Slide 1

Acquired Dyslexia

1944 — G.R. received a bullet wound to the head. Resulted in reading problems.

- antique read as vase
- uncle as nephew
- visual errors
  - “stock” as “shock”
  - “crown” as “crowd”
  - “wise” as “wisdom”
- concrete words read better then abstractions — “table” read more correctly than “truth”
- Reading rates: nouns (46%), adjectives (16%), verbs(6%), function words (2%).

Slide 2

- incapable of reading nonsense words — mave or nust.

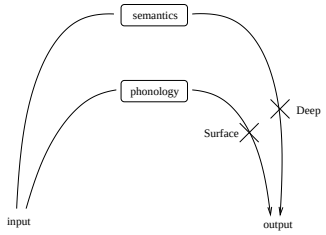
Slide 3

Dual Route Model

(Marshall and Newcombe)

Surface Dyslexia: Sounding out errors (“deef” for “deaf”). Misread exception words by regularizing, e.g. “yacht” read as “yatcht”.

Deep Dyslexia: Semantic errors, e.g “yacht” read as “boat”.



Shallow dyslexia may affect the phonological route while deep dyslexia affects the semantic route.

Slide 4

Hinton and Shallice model of the semantic route

(Scientific American, 1993)

Grapheme units: Represent the letter in position. Represented three and four letter words.

Hidden units Usual intermediate processing units

Sememe Units: Represented semantic features, e.g. ’has 4 legs’, ’furry’, ’fierce’, etc. 68 used and divided into 19 groups. Each group acted as a competitive filter, so one node from each group can respond.

Clean-up units: The feedforward network tends to make words like ’cot’ and ’cat’ very similar at output. Clean up units fixed this. The act like a Hopfield model with correct semantic representation as fixed points. Initial representation at output learned to be within basins of attraction of the fixed points.

Slide 5

Lesioning the model

Three types of damage:

- weights set to 0
- noise added to weights
- hidden units removed

All four types of errors found in lesioned network:

semantic errors: 'cat' for 'dog'

visual errors: 'bun' for 'bug'

mixed errors: 'ram' for 'rat'

weird errors: 'hawk' for 'log'

Lesions to different areas caused similar problems, but in differing proportions.

Slide 6

- lesioning clean-up units — changes the basin boundaries
- lesioning grapheme units — changes the semantic response

Slide 7

Interpretation

Explains first puzzle of acquired dyslexia.

- Damage anywhere in semantic paths results in similar problems.
- In particular, damage near visual end causes semantic errors.

Explains visual errors

- Visual errors are not sounding errors (not 'loave' as 'love') (well, they cannot be in this model)
- The network makes visual errors with damage to the cleanup units (surprising?).
- Architecture was varied. Details unimportant, except there *must* be attractors.

Slide 8

- Reproduces visual + semantic errors
  - GR read 'sympathy' as 'orchestra' (via 'sympathy')
  - network read 'cat' as 'bed' (via 'cot')
- Reproduces a v. large lesion effect
  - Patient cannot say word, but category (e.g. animal, food)
  - Network attractors merge with large amounts of damage.

Slide 9

Concrete v. Abstract Words

Interpretation: related to number of features.

- e.g. 'post' has 16 features: size, use, etc.
- 'past' has 2 features: has duration, refers to previous time.

Damage near grapheme end causes abstract words to be more affected than concrete words, as found in most patients.

Damage near clean-up units, however, had the opposite effect. Concrete words more affected. (Concrete words rely on clean-up units more.)

- One clinical case of this was found — "concrete word dyslexia"

Slide 10

Conclusions

- A single explanation or model for all four types of errors. (Others assumed that four systems would be required). Another example of connectionist models allow multiple function from a single system.
- Model seems to reproduce the range of errors found in dyslexics.
- Suggests a representation for semantic information which is consistent with these errors.