Pure word blindness
The strange case of Monsieur Oscar C.......
A century ago, on the 27th February 1892, Dejerine presented his analysis of a case of pure word blindness to the Biological Society of Paris.

The patient, Monsieur Oscar C, had been referred to him by a colleague, the noted ophthalmologist E.Landolt, who had earlier published some initial observations on the case in a volume dedicated to F.C. Donders on the occasion of his 50th birthday.
Dejerine’s report on pure word blindness

Jules Dejerine
Dejerine’s report on pure word blindness

Jules Dejerine
On the 23rd October, 1891, the patient went for a walk after experiencing some right-sided numbness of his arm and leg. He remembered clearly that he was quite capable of reading the advertisements in shop windows during the walk.

The next day, the numbness persisted, and to his alarm, Oscar C. also found that he was completely unable to read, even though he had no difficulty writing. In other respects, he appeared to be linguistically intact.
Thinking that his problem was visual in nature, he visited an ophthalmologist (Landolt) who recorded the following observations:

“Faced with the Snellen chart, he could not name any of the letters of the display, even though he affirmed that he could see them perfectly. Required to copy on paper what he saw, he managed but not without effort, to produce the letters line by line, as if he were dealing with a technical drawing”.
In spite of all of his efforts, he was incapable of naming the letters. He compared the A to an easel, the Z to a snake and the P to a buckle.

Landolt confirmed that the patient had normal visual acuity, but a right homonymous hemianopsia.
Dejerine, after examining the patient, wrote that Monsieur C had completely lost the significance of letters and words as linguistic codes, and that they appeared to him as meaningless perceptual forms.
What can a careful and detailed analysis of brain-damaged cases contribute to our understanding of the functional role of the left mid-fusiform gyrus?

Patients with pure alexia or letter-by-letter (LBL) reading.
Discuss current and previous attempts to understand how the perception of words can be affected in such an apparently selective way.

I will then describe more recent experiments that disclose a paradox.
I will then describe some evidence that attempts to resolve this paradox.

This leads to a new interpretation of the disorder and suggests some valuable insights into the mechanisms responsible for visual word recognition.
Dejerine’s interpretation:

The lesion prevents both visual cortices from access to visual word forms in the left hemisphere.

Words are no longer seen as familiar perceptual units.
“In looking at objects with one eye or both eyes, we see them with our two hemispheres.

It is the same with letters. We see them with our two occipital lobes but we see them with the help of these common visual centers as designs of some sort, like we see the letters of a language which is unfamiliar to us, like Russian or Hebrew.”
“In order for us to identify a letter, for a collection of certain letters to activate the idea of a word, it is necessary that these common visual centers enter into a connection with the language zone”.
Most cases are not as severely impaired as Monsieur C. Patients generally can decipher individual letters and then laboriously assemble the word from single letters. The modern term for this kind of reading is letter-by-letter reading.

Dejerine and Pelissier

Le siege d’Andrinople:

Le, yes, that’s it, L.....E....le, after that an S...E... siecle, I have perceived Le siecle.......D......E... that’s an E, let’s see .... and after that?
Example: Patient IH

![Graph showing reaction time in milliseconds for high and low frequency conditions across different sessions.]
The performance of patients with damage to left occipito-temporal cortex looks as if they are reading via a slow, sequential analysis of individual letters.
The performance of patients with damage to left occipito-temporal cortex looks as if they are reading via a slow, sequential analysis of individual letters.

This apparent truth seems so obvious, given the facts, that it has driven every theoretical claim about pure alexia ever since Dejerine.
Patterson and Kay’s analysis:
Patterson and Kay’s analysis:

Letters

Visual Word Form
Patterson and Kay’s analysis:

Letters

Visual Word Form
Patterson and Kay’s analysis:

Letters

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Letters

Visual Word Form

LET
Reading after a lesion to the left mid-fusiform gyrus appears to be reduced to a slow, sequential analysis of individual letter identities.

Cohen, Matinaud, Lemer, Lehericy, Samson, Obadia, Slachevsy and Dehaene (Cerebral Cortex, 2003)

These authors propose a fairly detailed anatomical model of the functional connections between a visual word form system in the left hemisphere and earlier perceptual mechanisms in each hemisphere.
Letter-by-letter reading is the result of serious impairment to the VWF system in the left middle fusiform area.

The right hemisphere remains capable of identifying individual letters but may not be capable of representing letters in a case invariant format.
Letter-by-letter reading is the result of serious impairment to the VWF system in the left middle fusiform area.

The right hemisphere remains capable of identifying individual letters but may not be capable of representing letters in a case invariant format.

Letter-by-letter reading is the result of a kind of spelling mechanism in the left hemisphere that receives letter information (presumably in serial fashion) from the right hemisphere.
Left hemisphere

Right hemisphere

VWF

FAMILY

Wednesday, 2 October, 13
All modern (and classical) accounts assume that: Patients presumably have very restricted access to higher-level units from print and so perceive only a series of individual letters.
The word superiority effect (WSE).

It is easier to identify a letter in a word than the same letter in isolation.
TASK: Report the letters you see

XXXXXXXXXXXXX
HAND
HAND versus ##N##
Figure 12: McClelland & Rumelhart’s Interactive Activation model: A few of the neighbors of the node for the letter T in the first position in a word, and their interconnections.
Figure 13: This degraded stimulus is easily read as *WORK* by human readers.
a diagonal pointing towards the bottom right. Figures 14 and 15 show the activation levels of certain letter and word nodes over time. Time in the computer is measured in epochs of activation events. Figure 14 shows the early activation equally rising for the \( k \) and \( r \) letter nodes. This is because the visual feature information supports both of those letters, while the \( d \) letter node is unsupported. During the early epochs the letter nodes are only receiving activation from the visual feature nodes, but later activation is provided by the word nodes. Figure 15 shows the activation among four words: work, word, weak, and wear. Since the first three letters of the word are not degraded, the letter nodes easily recognized them as \( w \), \( o \), and \( r \) for the first three positions respectively. These letters provide early activation for the words work and word, but not for weak and wear. The word nodes then start to send activation back down to the letter node level indicating that the fourth letter could be \( k \) or \( d \). Since \( k \) is already an active letter node while \( d \) is an inactive node, the \( k \) node is further strengthened. This allows the \( k \) letter node and the word work to continuously increase in activation and send inhibitory activation to their competitors, the letter \( r \) and the word word. Similar activation patterns can also explain the word superiority effect.

**Figure 14**: The activation level over time for letter nodes in the fourth position of a word.
Figures 14 and 15 show the activation levels of certain letter and word nodes over time. Time in the computer is measured in epochs of activation events. Figure 14 shows the early activation equally rising for the \textit{k} and \textit{r} letter nodes. This is because the visual feature information supports both of those letters, while the \textit{d} letter node is unsupported. During the early epochs the letter nodes are only receiving activation from the visual feature nodes, but later activation is provided by the word nodes. Figure 15 shows the activation among four words: \textit{work}, \textit{word}, \textit{weak}, and \textit{wear}. Since the first three letters of the word are not degraded, the letter nodes easily recognized them as \textit{w}, \textit{o}, and \textit{r} for the first three positions respectively. These letters provide early activation for the words \textit{work} and \textit{word}, but not for \textit{weak} and \textit{wear}. The word nodes then start to send activation back down to the letter node level indicating that the fourth letter could be \textit{k} or \textit{d}. Since \textit{k} is already an active letter node while \textit{d} is an inactive node, the \textit{k} node is further strengthened. This allows the \textit{k} letter node and the word \textit{work} to continuously increase in activation and send inhibitory activation to their competitors, the letter \textit{r} and the word \textit{word}. Similar activation patterns can also explain the word superiority effect.

**Figure 15:** The activation level over time for four word nodes.
Question 1

Which part of the model has feedforward-feedback connection?

a) The connections between features and letters.
b) The connection between letters and words.
c) Both of the above.
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b) The connection between letters and words. **
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Question 2

What do we mean by the orthographic neighbourhood of a four-letter word like BOOK?

a) All the words that share the first letter with BOOK.
b) All the words that share 2/4 letters with BOOK.
c) All the words that share 3/4 letters with BOOK.
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What do we mean by the orthographic neighbourhood of a four-letter word like BOOK?

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Question 3

What do we mean by saying that a target word exists in a low density orthographic neighbourhood?

a) Many words share 3/4 letters with the target word.
b) Few words share 3/4 letters with the target word.
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Question 4

Which of the following produces better recognition of letters in a four letter word in a LBL reader?

a) A four letter word from a high density orthographic neighbourhood.
b) A four letter word from a low density orthographic neighbourhood.
Question 4

Which of the following produces better recognition of letters in a four letter word?

a) A word from a high density orthographic neighbourhood.**
b) A word from a low density orthographic neighbourhood.
What, according to Dejerine, is the nature of the lesion responsible for pure alexia?

a) Damage to Centre V.
b) A disconnection between the eye and Centre V.
c) A disconnection between Centre V and Centres A and B.
Question 5

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A simple test of the claim that letters do not access higher level orthographic units:

The patient should show very weak influences of higher-level orthographic representations on letter perception.

Normal readers are much better at identifying letters in words than random letters or even letters in matched pseudowords.
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Masked word presentation

83 msec

50 msec
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</tr>
<tr>
<td>1–9</td>
<td>06/44</td>
<td>07/44</td>
</tr>
</tbody>
</table>
Is the WSE in IH due to guessing? For example, he sees, HA…. and then guesses H – A – N – D. When you present, GAND, he guesses wrongly (e.g. G- A – M - E), so HAND > GAND.

If this is true, IH’s guesses should be words, especially more common words.

But, in fact, 53% of IH’s responses were nonsense words for real words and 58% were nonsense words when actual nonsense words were presented. Also, the median frequency of his WORD responses to words was only 21, indicating that he did not simply guess by trying to think of familiar words. Also, IH is anomic so a guessing strategy in which he simply tries to think of words (many of them low frequency) is unlikely.
Another very specific test for the argument that IH is simply using some kind of guessing strategy when reading words.

Orthographic neighborhood
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Orthographic neighborhood

BOOT
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Orthographic neighborhood

BOOT
BOAT
HOOT
BOOM
MOOT
BOOK
FOOT
BOOR
BOON
LOOT

FILM
FILL
FILE
Another very specific test for the argument that IH is simply using some kind of guessing strategy when reading words.
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Orthographic neighborhood

BOOT

BOAT   ROOT
HOOT   SOOT
BOOK   FOOT
BOOM   BOOR
BOON   LOOT
MOOT

FILM

FILL
FILE

BOOT is a word from a High-Density Neighborhood

Wednesday, 2 October, 13
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Orthographic neighborhood

BOOT

BOAT
HOOT
ROOT
SOOT
BOOK
FOOT
BOOM
BOOR
BOON
LOOT
MOOT

FILM
FILL
FILE

BOOT is a word from a High-Density Neighborhood

FILM is a word from a Low-Density Neighborhood
High density words are less guessable than Low density words
High density words are less guessable than Low density words

BOO?
High density words are less guessable than Low density words

BOO?  BOOK BOOT BOOM BOON BOOR
High density words are less guessable than Low density words

BOO?
BOOK BOOT BOOM BOON BOOR
LIS?
High density words are less guessable than Low density words

BOO? BOOK BOOT BOOM BOON BOOR

LIS? LIST LISP
High density words are less guessable than Low density words

BOO?
BOOK BOOT BOOM BOON BOOR
LIS?
LIST LISP

The results were interesting:
High density words are less guessable than Low density words

BOO?  BOOK BOOK BOOT BOOM BOON BOOR
LIS?  LIST LISP

The results were interesting:  High Density  10/45
High density words are less guessable than Low density words

BOO?

BOOK BOOT BOOM BOON BOOR

LIS?

LIST LISP

The results were interesting:

High Density   10/45

Low Density    5/45
Reading in LBL readers is affected by higher level variables like orthographic neighborhood size.

Reading is also affected by other higher level variables that affect normal readers.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Word frequency</td>
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<td>Imageability</td>
<td>6322 ms</td>
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</tr>
<tr>
<td>Neighborhood</td>
<td>5383 ms</td>
<td>4478 ms</td>
</tr>
</tbody>
</table>
Effect of orthographic neighborhood.

It looked as if IH found high density words easier than low density words.
Effect of orthographic neighborhood.

It looked as if IH found high density words easier than low density words.
Effect of orthographic neighborhood.

It looked as if IH found high density words easier than low density words.

BOOT

BOAT   ROOT
HOOT   SOOT
BOOK   FOOT
BOOM   BOOR
BOON   LOOT
MOOT

Wednesday, 2 October, 13
Effect of orthographic neighborhood.

It looked as if IH found high density words easier than low density words.
Effect of orthographic neighborhood.

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Let’s take another look at this phenomenon.
Figure 1. Average correct response times (ms) in IH as a function of orthographic neighbourhood size (N size; Expt. 1).

Figure 2. Error rates (%) in IH as a function of orthographic neighbourhood size (N size; Expt. 1).
Normal readers show very similar effects.

The explanation for this effect assumes parallel letter analysis.
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The interactive-activation model of Rumelhart and McClelland (1986), includes the assumption that a word with many neighbours generates high levels of concurrent activation over candidates that share letters with the target.
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The interactive-activation model of Rumelhart and McClelland (1986), includes the assumption that a word with many neighbours generates high levels of concurrent activation over candidates that share letters with the target.

Because of this increased activity, the letter clusters in a word from a dense neighborhood receive more excitatory feedback from the partially activated set of words that resembles it.
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The explanation for this effect assumes parallel letter analysis.

The interactive-activation model of Rumelhart and McClelland (1986), includes the assumption that a word with many neighbours generates high levels of concurrent activation over candidates that share letters with the target.

Because of this increased activity, the letter clusters in a word from a dense neighborhood receive more excitatory feedback from the partially activated set of words that resembles it.

Words with many orthographic neighbors are therefore read more easily than words with fewer neighbors (Sears, Hino and Lupker, 1999).
Why do I say that the effect of neighborhood requires parallel activation of letters (all the letters activated at the same time)?
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Snodgrass and Minzer (1993) presented words in a series of increasing fragments and subjects were either asked to make successive attempts at identifying the word or to produce a single response.
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B O
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B O A
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Boat

In neither case was there a beneficial influence of increased N size on performance.
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B O A T

In neither case was there a beneficial influence of increased N size on performance.

But this successive guessing procedure is exactly what LBL readers are supposed to be doing!
Pugh et al. (1994) found, in normal readers, that more orthographic neighbors hinder rather than enhance word identification if a letter distinguishing the target from its neighbors is delayed by 100 ms relative to the other letters.
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The effect of orthographic neighborhood size is actually not compatible with letter-by-letter reading.
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Conclusion: LBL readers cannot be reading letter-by-letter if they show normal effects of orthographic neighborhood!
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What does this mean, then?
The effect of orthographic neighborhood size is actually not compatible with letter-by-letter reading.

Conclusion: LBL readers cannot be reading letter-by-letter if they show normal effects of orthographic neighborhood!

What does this mean, then?

![Graph showing response time as a function of word length](image)
Paradox boils down to this:

No variable we have looked at so far (word frequency, neighborhood size, word superiority effect) distinguishes LBL reading from normal reading, except for the fact that LBL readers are very slow and show massive effects of word length on performance.
To resolve this paradox, we have to give up an idea that seems to be obviously true, but actually must be false.

This function cannot be a simple consequence of sequential letter-by-letter reading!
To resolve this paradox, we have to give up an idea that seems to be obviously true, but actually must be false.

This function cannot be a simple consequence of sequential letter-by-letter reading!
LBL reading cannot really be letter-by-letter, and we have been deceived (for a century!) by the surface aspects of the phenomenon: very substantial effects of word length on reading speed.

LBL reading must include substantial parallel analysis of orthography.
(i) Presenting words one letter at a time abolishes higher level effects in “LBL” reading.

The rate of sequential presentation is determined from the slope of the word identification function for a given patient.
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The rate of sequential presentation is determined from the slope of the word identification function for a given patient.
FAMILY
FAMILY +
Higher level effects are present if the letters forming a word are displayed simultaneously.

<table>
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<td>Imageability</td>
<td>3464 ms</td>
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<tr>
<td>Neighbourhood size</td>
<td>2565 ms</td>
<td>3331 ms</td>
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</table>
Higher level effects are absent if the letters forming a word are presented sequentially.

<table>
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<td>1578 ms</td>
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These higher level effects depend on all the letters being present on the screen—thus, they reflect parallel letter encoding in LBL readers.
ii) The word length effect cannot be simply due to the number of letters in the word.

There must be another variable (not the number of letters) that we can find that is the true cause of the effect of length. This variable should reflect the actual fact that LBL reading is still based on parallel mapping of letters to higher level orthographic units.
Word length is not the actual variable responsible for the effect of the number of letters on reaction time.
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Letter confusability

- The degree of visual similarity between a target letter and remaining letters of the alphabet.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
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<td>D</td>
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<tr>
<td>F</td>
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<td>0.005</td>
<td>0.0035</td>
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</tbody>
</table>
Letter confusability

- The degree of visual similarity between a target letter and remaining letters of the alphabet.

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<tr>
<th></th>
<th>A</th>
<th>B</th>
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<td>A</td>
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</table>
\[ A + R + B + R + E \]
\[ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \]
\[ .42 \quad .6 \quad .72 \quad .6 \quad .062 \]

\[ 2.402 = \text{summed confusability} \]
\[
\text{A} + \text{R} + \text{B} + \text{R} + \text{E}
\]

\[
\begin{align*}
.42 & \quad .6 & \quad .72 & \quad .6 & \quad .062 \\
2.402 &= \text{summed confusability} \\
\text{Average confusability} &= \frac{2.402}{5} = 0.48
\end{align*}
\]
Figure 12.2 The frequency distribution of total confusability scores for different word lengths (See color Plate 12).
A very important point:

If you take 4, 5, 6 and 7 letter words at random, the AVERAGE LETTER CONFUSABILITY for each word length will be the same.

H A N D

\[
\begin{align*}
0.51 & \rightarrow 0.41 \\
0.41 & \rightarrow 0.6 \\
0.6 & \rightarrow 0.5
\end{align*}
\]

\[
= 2.02/4 = 0.50
\]

B L A N K E T

\[
\begin{align*}
0.72 & \rightarrow 0.25 \\
0.25 & \rightarrow 0.42 \\
0.42 & \rightarrow 0.55 \\
0.55 & \rightarrow 0.55 \\
0.55 & \rightarrow 0.6 \\
0.6 & \rightarrow 0.4
\end{align*}
\]

\[
= 3.49/7 = 0.498
\]

But notice --- the summed letter confusability is bigger for longer words.
A very important point:

If you take 4, 5, 6 and 7 letter words at random, the AVERAGE LETTER CONFUSABILITY for each word length will be the same.

H A N D

.51 .41 .6 .5

= 2.02/4 = 0.50

B L A N K E T

.72 .25 .42 .55 .55 .6 .4

= 3.49/7 = .498

But notice --- the summed letter confusability is bigger for longer words.
A very important point:

If you take 4, 5, 6 and 7 letter words at random, the AVERAGE LETTER CONFUSABILITY for each word length will be the same.

\[
\begin{align*}
\text{HAND} & : 0.51, 0.41, 0.6, 0.5 \\
& = 2.02 / 4 = 0.50
\end{align*}
\]

\[
\begin{align*}
\text{BLANKET} & : 0.72, 0.25, 0.42, 0.55, 0.55, 0.6, 0.4 \\
& = 3.49 / 7 = 0.498
\end{align*}
\]

But notice --- the **summed letter confusability is bigger for longer words.**
Conjecture: The word length effect in LBL reading is due to the fact that the summed letter confusability increases systematically as word length increases. If we can control for summed confusability across different lengths, then the word length effect should disappear.
Figure 12.2 The frequency distribution of total confusability scores for different word lengths (See color Plate 12).
<table>
<thead>
<tr>
<th>Case</th>
<th>Word length effect (ms / letter)</th>
<th>Letter confusability effect (in ms)</th>
<th>Localisation of the lesion</th>
<th>Publication reporting details on patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK</td>
<td>400</td>
<td>280</td>
<td>Left occipital lobe (CT scan)</td>
<td>Behrmann, Plaut &amp; Nelson (1998)</td>
</tr>
<tr>
<td>DM</td>
<td>410</td>
<td>500</td>
<td>Left medial and inferior occipitotemporal gyrus (MRI)</td>
<td>Osswald, Humphreys &amp; Olson (2002)</td>
</tr>
<tr>
<td>EL</td>
<td>405</td>
<td>480</td>
<td>Left peristriate infero-temporal, posterolateral temporal and dorsal parietal cortices (CT scan)</td>
<td>Montant &amp; Behrmann (2001)</td>
</tr>
<tr>
<td>HJA</td>
<td>600</td>
<td>1300</td>
<td>Inferior temporal, lateral occipitotemporal, fusiform, and lingual gyri, all affected bilaterally (MRI)</td>
<td>Humphreys &amp; Riddoch (1987)</td>
</tr>
<tr>
<td>LH</td>
<td>550</td>
<td>600</td>
<td>Left temporo-occipital encephalomalacia (MRI)</td>
<td>Fiset, Arguin &amp; McCabe (submitted)</td>
</tr>
<tr>
<td>WR</td>
<td>750</td>
<td>850</td>
<td>Left temporo-occipital area (neurological examination)</td>
<td>No publication</td>
</tr>
</tbody>
</table>
Words aligned
BAKER

<table>
<thead>
<tr>
<th>Reaction Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

TCS unmatched

TCS matched
The results of each patient were analysed individually. All patients showed a significant interaction of word length and matching condition (average vs. summed confusability)

(DK : [F(2, 221) = 4.2, p < 0.05]; DM : [F(2, 227) = 4.3, p < 0.05]; EL [F(2, 217) = 16.1, p < 0.001]; HJA : [F(2, 215) = 6.8, p < 0.005]; IH : [F(2, 258) = 4.6, p < 0.05]; LH : [F(2, 318) = 13.9, p < 0.001]; WR : [F(2, 262) = 7.7, p < 0.005].

Wednesday, 2 October, 13
Wednesday, 2 October, 13
Wednesday, 2 October, 13
Wednesday, 2 October, 13
Wednesday, 2 October, 13
Wednesday, 2 October, 13
But that is not Daniel Fiset’s explanation.

The explanation is very subtle.....
But that is not Daniel Fiset’s explanation.

The explanation is very subtle.....

Written word
But that is not Daniel Fiset’s explanation. The explanation is very subtle.....

Written word

Parallel letter analysis
But that is not Daniel Fiset’s explanation.

The explanation is very subtle.....
But that is not Daniel Fiset’s explanation.

The explanation is very subtle.....
But that is not Daniel Fiset’s explanation.

The explanation is very subtle.....
So we need to find out:

(a) Whether controlling for summed letter confusability across different word lengths removes the effect of word length for the trivial reason that individual letters making up shorter words must necessarily be more visually confusable on the average than letters in longer words, in order to control for summed letter confusability.
b) Or whether, controlling for summed letter confusability across different word lengths removes the effect of word length because Daniel Fiset’s strange idea is correct.
Three ways to check

1) We see if the time to identify each letter individually can predict overall RT.
Three ways to check

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Three ways to check

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Three ways to check

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Three ways to check

1) We see if the time to identify each letter individually can predict overall RT.
The answer is no!

Another test: Examine the time to name each letter in the word, using a spatial cue to randomly signal which letter to identify. Then check to see if you can predict word identification times from the summed letter identification times.

Answer is again no!
BEAST

The answer is no!

Another test: Examine the time to name each letter in the word, using a spatial cue to randomly signal which letter to identify. Then check to see if you can predict word identification times from the summed letter identification times.

Answer is again no!
The answer is no!

Another test: Examine the time to name each letter in the word, using a spatial cue to randomly signal which letter to identify. Then check to see if you can predict word identification times from the summed letter identification times.

Answer is again no!
Last test: Prevent normal parallel encoding of letters by scrambling the usual adjacent positioning of the letters

Parallel letter analysis

"Noisy" encoding

Summed letter confusability effects

Focal attention on letters
Last test: Prevent normal parallel encoding of letters by scrambling the usual adjacent positioning of the letters

H U E
O S

Focal attention on letters

Parallel letter analysis

Summed letter confusability effects

“Noisy” encoding
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H  U  E
O  S

Focal attention on letters

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“Noisy” encoding
Last test: Prevent normal parallel encoding of letters by scrambling the usual adjacent positioning of the letters

H     U     E
O     S
HOUSE
Parallel letter analysis
Parallel letter analysis

“Noisy” encoding
Parallel letter analysis

“Noisy” encoding

Summed letter confusability effects

HOUSE
Parallel letter analysis

"Noisy" encoding

Summed letter confusability effects

HOUSE
Parallel letter analysis

“Noisy” encoding

Summed letter confusability effects

Focal attention on letters

Parallel letter analysis

HOUSE
Matching across word lengths on:

- Summed confusability

Reaction time (in ms)

Word length (Number of letters)

5  6  7
<table>
<thead>
<tr>
<th>Temps de réaction (en ms)</th>
<th>Nombre de lettres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Confusabilité moyenne</th>
<th>Confusabilité totale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appariement sur la:

- Confusabilité moyenne
- Confusabilité totale
LBL readers identify this word by a purely sequential analysis of letters.
LBL readers identify this word by a purely sequential analysis of letters.

LBL readers do not identify this word by a purely sequential analysis of letters.
LETTER ANALYSIS
LETTER ANALYSIS

Visual Word Activation
LETTER ANALYSIS

Visual Word Activation
The lesion has resulted in noise in the mapping of letter identities when normal (expert) reading processes become active.
The lesion has resulted in noise in the mapping of letter identities when normal (expert) reading processes become active.

Subsequent attention to parts of the word (a repair process) takes place within the context of a structured word percept.
It is not the case that the lesion in LBL reading abolishes visual word expertise.
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It is not the case that the lesion in LBL reading abolishes visual word expertise. The impairment arises because the patient continues to make habitual use of parallel and interactive letter-word integration. This process generates abnormal amounts of noise at the letter level. During word activation, the noise is “repaired” (as word activation continues) by the patient attending to discrete letter locations.
Questions that remain:

Relationship between left and right hemispheres and perceptual expertise for words and other special kinds of visual tasks like face recognition.

How does attention interact with normal and impaired reading mechanisms?

How does the brain build these specialized regions? Are they innate?
Also a moral to the story:

Dejerine’s theory was based on a surface impression of the clinical phenomena.
Beneath these phenomena lurks a maze of subtlety and complexity.

LBL reading is not really what it appears on the surface, letter....by.....letter reading!