Too Little Stimulation Is Bad

Normal

Sensory-Deprived
AGE 3: More Cognitive Stimulation
AGE 7: Less likely to have attention problems
AGE 3
More Television

AGE 7
More likely to have attention problems
BUILDING BLOCKS STUDY

- Randomized trial at Seattle clinic
- ~200 kids 18-24 months
- ½ got blocks at beginning; ½ got blocks at end
- Parents got “Bloctivities”
  - Sort blocks, stack blocks, count blocks
Language percentiles after 6 months

56% received blocks early
42% received blocks late
Virtual Teachers

- **Upside**
  - Available 24/7
  - Can be Engaging
Virtual Teachers

• **Upside**
  – Available 24/7
  – Can be Engaging

• **Downside**
  – Expensive Programs
  – Require Maintenance
  – No Personal Interaction
  – Not always Effective
  – Need Huge Time on Task
Learning Efficiency

• 5 hard-of-hearing students (8-10 yrs. old)  
  – 45 words, about 2.5 hours
• 11 hard-of-hearing students (11-14 yrs. old)  
  – 81 words, about 3.5 hours
• 8 hard-of-hearing students (6-10 yrs. old)  
  – 24 words, about 9 hours across 10 weeks
• 8 autistic children (7-12 yrs. Old)  
  – 49 words, about 7 hours across 6 months
• 6 autistic children (7-12 yrs. Old)  
  – 18 words, about 3 hours across 3-8 weeks

• Note that the longer times required for the last three studies include additional time for testing in the multiple baseline design.
http://www.youtube.com/watch?v=Tpge6c3lc4g
Edmund Huey wrote in 1908:

to completely analyze what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind, as well as to unravel the tangled story of the most remarkable specific performance that civilization has learned in all its history.
Aoccdrnig to a rscheeahcr at an Elingsh uinervtisy, it deosn't mttaeer in waht oredr the ltteers in a wrod are, the olny iprmoetnt thng is taht the frist and lsat ltteer are in the rghit pclae. The rset can be a toatl mses and you can sitll raed it wouthit porblem. Tihs is bcuseae we do not raed ervy lteter by itslef but the wrod as a wlohe.
Empirical Tests

• We analyzed 1000 most frequent words in English
• 9% are uniquely defined by their exterior letters
• Adding word length increased this percentage to 40%
• 24% of the words have a unique word shape
• When exterior letters, interior word shape and length were considered as features, 75% are uniquely described.
• However, this requires the reader to recognize the first and last letters, the length of the word, and the word shape of the interior letters.
• This is not a trivial amount of processing to bypass a strategy simply of processing the letters of the word.
Two Important Influences

• Bottom Up Visual Processing
• Top Down Knowledge Processing
Infants Seeing Letters

- 3-month-olds discriminated and remembered the letters L and T
- Infants were trained to kick their leg to move a mobile composed of blocks that were decorated with the letter L
- They did not transfer this learning when they were subsequently tested with a mobile decorated with the letter T
- they could tell the difference between the two letters (see also Rovee-Collier, 1997).
Fig. 1. Illustration of the stimulus-generation process. Each original letter (upper left) was first decomposed into five spatial-frequency bandwidths of one octave each (top row). Each bandwidth was then independently sampled with randomly positioned Gaussian windows (i.e., bubbles), so that sparse information was revealed (middle row). The information samples were summed across the five scales to produce an experimental stimulus (bottom row).

Features for Identification of Uppercase and Lowercase Letters
Daniel Fiset,1 Caroline Blais,2 Catherine E´thier-Majcher,2 Martin Arguin,2 Daniel Bub,1 and Fre´de´ric Gosselin2
Fig. 4. Relative use of the five sampled spatial-frequency bandwidths for recognition of uppercase and lowercase Arial letters.
Figure 5. Results of the overall a priori feature analysis, all letters and all frames confounded. Error bars indicate 95% confidence intervals. To view a colour version of this figure, please see the online issue of the Journal.
Letter Information

• Groups of confusable letters
  – a s z x
  – e o c
  – n m u
  – r v w
  – d h k b
  – t i l f
  – g p j y q
<table>
<thead>
<tr>
<th>Letter</th>
<th>Hit</th>
<th>False Alarm</th>
<th>d'</th>
<th>Confusions Greater than 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.372</td>
<td>.015</td>
<td>1.85</td>
<td>e(14), g (7)</td>
</tr>
<tr>
<td>b</td>
<td>.743</td>
<td>.020</td>
<td>2.72</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>.449</td>
<td>.016</td>
<td>2.05</td>
<td>o(6), e(5)</td>
</tr>
<tr>
<td>d</td>
<td>.639</td>
<td>.011</td>
<td>2.64</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>.365</td>
<td>.017</td>
<td>1.79</td>
<td>o(8), c(6), g(5)</td>
</tr>
<tr>
<td>f</td>
<td>.456</td>
<td>.020</td>
<td>1.94</td>
<td>i(14), l(8), t(7)</td>
</tr>
<tr>
<td>g</td>
<td>.703</td>
<td>.022</td>
<td>2.56</td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>.662</td>
<td>.020</td>
<td>2.46</td>
<td>n(5), b(5)</td>
</tr>
<tr>
<td>i</td>
<td>.277</td>
<td>.023</td>
<td>1.42</td>
<td>l(22), f(11), t(6), j(6)</td>
</tr>
<tr>
<td>j</td>
<td>.412</td>
<td>.017</td>
<td>1.92</td>
<td>l(7), i(6)</td>
</tr>
<tr>
<td>k</td>
<td>.655</td>
<td>.014</td>
<td>2.61</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>.530</td>
<td>.022</td>
<td>2.10</td>
<td>i(10), k(5)</td>
</tr>
<tr>
<td>m</td>
<td>.628</td>
<td>.010</td>
<td>2.66</td>
<td>n(6)</td>
</tr>
<tr>
<td>n</td>
<td>.497</td>
<td>.013</td>
<td>2.24</td>
<td>h(15), r(8), m(5)</td>
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<tr>
<td>o</td>
<td>.331</td>
<td>.014</td>
<td>1.78</td>
<td>c(10), b(8), p(8), a(6)</td>
</tr>
<tr>
<td>p</td>
<td>.730</td>
<td>.016</td>
<td>2.78</td>
<td></td>
</tr>
<tr>
<td>q</td>
<td>.649</td>
<td>.010</td>
<td>2.71</td>
<td>a(6)</td>
</tr>
<tr>
<td>r</td>
<td>.591</td>
<td>.023</td>
<td>2.24</td>
<td>t(8)</td>
</tr>
<tr>
<td>s</td>
<td>.324</td>
<td>.010</td>
<td>1.87</td>
<td>e(7), c(7), g(7), a(5)</td>
</tr>
<tr>
<td>t</td>
<td>.382</td>
<td>.020</td>
<td>1.76</td>
<td>f(12), r(12), i(9)</td>
</tr>
<tr>
<td>u</td>
<td>.554</td>
<td>.010</td>
<td>2.46</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>.520</td>
<td>.015</td>
<td>2.16</td>
<td>y(13)</td>
</tr>
<tr>
<td>w</td>
<td>.632</td>
<td>.010</td>
<td>2.66</td>
<td>x(5)</td>
</tr>
<tr>
<td>x</td>
<td>.730</td>
<td>.010</td>
<td>2.94</td>
<td></td>
</tr>
<tr>
<td>y</td>
<td>.686</td>
<td>.015</td>
<td>2.67</td>
<td>v(11)</td>
</tr>
<tr>
<td>z</td>
<td>.571</td>
<td>.010</td>
<td>2.51</td>
<td>x(7)</td>
</tr>
</tbody>
</table>
Figure 2.8.1 A chart demonstrating variations in acuity with retinal position.
(From Anstis, 1974.)
Unfriendly Neighbors
Tunnel Vision

Xxxx xxxxxx xxx xx xxxxxx xxxx.
Ecec ecece cec ce cecece ceccece.
Ijtji jitij itijt iti jtjt ijtitiij itjitiij ijt.
Now is the timexfor all good men.
Two Important Influences

• Bottom Up Visual Processing
• Top Down Knowledge Processing
Figure 2. The same visual configuration can be interpreted as two different letters, depending on the meaningful context.
Word Superiority Effect:

Letters better recognized in a word or pseudoword than a nonword.
Word Shape Doesn’t Change Word Advantage:

Letters better recognized in a word or pseudoword than a nonword.

<table>
<thead>
<tr>
<th>Word</th>
<th>Pseudoword</th>
<th>Nonword</th>
</tr>
</thead>
<tbody>
<tr>
<td>rEAd</td>
<td>tHaP</td>
<td>yIbv</td>
</tr>
<tr>
<td>bACK</td>
<td>SuCE</td>
<td>gTsl</td>
</tr>
<tr>
<td>wEak</td>
<td>BleT</td>
<td>MblA</td>
</tr>
</tbody>
</table>

Marilyn Adams, 1979
The structure of English orthography.
The Hague: Mouton & Co.
Dick Venezky and I (Venezky & Massaro, 1979, p. 87) observed that phonics instruction “draws attention to the orthographically regular features of printed words”
Two Types of Constraints

• Orthographic Structure
  – Rule-Based Structure
  – Frequency of Occurrence

• Sound/Spelling Correspondences
  – Spelling-to-Sound Regularity
  – Sound-to-Spelling Regularity
Two Types of Orthographic Structure

• Rule-Based Structure
  – CvC
    • Short vowel
  – CvCe
    • Long vowel
  – Scribs did not like the letter v in final position, so added the letter e
  – Final /v/ spelled [ve]
    • love

• Frequency of Occurrence
  – [fr] occurs in initial but not final position
  – Recent Letter and Word Counts
    • http://norvig.com/mayzner.html
Reading Baboons

• Words vs. Nonwords
  – TRAY vs ARYU
  – 500 words
  – About 50,000 trials

• Learned the Distinction
  – 6 Baboons
    • 75% Correct
Law of Practice and Experience
People change logarithmically, not linearly
Figure 1.3. Speed of cigar making (cycle time) as a function of practice (number of cigars produced).

SOURCE = Adapted from Crossman (1959).
<table>
<thead>
<tr>
<th>Orthographic Regularity</th>
<th>Rule-Based Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>Frequency of Occurrence</td>
</tr>
<tr>
<td>(15.033)</td>
<td></td>
</tr>
<tr>
<td>Coined</td>
<td></td>
</tr>
<tr>
<td>(13.420)</td>
<td></td>
</tr>
<tr>
<td>Summed Positional Log</td>
<td></td>
</tr>
<tr>
<td>Bigram Frequency</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Rodipe</td>
<td>Dripoe</td>
</tr>
<tr>
<td>(11.688)</td>
<td>(8.523)</td>
</tr>
<tr>
<td>Diceon</td>
<td>Nidcooe</td>
</tr>
<tr>
<td>(11.143)</td>
<td>(7.842)</td>
</tr>
<tr>
<td>Prdipe</td>
<td>Dpriseo</td>
</tr>
<tr>
<td>(11.625)</td>
<td>(8.509)</td>
</tr>
<tr>
<td>Cnoied</td>
<td>Endcoi</td>
</tr>
<tr>
<td>(11.083)</td>
<td>(7.883)</td>
</tr>
</tbody>
</table>
Sound/Spelling Correspondences

• Spelling-to-Sound Regularity
  – How likely a letter maps into a particular speech segment

• Sound-to-Spelling Regularity
  – How likely a speech segment maps into a particular letter or grapheme
Concept of Fluency

• Speed of Reading
• Influenced by
  – How likely letters occur
  – How likely letters map into sounds
  – How likely sounds map into letters