Using Amnesia to Understanding Normal Memory

Importance of Deficits

In complex systems the parts are often so integrated that they cannot be detected in normal operation

Need to break the system to discover the components—not just physical components but functional ones

"When functioning smoothly, the brain systems that support episodic and semantic memories allow us to recognize objects in the world, to travel in time, and to construct our life stories. But when they are disrupted by brain damage, we are afforded a glimpse of the building blocks from which we build the tales of our past that confer coherence and meaning on our day-to-day lives."

Dissociation of Memory Types

Patients who exhibit deficits with (including total loss of) memory with preservation of another type of memory

Double dissociation: contrasting deficit patterns in different patients

Double dissociation between semantic and episodic deficits

Frederick, HM, KC, etc.: loss of episodic memory but preservation of semantic or procedural memory

Gene (KC): loss of all episodic memory, but retains much semantic memory, including for episodes in his past—but he remembers these as we remember facts about other people's lives (lacking any sense that he had experienced the events).

Semantic dementias—Pick's Disease: semantic deficit with little episodic deficit

Patient of Ennio De Renzi: damage to frontal parts of temporal lobe resulted in loss of meanings of common words, loss of knowledge of historical events, and of the basic attributes of animate and inanimate objects.

Dissociations within Semantic Memory

Warrington and Shallice (1984): category specific semantic memory deficits

SBY—problem defining living things terms, but not artifact terms

- Wheelbarrrow: object used by people to take material about
- Towel: material used to dry people

But

- Wasp: bird that flies
- Spider: a person looking for things; he was a spider for a nation or country

Living/Non living distinction

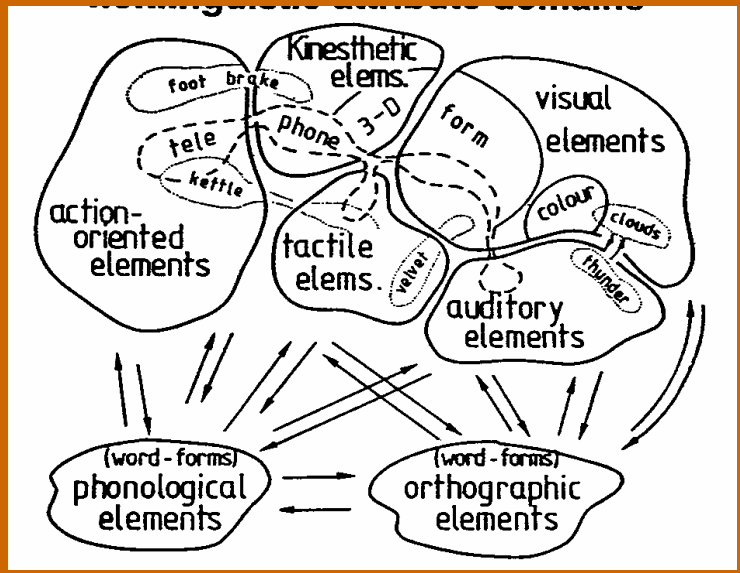
Double dissociation: other patients show deficit in identifying non-living things with spared recall of living things

Damasio: types of information used to identify particular categories

- Living things are most distinguished by their appearance
- Artifacts are most distinguished by their function or use—including the types of body motions we make in using them

What organizes semantic categories?

Allport: semantic memory divided into different sensorimotor modalities: visual knowledge, tactile knowledge, motor knowledge



In PET studies by Alex Martin et al.

- Animals terms elicited activity in lower parts of temporal lobe
- Tools activated this area but also left prefrontal motor cortex

Frontal Lobe Deficits

Damage to prefrontal cortex generally does not produce general amnesia

Rather

- Source amnesia
- False recognition
- Confabulation

Results in patients not recognizing their deficit

Imaging does reveal activity in prefrontal cortex during encoding and retrieval

- Patient BG—more false recognition for items in the same category as the studied item.
- Suggests possible role of prefrontal areas in suppressing common category information so as to focus on item specific differences.

Yet another memory type, one not requiring consciousness

For James, the mind was the conscious mind

Two dramatic examples of cognitive processing without awareness

- Blindsight
- Implicit memory

Priming

PRIMING: Recent exposure to stimulus (words) makes it easier to access the item on subsequent tasks

- Being presented with a word on a list (*couple*), and later asked to complete a stem (*COU*)

Long lasting effect—up to weeks, long after conscious recall has failed

Priming does not show depth of processing effect

But is sensitive to the modality of presentation

Distinct from episodic and semantic memory

The result of "the operation of some other, as yet little understood, memory system." (Schacter, p. 169)

Procedural Knowledge, *Knowing How*, and Implicit Memory

Ryle: Distinction between *knowing that* and *knowing how*

Cohen and Squire: amnesics can learn new abilities without any memory of previous experience

- Learning such motor skill engages the basal ganglia and the cerebellum

Schacter and Graf introduced the term "implicit memory"

Priming and Perception

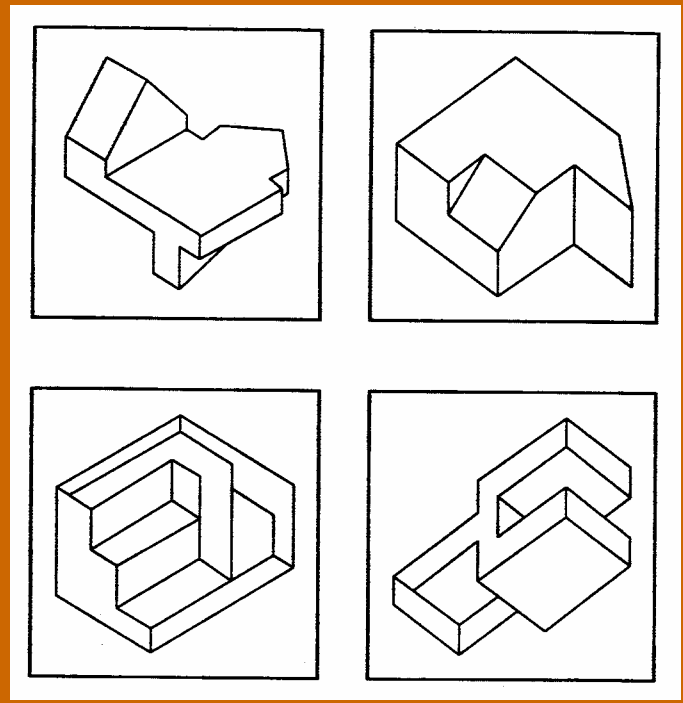
Priming is sensitive to the modality of stimulus and retrieval cue

- With visually presented words, even to the font in which the word is presented

Priming for shapes: Schacter and Cooper

- Possible shapes produce priming
- *Impossible shapes do not*

Possible shapes produced activation in inferior temporal gyrus and fusiform gyrus



Perceptual Representation System

"The PRS is specialized to deal with the form and structure of words and objects, but it does not "know" anything about what words mean or what objects are used for. Meaningful associations and concepts are handled by semantic memory, which cooperates closely with PRS." (Schacter, p. 184).

Summary of Memory Systems

Different systems operate semi-autonomously:

"While working memory operates on the incoming information . . . other memory systems in the complex, massively parallel computational machine that is the brain are also involved, separately from the process of working memory. Thus, PRS, the perceptual representation system, encodes and stores information about the features of the visual objects represented by the letter strings AARDVARKS EAT ANTS. The semantic memory system, or a set of its (presumably numerous) subsystems, encodes and stores propositional information about the feeding habits of animals named aardvarks. The episodic system integrates, registers, temporally dates, and spatially localizes the rememberer's experience of the experience of being present and witnessing the sentence appearing on and disappearing from the screen" (Tulving, 1999, p. 20).

Objections to Memory Systems

Dissociations often found equally between two different tasks that are supposed to involve the same memory system

Blaxton (1989) dissociated

Two tasks thought to involve episodic retrieval

- Semantic cued recall
- Graphemic cued recall

Two tasks thought to involve semantic memory

- Word fragment completion
- Answering general-knowledge questions

What is Gained or Lost by Identifying Memory Systems?

Differentiate types of memory phenomena—phenomena to be explained

- Valuable insofar as it helps us avoid trying to offer a common explanation for different phenomena

But in itself it does nothing to help explain the various memory phenomena

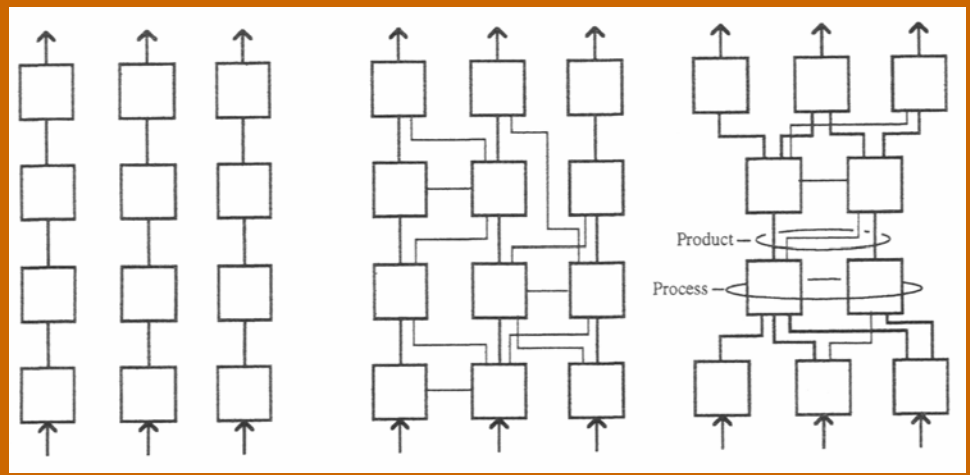
- That requires decomposing the phenomena in component processes and their operation

Emphasizing memory system may actually inhibit the search for these processes by obscuring commonalities of processes

Components of Processing Alternative

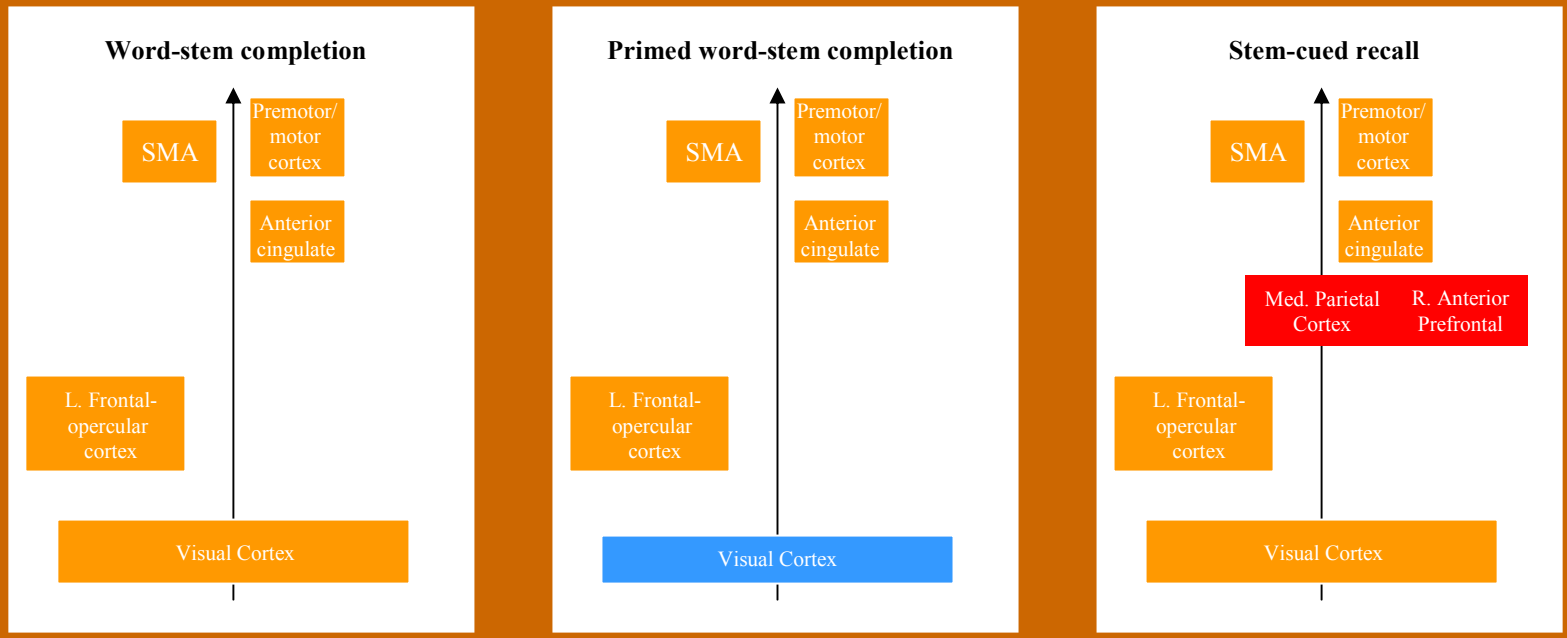
Emphasize different information processing operations that figure differentially in different tasks

- Comparable to processing steps in a computer program



Components recruited in different word stem completion tasks

Different processing areas are recruited in different tasks



Roediger, Buckner, and McDermott (1999)

May also Artificially Divorce Memory from Other Cognitive Operations

Memory may not be an independent faculty

May figure in other cognitive processes

Gabrieli: same areas activated in lexical processing and encoding of semantic memory:

> In psychological research on cognition, it is common for different researchers to focus on language, on working memory, on episodic memory, or on implicit memory. The brain and mind, however, need not be organized in the same way that researchers divide cognitive domains. Indeed, one promise of functional neuroimaging is to reveal the natural organization of the brain and mind. Although there is a great deal yet to be understood about the mental operations mediated by the left prefrontal cortex, including how many distinct but adjacent operations occur in that region, it seems already that those operations may be the same whether they are considered in the context of language, working memory, episodic memory, or implicit memory. The left prefrontal cortex thus serves as a crossroads between meaning in language and memory. (Gabrieli et al., 1998)