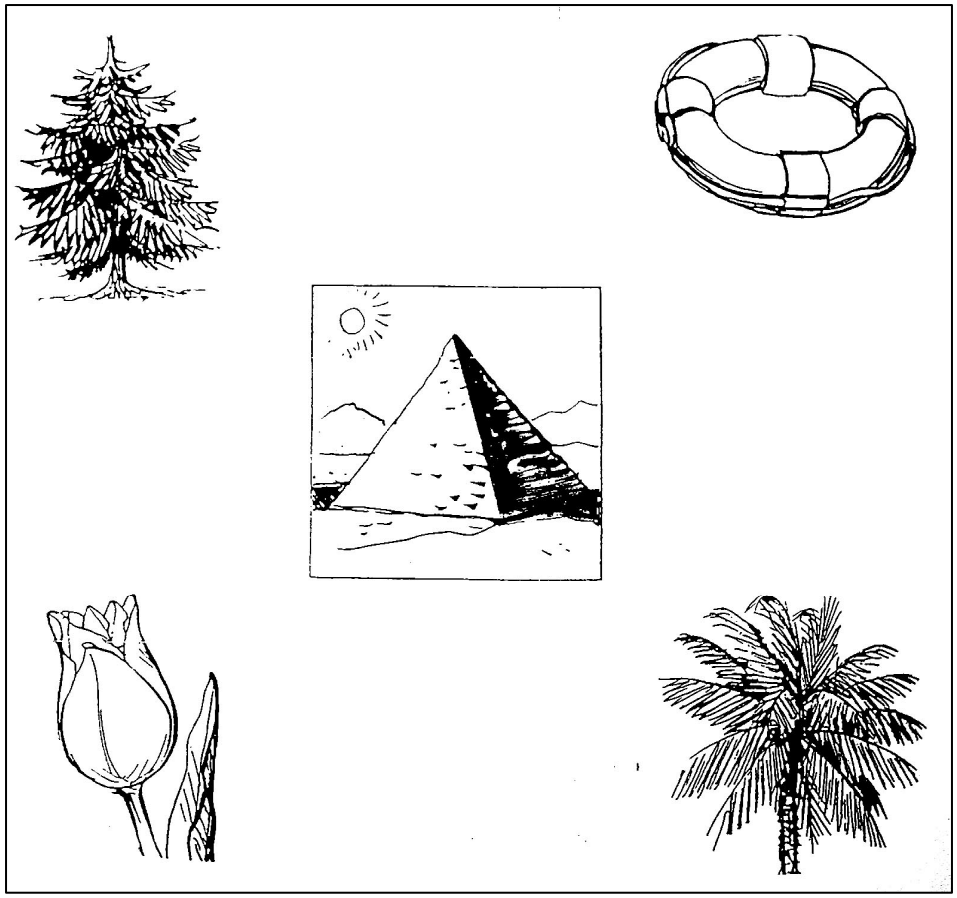
Testing the Semantic System

- Naming from different modalities (semantic errors)
- Sort items according to the category to which they belong to (dog, cat, caw and do on)
- Semantic matching tasks
  - Which 2 items are used together (hammer & nail)
  - Which 2 items are found in the same context (P & P)
  - Which 2 items share the same function (radio & CD player)
- Questions concerning visual perceptual as well as functional associative knowledge (Barbarotto et al. 1996; Silveri & Gainotti 1988).
- Pantomiming the use of objects

*All these tests can be administered using either visual or verbal stimuli.

Picture-to-Picture Matching
Pyramid & Palm Tree Test



Word-to-Word Matching
Pyramid & Palm Tree Test

pine tree life preserver

pyramid

tulip palm tree

Questionnaire

HAMMER

1. supraordinate info: is it an object, a vegetable or an animal?
2. category info: is it a tool, a musical instrument or a gem?
3. subordinate perceptual info: is it made of glass, of metal or of cement?
4. subordinate structural info: is it smaller than a screw? (yes/no)
5. functional info: is it used for cutting, screwing or sticking nails?
6. the protypical user of the object: is it used by the painter, the carpenter, the glazer?

Barbarotto et al. 1996

Independent SDS & Semantic System

- Based on observing a double dissociation, it has been proposed that stored knowledge is organized in two separate subsystems:

1. Patients with a damaged SDS but spared semantic system proper.

2. Patients who performed normally on the object decision task but pathologically on tasks tapping semantic knowledge.

Pattern 1: Sartori & Job 1988; Caramazza & Shelton 1998? (for animals only).

Pattern 2: Riddoch & Humphreys 1987; Stewart Parkin & Hunkin 1992; Sheridan & Humphreys 1993; Hillis & Caramazza 1995; Humphreys & Riddoch 1999; Fery & Morais 2003.

Semantic Dementia

- This is a form of primary progressive dementia that primarily impacts on semantic memory.
- Deficits:
  - anomia with semantic paraphasia (naming)
  - amnesia, surface dyslexia
  - spared object use (Buxbaum et al. 1997; Lauro-Grotto et al. 1997).

- There are patients, particularly those with *semantic dementia*, who, in addition to the deficits in performing semantic tasks, they also show difficulties in performing the object decision task (Rogers et al. 2003):
  - these patients thus suffer damage to both the SDS and the semantic system.

ASSOCIATIVE A. & SEMANTIC SYSTEM

- Agnosic deficits have been explained in different ways, depending on which model of conceptual organization was adopted.

- Two main views:
- Multiple-semantic systems
- Amodal semantic system

  (also called Organized-Unitary-Content hypothesis, OUCH by Caramazza et al.).

MULTIPLE SEMANTIC SYSTEM

- This view holds that the conceptual knowledge is organized in modality specific systems (verbal, visual), depending on the type of stimulus that the patient is asked to process (words or pictures).

- Evidence for separate systems come from patients who showed a selective deficit either in processing words or in processing pictures.

Shallice,1988; McCarthy & Warrington 1994

Damage to the Verbal Semantic System

TOB	*Pictures*	*Words*
identification task	% correct	% correct
Living things	94	33
Inanimate things	98	89

- TOB suffered from a progressive disorder of semantic memory that affected his ability to comprehend the spoken names of animals (only superordinate category: “it’s an animal”) but spared his knowledge of named objects.

- Most remarkably, he was able to give good definitional and associative information about visually presented stimuli, irrispective of their semantic category.

McCarthy & Warrington 1988

Damage to the Visual Semantic System

PHD	*Pictures*	*Words*
identification task	% correct	% correct
animals	33	77
foods	100	96

- PHD sustained a severe closed head injury, leaving him with a disproportionate impairment in recognizing visually presented animals and in matching animal identity (2 different pictures of caws) relative to objects.

- However, PHD was normal on the object decision task, and better when instead of pictures he was asked to define spoken words.

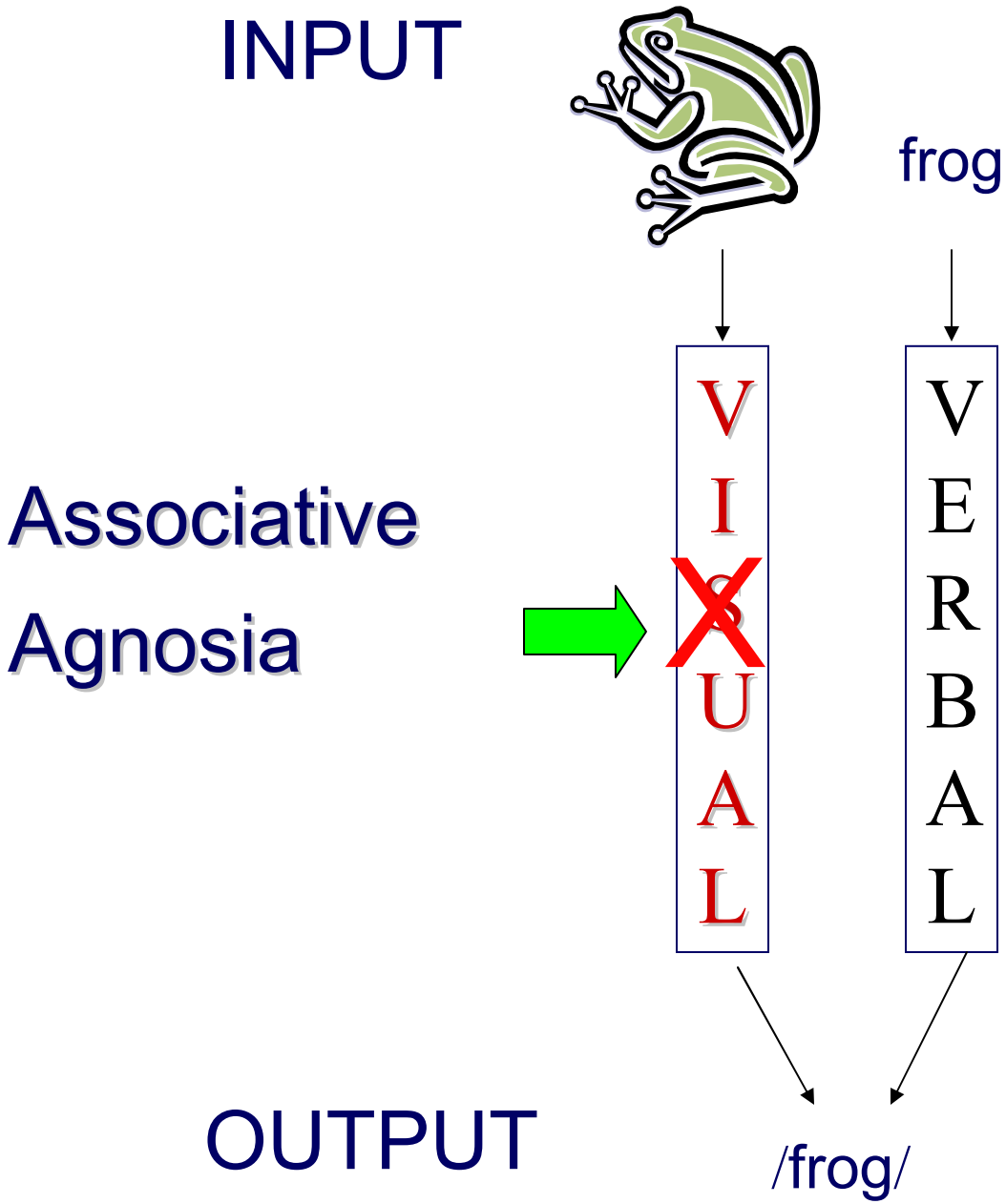
in McCarthy & Warrington 1994

VISUAL ASSOCIATIVE A. & MULTIPLE SEMANTIC SYSTEM

- Associative visual agnosia can be interpreted in terms of a damage of the *visual semantic system*.

- Within this framework, it is not clear what the differences between the SDS and semantic system proper are.

Shallice,1988; McCarthy & Warrington 1994


INPUT
frog
Associative
Agnosia
VISUAL
VERBAL
OUTPUT
/frog/

AMODAL SEMANTIC SYSTEM

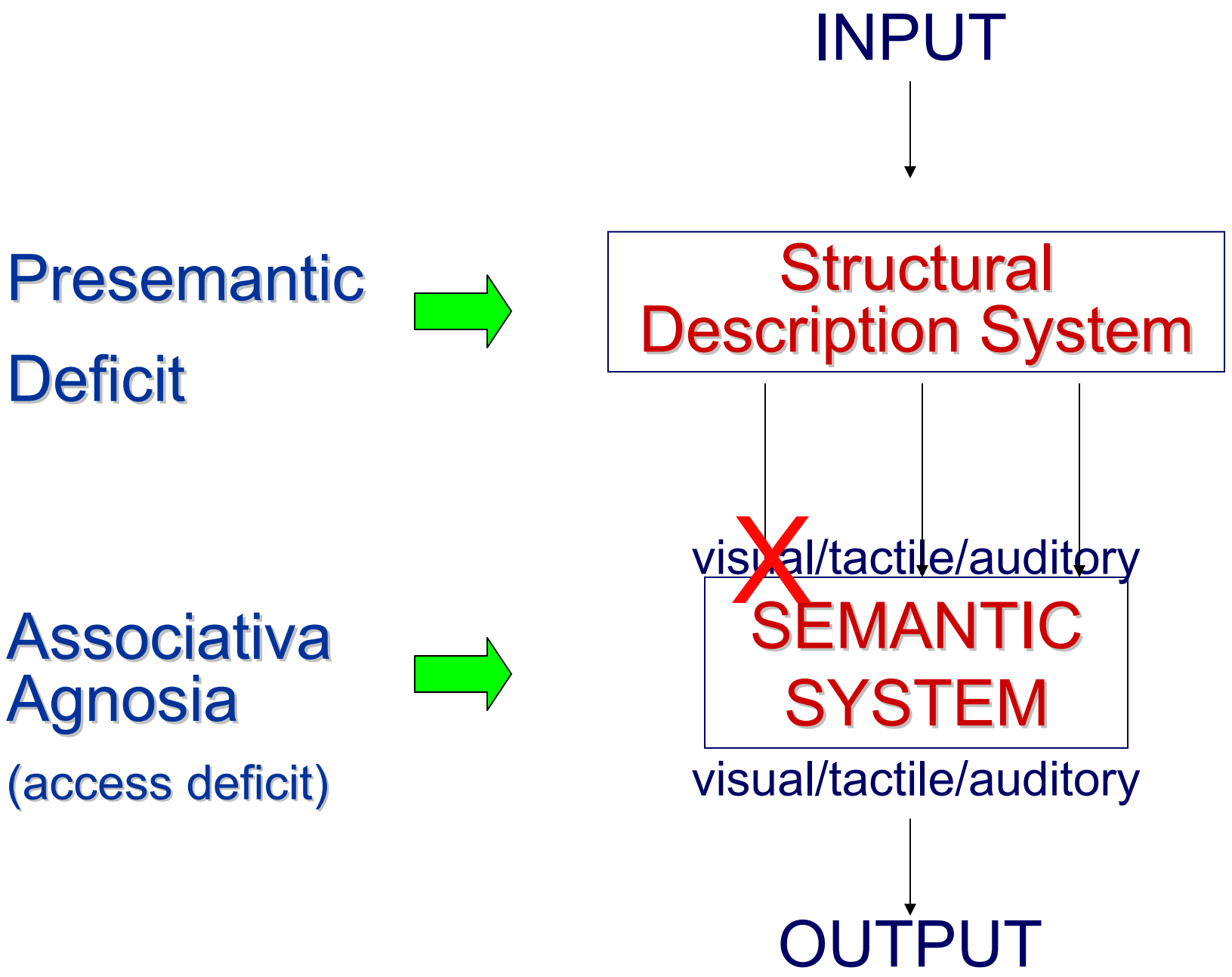
- It is only one abstract representation of a give concept.
- One can access it from different modalities (visual, verbal, tactile etc.), after a pre-semantic processing (SDS).
- There are different modality-specific outputs.

(Riddoch et al. 1988; Caramazza et al. 1990)

VISUAL ASSOCIATIVE A.
&
AMODAL SEMANTIC SYSTEM

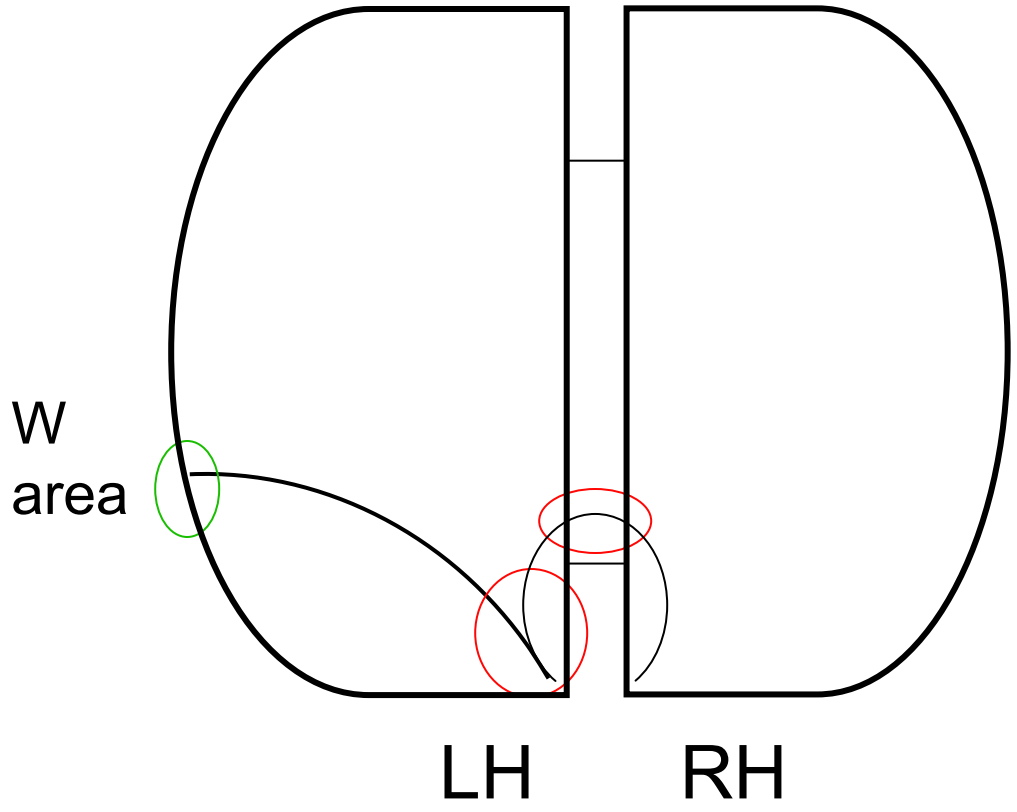
- With this framework, visual associative agnosia would correspond to a deficit in accessing the unitary semantic system from the visual modality *only*.

- Performance on the Object Decision and Head Test should be normal (integrity of the SDS) (e.g. patients JB).


INPUT
Presemantic
Deficit
Structural
Description System
visual/tactile/auditory
Associativa
Agnosia
(access deficit)
SEMANTIC
SYSTEM
visual/tactile/auditory
OUTPUT

OPTIC APHASIA (Freund 1889)

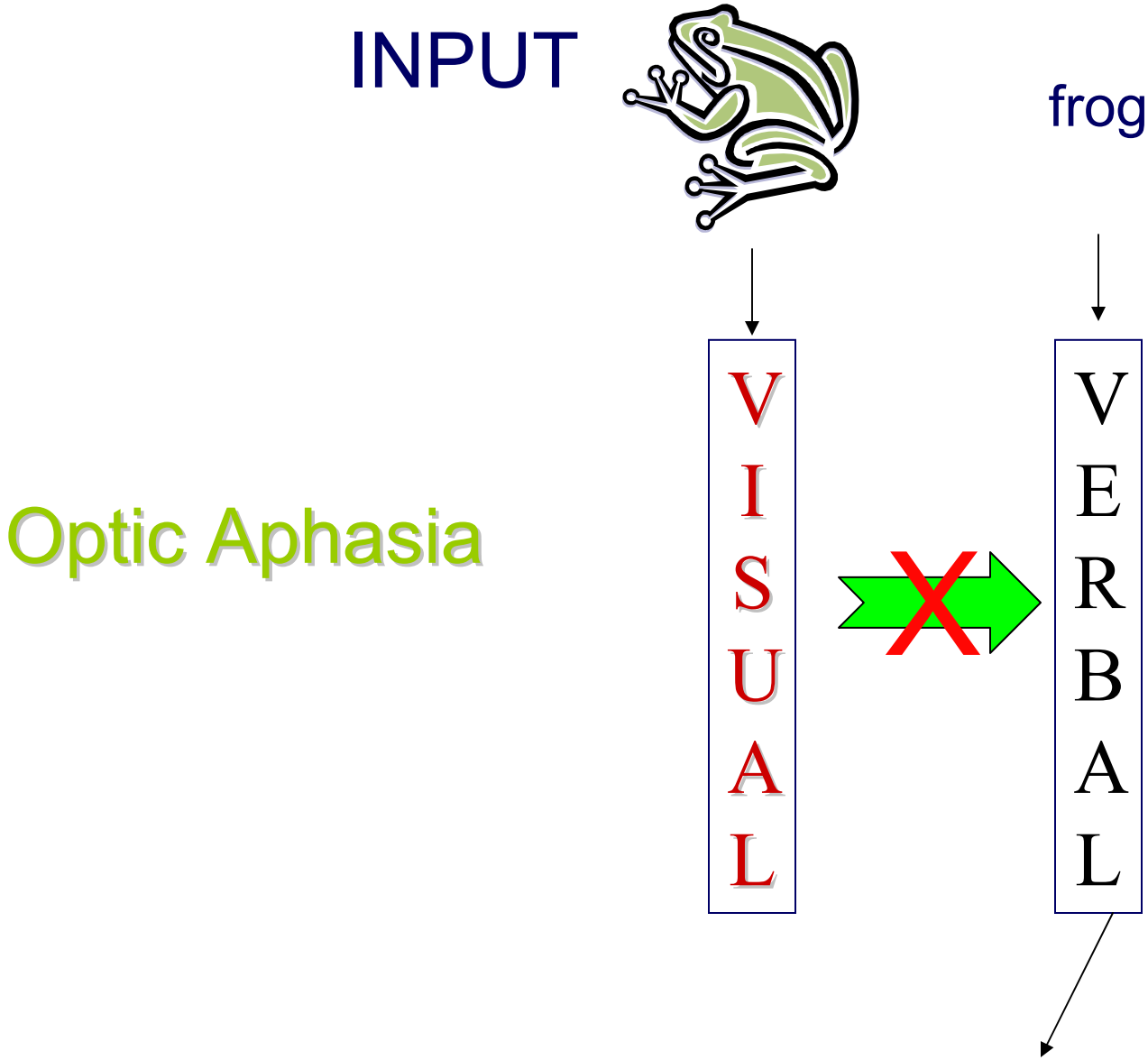
- The patient shows a deficit in confrontation naming of objects.
- In contrast, the patient could name them when they presented in other modalities (tactile, on definition, auditory).
- *Left Occipital Lesion + Splenium of Corpus Callosum*
- Visual processing is carried out in the spared but there is no access to speech areas in the LH.



VISUAL VS VERBAL SEMANTICS

Lhermitte & Beauvois 1973; Beauvois 1982

- The functional breakdown in OA patients is between the visual semantic and the verbal semantic system:
  - visual semantic system is intact as demonstrated by the preserved ability to perform semantic associative matching tasks and to pantomime the use of objects (no apraxia).
  - verbal semantic system is also intact because naming from other modalities is normal.


INPUT
frog
Optic Aphasia
VISUAL
VERBAL
OUTPUT
/frog/

VISUAL AGNOSIA & OPTIC APHASIA

- Differently from associative agnosics, optic aphasics perform normally on tasks tapping visual semantic knowledge (matching, categorization).

- AO patients can recognize the objects as suggested by their spared ability to show how they would use them.

- They are not sensitive to the quality of the stimulus (i.e. real objects are better recognized than line-drawings), as visual agnosics are.

- They do not have difficulties in coping with everyday life as agnosics.

ETIOLOGY AND BRAIN CORRELATES OF VISUAL AGNOSIAS

- *APPERCEPTIVE A.*
- Bilateral stroke of the posterior cerebral artery involving bilateral visual associative areas (not primary visual area, BA17).
- Tumor lesions of the occipital cortex
- Traumatic focal lesions of the occipital cortex
- Post-anoxic syndromes
  - *carbon monoxide intoxication*
  - *hart attack*
- Degenerative pathologies
  - *AD and focal, slowly progressive dementias*

- *INTEGRATIVE A.*
- Bilateral stroke of the posterior cerebral artery bilateral involving the temporo-occipital cortex, (including lingual & fusiform gyri).

- *PERCEPTUAL CATEGORIZATION*
- Stroke of the left middle artery involving the parietal cortex of the right hemisphere.

- *ASSOCIATIVE A.*
- Stroke of the left posterior cerebral artery that supplies the occipito-temporal cortex
- (unusual bilateral medial occipito-temporal c.)

CATEGORY-SPECIFIC DEFICITS

- After brain damage, the ability to identify exemplars that belong to living categories (fruits, vegetables, animals etc.) or to non-living categories (tools, vehicles, clothes etc.) can result selectively affected.

First observations:

- Nielsen (1937)
- Mc Crae & Trolle (1956)

DOUBLE DISSOCIATION

Warrington & Shallice (1984)

- Described 2 patients with a selective identification deficit as affecting animals, foods and plants, but still able to recognize inanimate objects.
- Other cases: Sartori & Job 1988, Silveri & Gainotti 1988, Farah et al. 1989.

- The opposite dissociation, i.e. a selective identification deficit of inanimate objects and spared recognition of biological exemplars has been observed too, though less frequently.
- Hillis & Caramazza 1991; Sacchett & Humphreys 1992; Warrington & McCarthy 1994.

SOME THEORETICAL ACCOUNTS

The Sensory/Functional Theory

Warrington & Shallice (1984)

- There are two semantic subsystems, one for concepts about living exemplars, the other for non-living ones:
  - the former deals with sensory features, the other with functional features.
- Living things are better characterized by sensory features and manmade objects are better characterized by their functions and their manner of usage.
- Damage to the sensory subsystem leads to a deficit in identifying LT, whereas a damage to the functional subsystem leads to a deficit in identifying NLT.

The Domain-specific Hypothesis
Caramazza & coll.

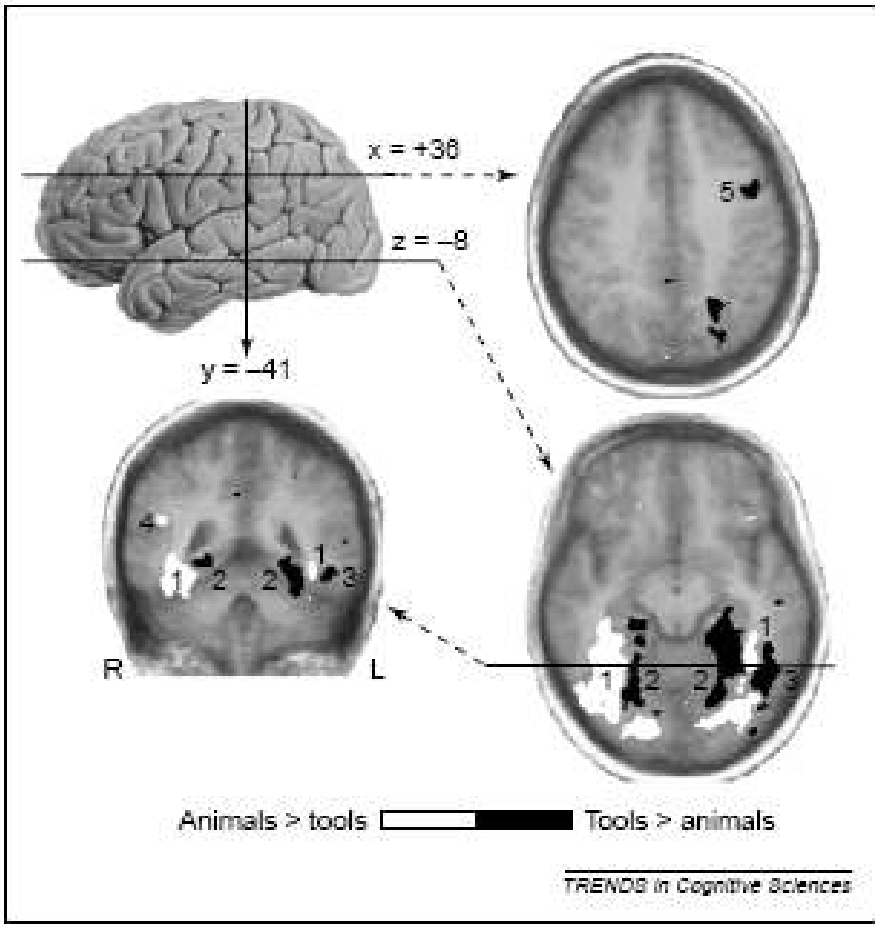
- “Its central assumption is that evolutionary pressures have resulted in specialized (and functionally dissociable) neural circuits dedicated to processing, perceptually and conceptually, different categories of objects.

- It provides independent motivation for specifying what constitutes a conceptual category in the brain because it is restricted to only those categories for which rapid and efficient identification could have had survival and reproductive advantages.

- Plausible candidate categories are ‘animals’, ‘fruit/vegetables’, ‘conspecifics’, and possibly ‘tools’. “

Acquired disorders of category-specifc deficits

- Herpes Simplex Virus Encephalitis
  - affects the medial temporal cortex unilateral left or bilaterally (hippocampus included)
  - often associated with category specific deficits for LT
- Semantic dementia
- Alzheimer's disease



- Martin & coll.
- Medial aspects of the fusiform gyri differentially responded to “tool” stimuli (pictures and words).
- Lateral aspects of the fusiform gyri responded to “animal” stimuli.

Objects Faces Words

Farah (1990)

- In an historical review of the literature, she noted that researchers reported:
  - Pure deficits in face recognition (prosopagnosia) and in visual word recognition (alexia)
  - No pure agnosia (for objects)
  - No alexia and prosopagnosia

- Proposed a two process-account of vision.

- There are two processing operations that take place in parallel:
  - The coding of undifferentiated global forms
  - The processing of parts-based representations

Farah was wrong

- Rumiati et al 1994; Humphreys & Rumiati 1998

Pure agnosia

- Buxbaum et al 1996; De Renzi & Di Pellegrino 1998

Prosopagnosia and Alexia without Agnosia

BATTERIES FOR ASSESSING VISUAL OBJECT AND SPACE PERCEPTION

BORB (*Riddoch & Humphreys, 1993*)
Birmingham Object Recognition Battery

VOSP *(Warrington & James, 1991)*
Visual Object and Space Perception Battery