant categorisation (6 × 100 trials)
- **Training Phase:** two to three months
- **Training Session 3:** semantic categorisation (6 × 150 trials)
- **Scan Session 2:** semantic categorisation (6 × 150 trials)

**Letter training:**
Participants were first asked to study the alphabet, and copy the letters using pen and paper. Then they were then shown several blocks of a letter identification task, in which individual rune letters were shown on the screen, and were asked to press the corresponding key on the keyboard. At the end of this one hour training session, participants’ mean accuracy was 99%.

**Training phase:**
Participants were asked to read one short story (in the rune alphabet) per week, for two to three months.

**Semantic categorisation task:**
On each trial, an individual word (written in runes or in the Latin alphabet) was shown for 2s, and participants were asked to press one button if the word belonged to a target category (e.g. animals), or another if the word did not. All words in a single block were presented in the same alphabet (odd blocks: Latin, even blocks: runes).

**BEHAVIOURAL RESULTS**

Participants showed reduced word length effects (in terms of accuracy, but not reaction times), as a consequence of the reading-practice.

These results demonstrate that, behaviourally, the training led to a marked reduction in word length effects, suggesting a shift from serial (letter by letter) to more parallel reading.

**MRI RESULTS & DISCUSSION**

Main effect of alphabet, before and after training:
- **Blue:** regions that were more active when reading runes, compared to the Latin alphabet. BEFORE training (purple): same comparison, AFTER training

Light green: regions more active when reading the Latin alphabet BEFORE training (dark green: AFTER training)

Interaction between alphabet and time:
- **Purple:** regions more active when reading runes AFTER training (blue): subthreshold (p < 0.001 voxelwise, uncorrected)
- **Yellow:** regions more active when reading runes BEFORE training (orange): subthreshold (p < 0.001 voxelwise, uncorrected)

We further observed that, as reading skills improved, activation was reduced in both the dorsal (bilaterial superior parietal cortex) and ventral (predominantly right fusiform gyrus) reading networks. Conversely, activation increased in phonological and semantic regions, including the (left) inferior frontal gyrus and angular gyrus.

**MRI RESULTS**

Word Length effects (or the lack thereof):
There were no regions showing any significant (main or interaction) effects of word length. Even at much lower thresholds we observed only a main effect of word length in early visual cortex (Red: p < 0.1 voxelwise, no corrections for multiple comparisons).

**REFERENCES**

