



# Relationships among Cortical Thickness, Reading Skill, and Print Exposure in Adult Readers

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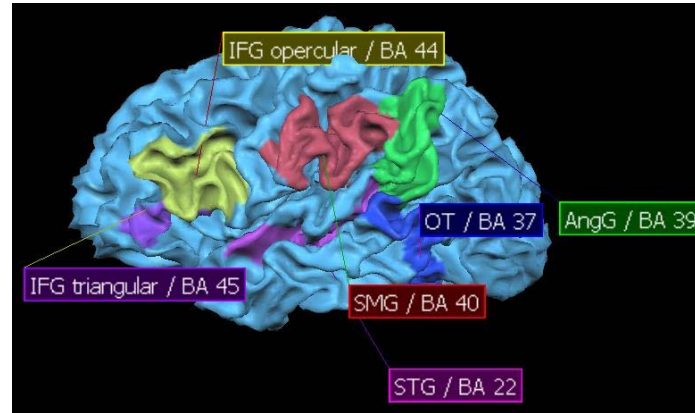


Reading and Dyslexia

<http://college.usc.edu/labs/reading/>

## Background

- Recent studies have shown that brain activation in dyslexic children can be influenced by reading instruction (Shaywitz et al., 2004). However, the impact of experience on brain structure is less well understood.
- One longitudinal study found a positive correlation between phonological processing ability and cortical thickness in the inferior frontal gyrus (IFG), and also found increasing thickness in the superior temporal gyrus (STG), in a sample of non-impaired children (Lu et al., 2007).
- It is possible that a third variable, such as reading experience, mediates the relationship between reading skill and cortical thickness.
- There is evidence that print exposure accounts for variability in reading skill independently of phonological awareness and decoding skill (e.g. Stanovich & Cunningham, 1992).
- However, no study has investigated the contribution of both reading skill and print exposure to changes in brain structure.



Regions of interest displayed on an individual subject's left hemisphere

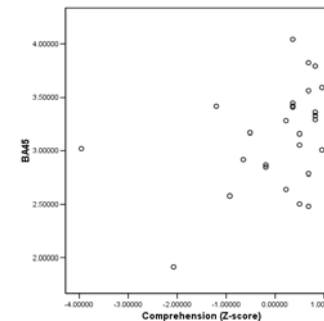
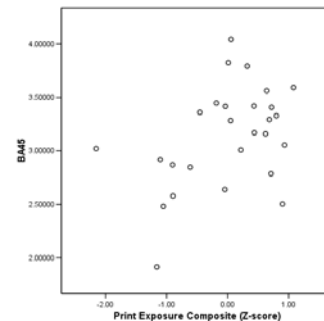
## Correlations

	Rapid Naming	Phonological Decoding	Word Reading	Comprehension	Print Exposure Composite
BA22 / Superior Temporal Gyrus †	.382*	.276	.485**	.375*	.405*
BA37 / Occipitotemporal Region	.204	.223	.205	.356*	.429*
BA39 / Angular Gyrus †	.229	.081	.191	.326	.529*
BA40 / Supramarginal Gyrus	.292	.096	.226	.219	.403*
BA44 / Inferior Frontal Gyrus (pars opercularis)	.133	.073	.153	.248	.416*
BA45 / Inferior Frontal Gyrus (pars triangularis)	.184	.073	.157	.360*	.413*
Print Exposure Composite	.329	.545**	.666**	.736**	

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

† Outliers greater than 3 SDs from mean values have been removed



## Present Study

- Developmental changes in cortical thickness have been found to be related to both age and experience-dependent learning.
- Can individual differences in reading skill and print exposure predict measurements of cortical thickness within the left hemisphere reading network?
- This poster reports adult data from an ongoing developmental study of cortical thickness and print exposure.

## Participants and Study Design

- Participants included 37 right-handed adults of varying reading skill, with average to above-average nonverbal IQ scores (as assessed by Woodcock-Johnson Tests of Cognitive Ability, Woodcock, McGrew & Mather, 2001).
- High-resolution structural images were acquired via a standard T1-weighted MPRAGE sequence on a Siemens MAGNETOM Trio 3 Tesla MRI unit using a CP head coil. Image analysis was performed using Brainvoyager QX 1.10.2, using semi-automatic "advanced" segmentation procedures.

## Measuring Print Exposure

- Updated versions of the Author, Magazine, and Book Title Recognition Tasks (Stanovich and Cunningham, 1992), which include a mix of genuine and foil items, have been administered to 27 of the participants. Participants indicate that they are familiar with the name of a popular author, magazine, or book title by putting a checkmark next to the item. Scores were Z-transformed and averaged to create a print exposure composite variable.

## Descriptive Statistics – Study Participants

	Mean	SD	Range
Verbal IQ (standard score)	104.73	10.14	86 – 128
Spatial IQ (standard score)	112.65	9.75	98 – 134
Comprehension (percentile)	67.78	31.40	1 – 99

## Descriptive Statistics – Cortical Thickness

	Mean	SD	Range
BA22	2.89464	0.36576	1.69304 – 3.50935
BA37	2.44979	0.49667	1.42492 – 3.29851
BA39	3.05277	0.45966	1.59710 – 3.66520
BA40	2.83408	0.50442	1.49593 – 3.74783
BA44	3.05791	0.45540	1.88284 – 3.89092
BA45	3.07468	0.52838	1.81495 – 4.04332

Cortical thickness measurements are in millimeters.

## Results and Interpretation

- Correlations indicate that individuals with more print exposure and who are of higher reading skill had thicker cortices within the left hemisphere reading network.
- Print exposure was the most consistent correlate of cortical thickness throughout the left hemisphere reading network, for adults. This may reflect the cumulative contribution of print exposure to cortical thickness through development. Alternatively, the print exposure measurements could be more psychometrically sensitive than the standardized reading tests.
- The correlation between phonological processing and IFG thickness that was previously reported in child samples (Lu et al, 2007) was not replicated by this study – perhaps this relationship does not persist through adulthood.

## Future Directions

- In order to more fully understand the relationships between reading skill, print exposure, and cortical structure, larger samples will be required, with more poor readers.
- Cross-sectional and longitudinal studies should be conducted, to help determine the directional relationship between reading skill, print exposure, and cortical structure, in children and in adults.