Developmental dyslexia

- Reading development lags behind other academic development. Achieved reading skill is limited: reading is slow and nonword reading is impaired.
- Dyslexia affects about 10% of the population, 4% severely.
Acquired dyslexias (incomplete list)

- Deep dyslexia:
  - Semantic errors, extensive left-hemisphere damage
- Surface Dyslexia.
  - Trouble with exception words (jetty vs. pretty; howl vs. bowl), can be a form of developmental dyslexia
- Pure alexia
  - Letter-by-letter reading. Occipitotemporal damage (VWFA!)
What causes developmental dyslexia?

Dyslexia is associated with abnormalities both in visual and auditory processing.
Dissociation of Normal Feature Analysis and Deficient Processing of Letter-strings in Dyslexic Adults

P. Helenius, A. Tarkiainen, P. Cornelissen, P.C. Hansen and R. Salmelin
Visual M100
Visual M170
Dyslexics and the “face M170”

Category-specific occipitotemporal activation during face perception in dyslexic individuals: an MEG study

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- Dyslexics do not differ from controls in facial processing
  - Same size effect for faces vs. other categories in the M170
Dyslexics and the Visual Word Form Area

Source:
Abnormalities in auditory processing

- Deficits in phonological processing the most consistent finding in all studies of dyslexia.
  - Phonological awareness
  - Rapid naming (pictures, colors, digits, letters)
  - Verbal short term memory
- No lower level auditory problem
- Problem: all dyslexics appear to have some phonological impairment but it’s not necessarily always the same one.
Dyslexics and the auditory M100

Abnormal Auditory Cortical Activation in Dyslexia
100 msec after Speech Onset

Päivi Helenius¹, Riitta Salmelin¹, Ulla Richardson²,
Seija Leinonen³, and Heikki Lyytinen³
Dyslexics and the auditory M100

- Dyslexics showed larger or longer latency M100s for speech sounds (/ata/, /atta/, and /a a/) than controls.

- No group differences in the M100s elicited by non-speech sounds.
Dyslexics and the auditory MMN

- Kujala et al. (2003): diminished left hemisphere MMN for a pitch change in dyslexics.
Dyslexia and neuropathological abnormalities

- Postmortem analyses of dyslexic brains have revealed focal reorganization of cortical layers or cerebrocortical microgyria.
Animal model of dyslexia

- Microgyria can be artifically produced in rodents.
- This causes their auditory processing to slow down.
Impaired Processing of Complex Auditory Stimuli in Rats with Induced Cerebrocortical Microgyria: An Animal Model of Developmental Language Disabilities

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**Figure 1.** (A) Photomicrograph of section from adult rat illustrating the presence of bilateral micrograin in the parietal cortices (arrowheads). (B) Higher power photomicrograph of the micrograin on the left of panel A (right hemisphere). In comparison with the undamaged six-layered cortex adjacent to it (right), micrograin cortex has four layers. Layer I is continuous with the molecular layer of the undamaged cortex and fuses to form a microcortex (arrow). Layer II is continuous with layers II-III of the undamaged cortex, but is un laminated. Layer III (lamina dissecans) is a glial scar that is the remnant of the original injury. Layer IV is continuous with layer Vb of the intact cortex. Solid lines show the medial and lateral borders of the micrograin area. *wm* = white matter. Bar for panel A = 800 μm, panel B = 200 μm.

**Figure 2.** Single trial schema of the gap detection paradigm. The duration of the gap randomly varied between the values of 0 (no gap), 2, 5, 10, 20, 30, 40, and 50 msec across 504 trials. SES = Startle-eliciting stimulus.

**Oddball Stimulus present or CUED trials**

- “Within-stimulus” ISI
- “Between-sequence” ISI

**Oddball Stimulus NOT present or UNCUED trials**

<table>
<thead>
<tr>
<th>Trial Type</th>
<th>Conditions</th>
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<tbody>
<tr>
<td>Oddball</td>
<td>±75 dB, Low-HI “Oddball” Stimulus Pair</td>
</tr>
<tr>
<td>Standard</td>
<td>±75 dB, Low-HI “Standard” Stimulus Pair</td>
</tr>
<tr>
<td>Control</td>
<td>±50 msec, 105 dB white noise SES burst</td>
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