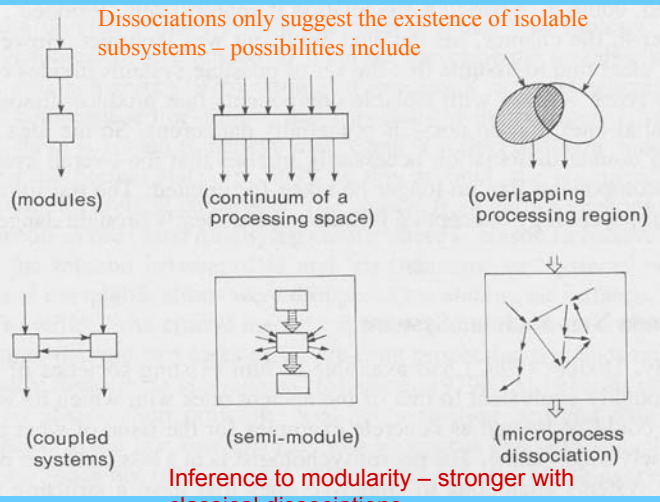
Types of Dissociation

- CLASSICAL – Intact task at normal level (which is not ceiling)
- STRONG – Better task much superior to grossly impaired task but not at normal level

Dissociations only suggest the existence of isolable subsystems – possibilities include



Inference to modularity – stronger with classical dissociations

Semantic Dementia

- Neuropsychological characteristics first quantitatively described by Warrington (QJEP 1975)
- Extensive further analyses by Hodges Patterson and colleagues since 1990
- Dementing condition histologically distinct from Alzheimer's Disease
- Affects inferior temporal cortex, particularly anteriorly more left than right

Semantic Dementia: Dissociations

- 1. Intact IQ (eg Raven's Matrices)
- 2. Intact sensory and perceptual processes (prior to level of meaning)
- 3. Intact short-term memory (eg span)
- 4. Intact episodic memory of non-semantic characteristics (Hodges group)
- 5. Relatively intact syntax, phonology and orthography
- BUT all types of knowledge eg of the significance (and name) of objects, word meanings etc grossly reduced

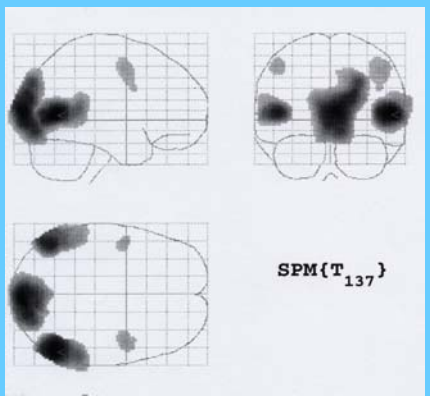
Semantic Processing through the ventral route

- Characteristics of semantic dementia fit anatomically well with this perspective
- NB Must apply to word processing as well as object processing
- For other reasons dorsal – ventral route distinction extended to consideration of auditory word processing by Scott and Johnsrude (2003) – with dorsal route 'carrying' syntactic and phonolgically mediated acoustic -> articulatory transformations

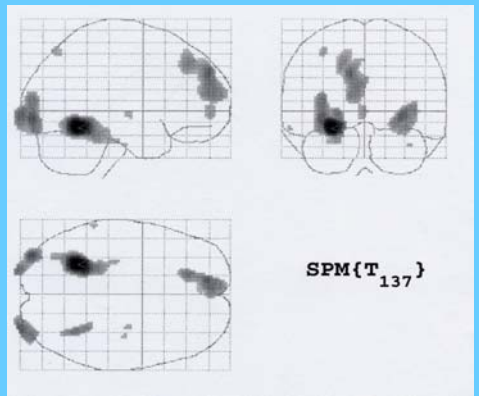
Rumiati et al NeuroImage 2004

- PET to allow limited and lower arm hand movements
- Factorial Design
- A. Two types of stimuli : 1. pantomime of meaningful actions (on video) eg cutting as with scissors, 2. objects with characteristic actions eg scissors
- B. Two types of response : 1. action (all single restricted hand movement), 2. name

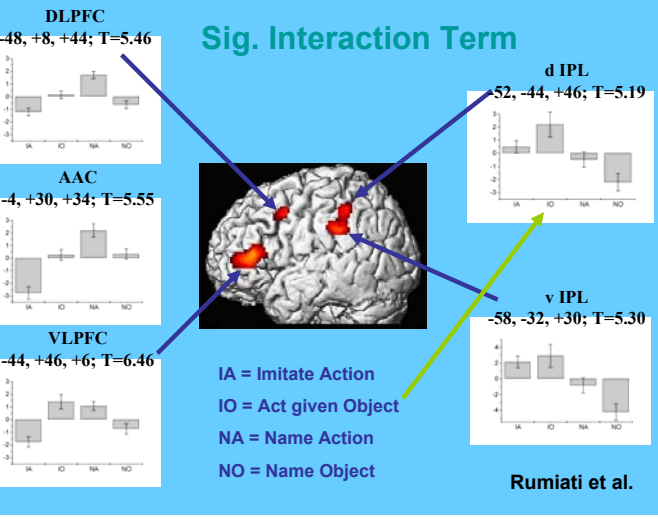
Action vs Object Stimuli



Object vs action stimuli

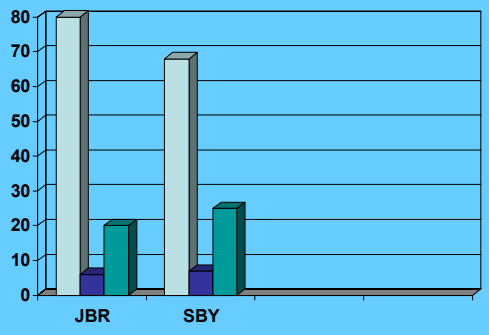


Sig. Interaction Term



Rumiati et al.

Non-Classical (Strong) Dissociations – herpes simplex encephalitis



TASK – give distinguishing meaning of (a assessed by independent judges)

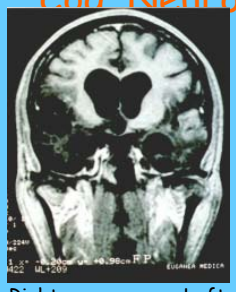
Proposal Sensory Quality v Function Knowled

From original descriptions in Warrington & Shallice Brain 1984

Gainotti (Cortex 2000)

- 20+ herpes encephalitic patients reviewed with a similar pattern across categories – 'category specificity'
- Now considerably more (see also Capitani et al Cognitive Neuropsychology 2004)
- Prototypic lesions (generally large) – bilateral anterior inferior temporal lobe, particularly medial

Patient MU (Borgo & Shallice Cog. Neuropsychology 2003



Right Left

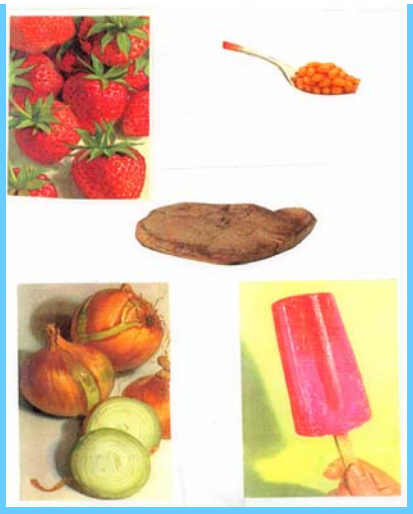
MRI scan: coronal section

Right Left

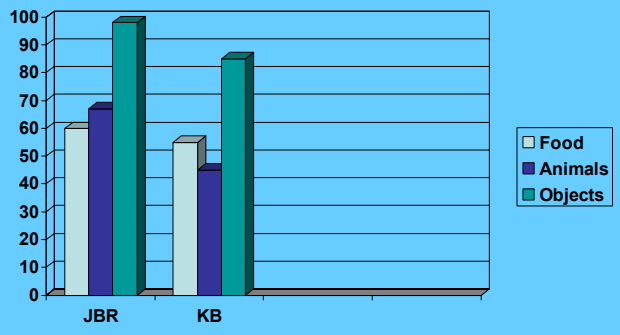
MRI scan: horizontal section

Extensive bilateral lesion of the temporal lobes principally affecting the medial and inferior regions

The superior part of the left temporal lobe is relatively unaffected



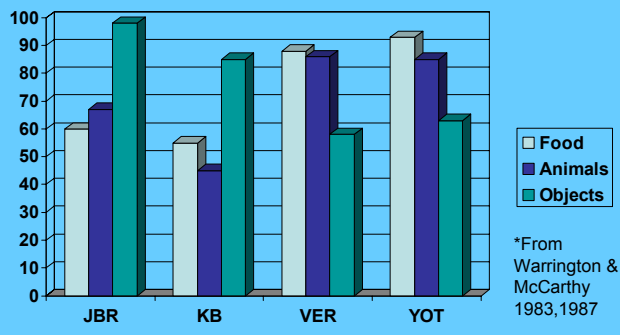
Word -Picture Matching (Herpes)



Herpes Category specificity

- Possible resource differences due to
- 1. Figure complexity (eg animals vs artefacts)
- 2. Familiarity (eg animals vs artefacts – when matched for word frequency)
- 3. Density of exemplars in feature space (animals more similar to each other than artefacts)

Word -Picture Matching

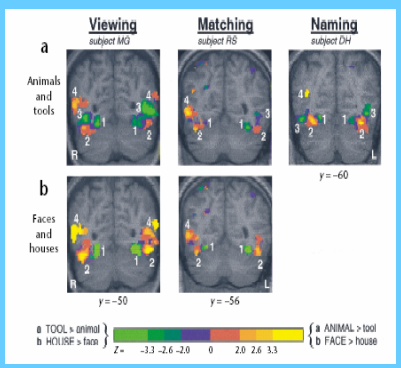


*From Warrington & McCarthy 1983,1987

Herpes Encephalitis

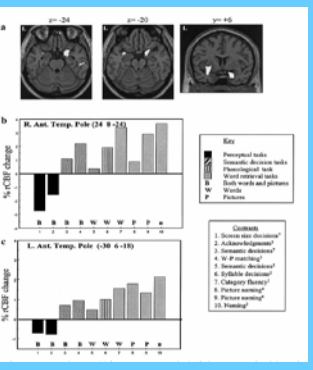
Vascular Global Aphasic Patients* with large perisylvian lesions

Chao Haxby & Martin Nature Neuroscience 1999



- Ss looked at pictures of different types of objects. Highly consistent category-specific effects obtained
- Animals fusiform – and also for their written names; tools lateral temporal (-> dorsal route)

Living things vs artefacts effects – normals vs patients – across tasks



- Devlin et al (NeuroImage 2002 metaanalysis)
- A - Living thing sig more activated than non-living in metaanalysis
- B, C – each task by two regions. Only discrepant tasks are non-semantic perceptual tasks
- Gainotti (Cortex 2000) herpes living things deficit – bilateral anterior inferior temporal cortex

Possible explanation of herpes category specificity pattern

- Separate routes to meaning for 'sensory quality' feature information ie inf. about shape, texture, colour, sound, tactile characteristics AND manipulable (ie tool-related) characteristics (originally 'function' info. But see Buxbaum & Saffran)
- Objects (artefacts) have their core meaning based on manipulability features

- OBJECTIONS
- 1. More specific category-specific effects eg Caramazza & Shelton J Cog Neurosci. 1998)
- 2. Predicts a difference in aspects of knowledge available to patient but this is not found (Capitani et al Cog Neuropsychol 2003)

Patient EW (Caramazza & Shelton 1998)

- 100% (or close to) on all tasks involving semantic processing except if they involve animals when generally 50 – 70%
- However such restricted category effects do not yet form a syndrome with a clear anatomical basis. So EW said to have a left fronto-parietal lesion.
- Possible exception – selective impairment of fruit and vegetable knowledge – BUT Crutch & Warrington (Cog Neuro 2003) argue that this is trough selective loss of colour knowledge

Capitani et al. review

(Cognitive Neuropsychology, 2003)

"Revised classification" of relation between knowledge type and category deficit for patients with living things semantic Deficit. Argue that:

- **8 patients:** Perceptual and 'functional./associative'. knowledge *equally* impaired (and defective)

- **2 patients:**
- "Some evidence of a *disproportionate* deficit of visual knowledge" *(re: Giulietta, Sartori et al., 93)*
- "a greater impairment for perceptual knowledge of biologica categories….should be viewed with caution …(as different types of knowledge) were probably assessed in different periods" *(re: Michelangelo, Sartori et al., '93)*

Partially inappropriate objection

- Because it presupposes that 'functional/ associative' knowledge about living things eg animal behaviours (trout swim, mules carry loads) have the same type of core features as tools
- Objection most salient for objects (artefacts)

Mass-kind categories

E.g.: (presented in identical transparent containers)

- Materials[1] (plastic, copper)
- Drinks (red wine, lemonade)
- Edible substances[2] (cocoa powder, mayonnaise)

– Not as easily differentially manipulable (as lack shape) as other artefacts

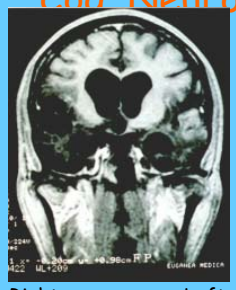
– Differ strongly in their sensory quality characteristics (e. colour, texture, pattern)

– Thus weighting of sensory quality-to-manipulability feature different from other artefacts

[1]Gave very poor percentage by JBR (Warrington & Shallice, 1984) exp. 7

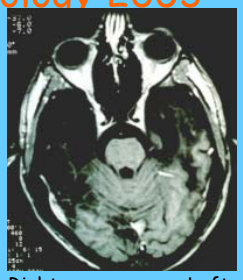
[2]Powders and creams - not fruit/vegetables etc.

Patient MU (Borgo & Shallice Cog. Neuropsychology 2003



Right Left

MRI scan: coronal section



Right Left

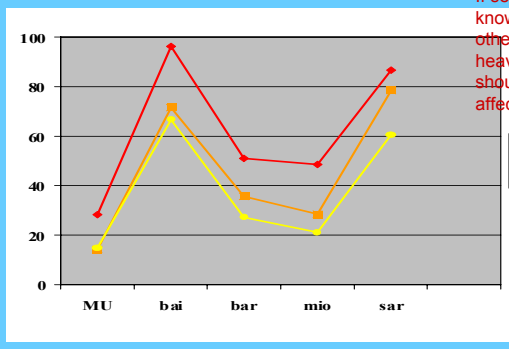
MRI scan: horizontal section

Extensive bilateral lesion of the temporal lobes principally affecting the medial and inferior regions

The superior part of the left temporal lobe is relatively unaffected

Original data: visual confrontation naming task

Three item sets



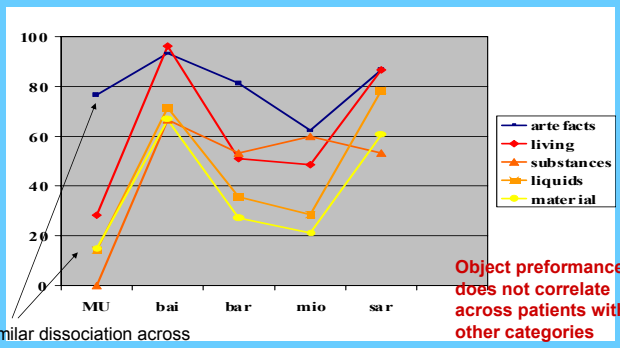
If sensory quality knowledge critical other categories heavily based on it should also be affected

MU vs 4 other herpes patients who do not show category specificity

Borgo & Shallice, Neurocase, 2001

Original data: visual confrontation naming task

Five item sets



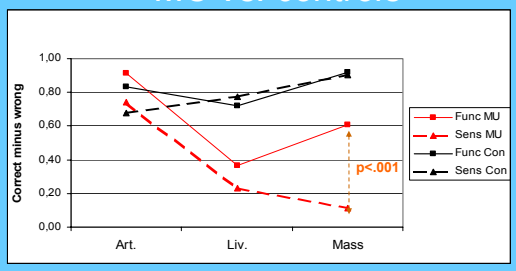
milar dissociation across tegories in matching tasks

Object preformance does not correlate across patients with other categories

Borgo & Shallice, Neurocase, 2001

Sensory vs. Functional/associative knowledge – using Garrard et al Brain 1998 criteria

MU vs. controls

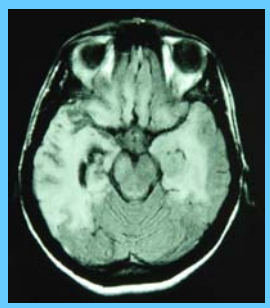


Uses measure *Correct – Wrong*

Borgo & Shallice (Cog Neuropsychol 2003)

Patient SER

Behaved similarly to MU in basic naming and matching tasks



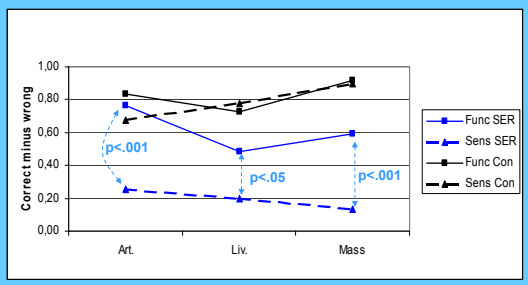
Right Left

MRI scan: horizontal section

bilateral lesions more evident on the right; areas affected: mostly temporal lobes, also frontal and parieto-occipital lesions

Sensory vs. Functional knowledge

SER vs. controls



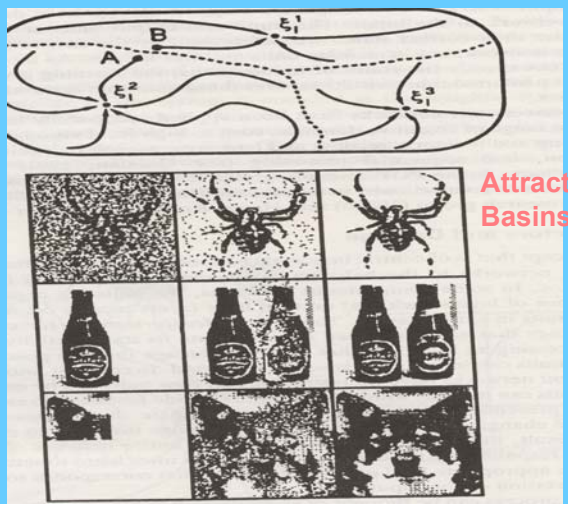
Uses measure *Correct – Wrong*

Category Specific Double Dissociations

- Many hypotheses are currently available – only some being based on modular systems
- Note that that the Double Dissociation is only strong – in virtually all patients – makes alternative non-modular positions more plausible
- However differential impairment of sensory quality vs function/ manipulability feature position most plausible

Main Problem for Impaired Sensory Quality Features Poisiton

- Relatively spared 'sensory quality' knowledge for artefacts
- BUT for artefacts sensory quality knowledge is often related to function (De Renzi & Lucchelli 1994) eg. Does a saw have teeth? So function knowledge supports visual knowledge
- This fits with the idea that the material basis of a concrete concept is an 'attractor basin' in a multi-dimensional space of features (Hinton & Shallice Psychological Review 1991)

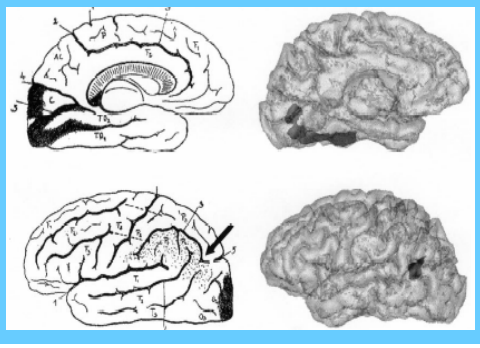


- Can one learn more than the modular organisation alone?

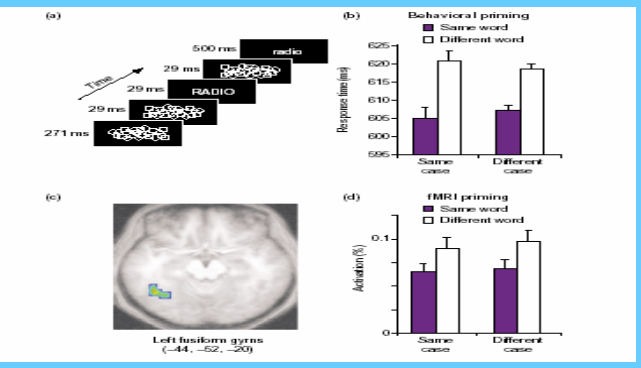
Inferences to more specific aspects of models

Example of model of Plaut & Shallice, Cognitive Neuropsychology 1993

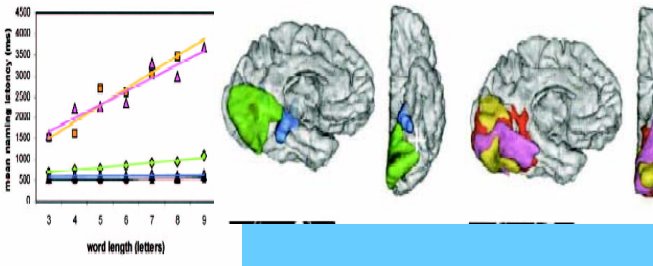
Dejerine (1892) locus of 'pure alexia'



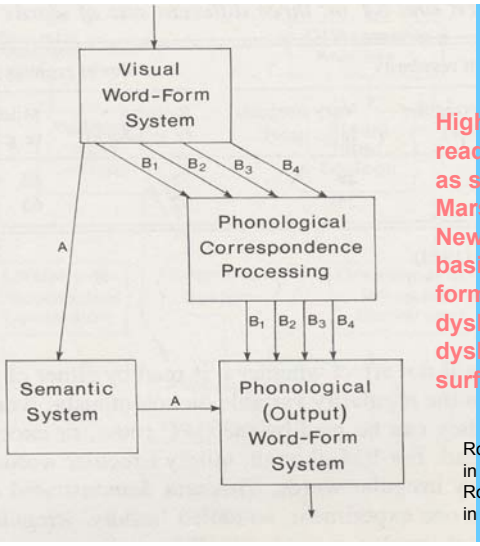
McCandless, Cohen & Dehaene TICS 2003



Cohen et al (Cerebral Cortex 2003)



Anatomy of patients showing operational sign of pure alexia (length effect – Warrington & Shallice Brain 1980) – damage ot visual word-form area as specified by FI on normal Ss (2+ 2-)



Higher levels of reading process – as suggested by Marshall & Newcombe 1973 on basis of different forms of acquired dyslexia – deep dyslexia and surface dyslexia

Route A inoperative in surface dyslexia; Route B inoperative in deep dyslexia

Deep dyslexia

- Patients read concrete nouns (eg tractor) well >70%
- Patients read verbs, function words (eg or, with), abstract nouns (eg faith) poorly (c. 10% or less)
- Both visual errors (eg bold -> bolt) and semantic errors(eg cold -> ice) occur
- See Coltheart, Patterson & Marshall, 1980 – Deep Dyslexia, Erlbaum.

Errors made by deep dyslexic patients – see Shallice 1988 book

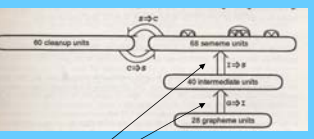
Patient	Semantic	Visual and/or semantic	Visual	Derivational	Other
PW[a]	54	4	13	22	6
GR[b]	56	?	22	11(?)	11
DE[a]	23	6	35	32	4
WS[c]	21	17	35	4	23
VS[d]	19	16	48	10	7
PS[e]	10	7	51	9	23
KF[f]	4	10	61	19	6

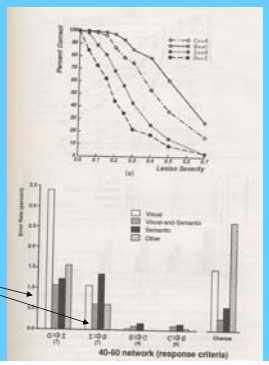
Features of Concepts

	Height	Neck-ness	Width	Glass Thick
Bottle	2 – 4	4	2	2
Vase	2 – 4	0 - 3	2 - 4	0 - 3
Glass	1 - 2	0 – 1	1 – 2	1 - 2

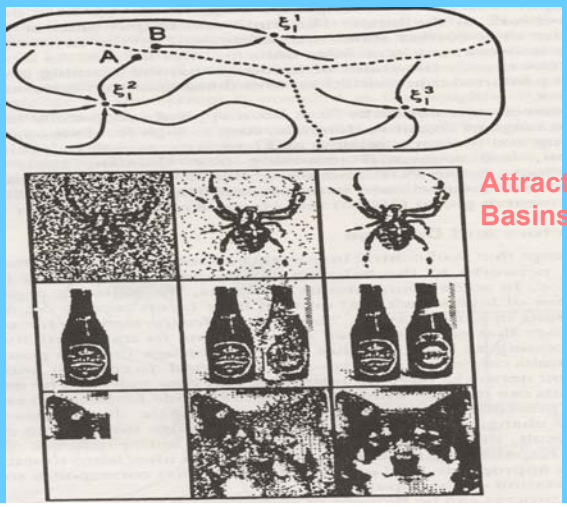
Basic Model of word reading to meaning in Plaut & Shallice Cog. Neuropsychology 1993

In original version operates over 7 time steps – trained on average of last three by back propagation through time





Effects of damage – note errors of all types occur if lesion is prior to the attractor

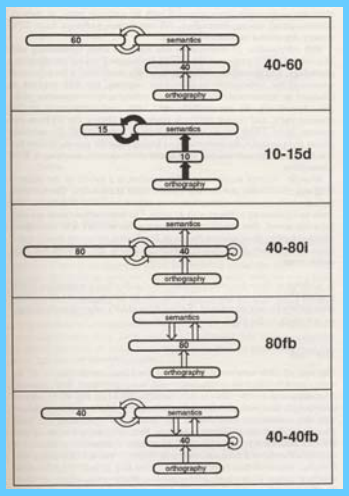


Attractor Basins

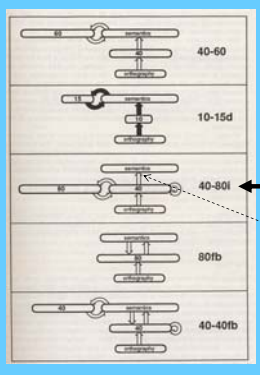
Robustness of effects

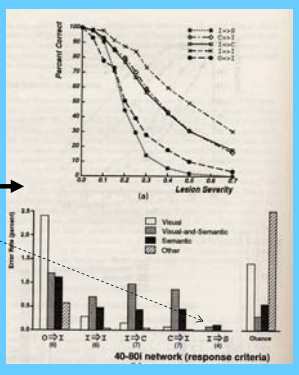
- Pattern of errors independent of
- 1. Precise no of connections and hidden units
- 2. Specific details of architecture – given that it contains an attractor system – and lesion before or at level of attractor
- 3. Learning algorithm (back propagation, deterministic Boltzmann machine, GRAIN)

Varieties of Architectures investigated. In all cases where substantive numbers of errors occur they include both visual and semantic errors



ffects generalise to other architectures with an attractor structure





Note very few errors post-attractor

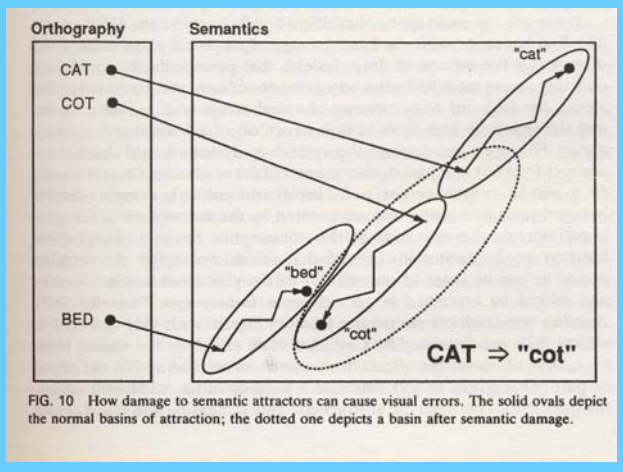


FIG. 10 How damage to semantic attractors can cause visual errors. The solid ovals depict the normal basins of attraction; the dotted one depicts a basin after semantic damage.

stract words presumed to have fewer features

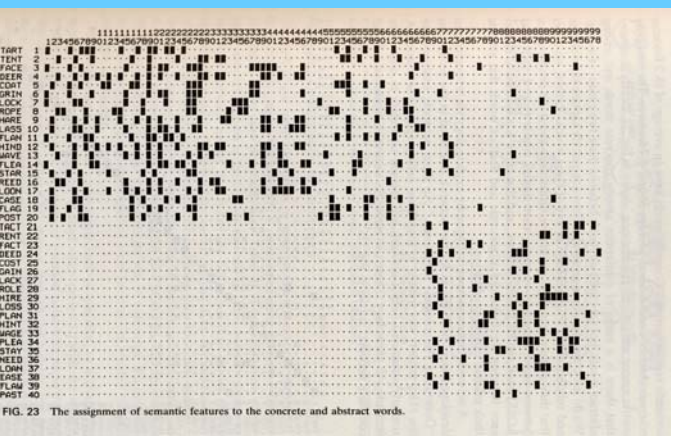
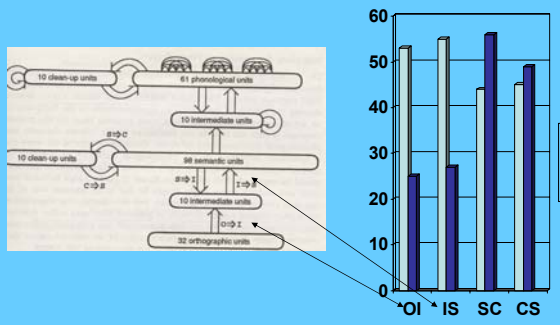


FIG. 23 The assignment of semantic features to the concrete and abstract words.

Network used to examine effects of abstraction

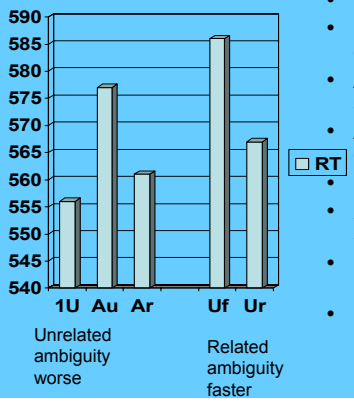


Concrete words 'read' better than abstract ones following input route lesions in the simulation

Simulation of lesioning attractor networks

- Both visual errors (eg bold -> bolt) and semantic errors(eg cold -> ice) occur wherever substantial numbers of errors occur following a lesion
- Concrete words are 'read ' better than abstract
- And many other more complex characteristics eg response in a visual error tends to be more concrete than stimulus eg hope -> rope

Rodd, Gaskell & Marslen-Wilson J. Memory & Language 2002



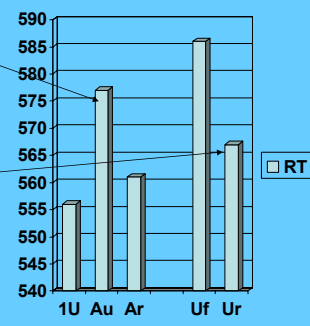
- LEXICAL DECISION
- 1. U Unambiguous words eg coal
- Au Ambiguous – unrelated senses eg bark
- Ar Ambig – related eg twist
- MORE SENSES WORSE
- 2 Uf Unambig. – few senses eg bet
- Ur Unambig. – many related senses eg belt
- MORE SENSES BETTER

Rodd et al Network

- 2-layer net with recurrent connections in output (semantic)
- Trained by error correction procedure
- Semantic representations – sparse (10% features)
- Ambiguous words – 2 different output representations to be activated
- Multiple senses – trained with noisy output feature representations
- Test – with noisy inputs
- Assess (i) speed of settling, (ii) distance into attractor basin, after a certain number of iterations

Rodd et al Cog Sci (in press)

- Unrelated ambiguity – deep separated attractors - slower – sy. So more than one unrelated meanings a handicap.
- Related ambiguity – broadening of a single attractor – system is faster to switch on relevant features and goes into attractor in a given no of iterations more deeply . So the more related meanings helps .



U=Unambiguous; Au = Ambiguous unrelated senses: Ar = Ambiguous related; Uf = Unambiguous few related senses; Ur = Unambiguous (many related senses)

Functional Architecture (Subsystems)

- Relation between task characteristics and underlying subsystems can be far from transparent (e.g. abstract, concrete)

Functional Architecture (Networks)

- Supports
- 1. Subsystem contains 'attractor' characteristics
- 2. Concrete nouns and abstract nouns differentiated by different type of features AND different quantitative aspects (ie simple no of features)

Functional Imaging

- 1.Change in cognitive demand
- 2.Change in neural activity
- 3.Change in vascular system properties
- 4a.Blood flow thru' radioactive tracers (PET
- 4b.Blood oxygenation level dependent(BOLD) signal (fMRI)

Specialisation only (ie not modules or isolable subsystems)

- Patients:
- Many other types of system theoretically compatible with observed dissociations

- Functional Imaging:
- Critical comparison subtractions between activation in two conditions
- Hence cannot infer absolute levels of activation in particular regions

Functional specialisation of cortex

- Neither method (neuro. or func.imag activation diffs.) allows one to infer the presence of modules in Fodor's 1983 sense) or isolable processing systems. Other possible architectures are compatible with the evidence.
- However isolable subsystems which are only partially informationally encapsulated and which are part of larger systems are the most plausible account of the type of evidence just presented

Double Dissociations

- To avoid resource artefacts technically require:
- Task A patient I > patient II
- Task B patient II > patient I
- NOT Patient I task A> task B
- Patient II task B > task A

Group Studies

- Objection made by Caramazza (Cog Neuro 1986) that average of a group need not correspond to possible values of ANY possible member of group
- Not a problem for dissociations per se as could occur only in highly implausible situations – 'monsters' (Lakatos – Brit J Phil Science 1963)

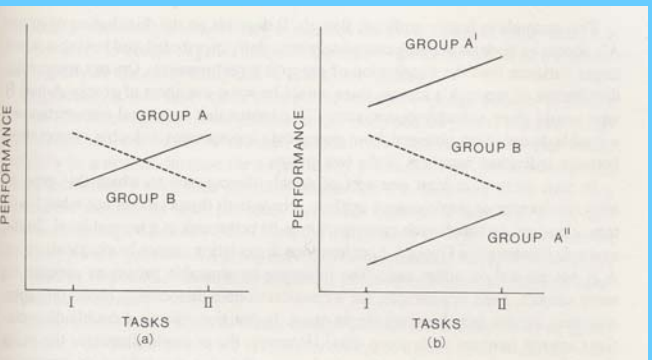
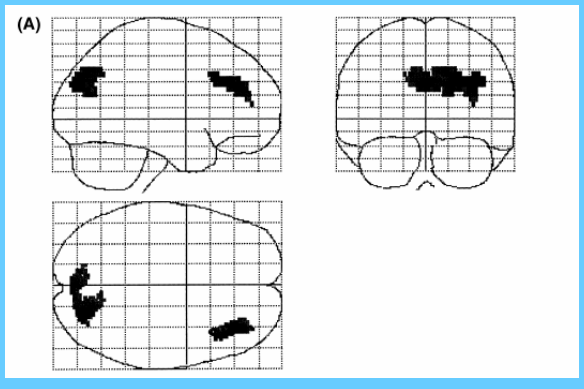
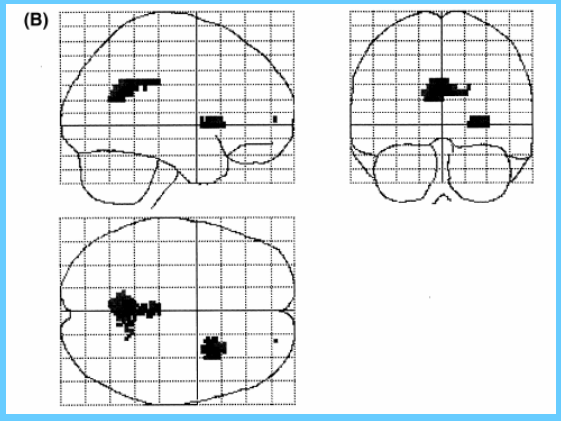


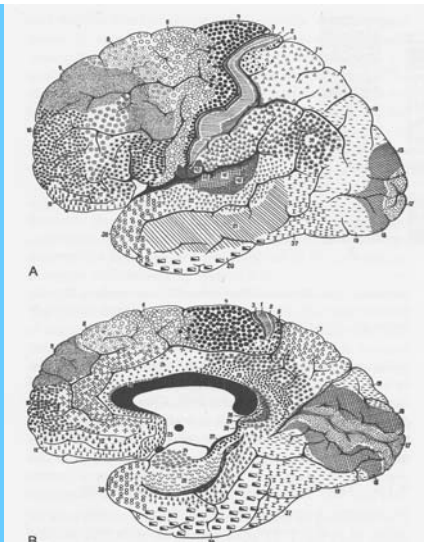
Figure 9.1. An example that illustrates that when a double dissociation exists between groups, one does not necessarily exist between any pair of individuals, selected one from each group. Group A in (a) is split into two subgroups, A′ and A,″ in (b).

Double Dissociations in Func Imag. (Fletcher et al Brain 1998)

- Retrieval of 2 types of material
- A - Organised word list (16 related words, eg 16 foods)
- B – Paired associates(eg wine – Burgundy)
- Right Dorsolateral Prefron. A > B > Con.
- Right Venterolateral Prefron. B > A > Con







Functional Architecture (Subsystems)

- Relation between task characteristics and underlying subsystems can be far from transparent (e.g. abstract, concrete)

Functional Architecture (Networks)

- Supports
- 1. Subsystem contains ‘attractor’ characteristics
- 2. Concrete nouns and abstract nouns differentiated by different type of features AND different quantitative aspects (ie simple no of features)