Separating Cognitive Systems

I. A Multitude of Cognitive Systems
II. Separating STS from LTS
III. Evidence from the Serial Position Curve
IV. Clinical Separation of STS and LTS

1. A Multitude Cognitive Systems

How can we identify separate cognitive systems, and distinguish them from different processes of the same cognitive system?

For example:
- Short Term Store vs Long Term Store
- Procedural Memory vs Declarative Memory

In Clinical Diagnosis:
- Broca's vs. Wernicke's Aphasia
- Autism vs ADHD (Johnson et al., 2007)
- General Optimism vs Unrealistic Optimism (self enhancement) (Alessandri & Pascalis, 2017)

But, parsimony suggests that we should be cautious in separating systems.

In science there is a preference for the least complex explanation for an observation. Occam's razor states that the explanation for any phenomenon should make as few assumptions as possible, eliminating those that make no difference in the observable predictions of the hypothesis or theory.

"Theories should be as simple as possible, but no simpler." (Einstein?)
I. A Multitude Cognitive Systems

Functional Dissociation: To separate systems based on differences in how they function.

Single Dissociation
Demonstrate that variables that impact the operation (functioning) of one system do not impact the operation of the second system.
Example: car fuel and electrical systems

Double Dissociation:
Demonstrate that variable A influences the operation of system 1 but not system 2, whereas variable B influences the operation of system 2 but not system 1.

II. Separating STS & LTS

The controversy
Atkinson & Shiffrin (1968)
multi-store model
vs.
Craik & Lockhart’s (1972)
single memory system: Levels of Processing

III. The serial position curve
A. Demonstration
B. Glanzer & Cunitz (1966)
C. Atkinson & Shiffrin interpretation
D. Rehearsal and the serial position curve
A. Demonstration

B. Glanzer & Cunitz (1966)

Results: Immediate recall vs. filled delay

B. Glanzer & Cunitz (1966)

Rate of presentation
C. Atkinson and Shiffrin interpretation:

1) Primacy due to cumulative rehearsal, leading to a high probability of storing items in LTS.
2) Slow presentation leads to increased rehearsal, and thus increased transfer to LTS.
3) Recency due to items present in STS.
4) Short delay causes loss of information from STS so that the last items in the list must be recalled from LTS.

D. Rundus (1971) overt rehearsal

Rundus (1971) supporting the A&S interpretation

III. Clinical Separation of STS and LTS

A. Introduction:
Patterns of memory disorders can be understood in terms of a loss of functioning of one or more of the proposed memory systems.
B. Studies of H.M.

(Scoville & Milner, 1957; Milner et al., 1968; Corkin et al. 1997)

Henry Gustav Molaison (1926-2008)

Hit by a bicycle at age 9, he subsequently developed seizures, with frequent blackouts.

In 1953, Scoville removed bilateral sections of H. M.’s hippocampus as a last ditch effort to treat his epilepsy.

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Brain Structures Important to Memory

http://www.g2conline.org/2022

Thalamus
Hypothalamus
Amygdala
Hippocampus

Growth for epilepsy
left is (HA)
destroy these areas

MRI’s from H.M.
showing areas where
the temporal lobes were
resected (from Corkin et al. 1997).

Intact temporal pole.
(TP = temporal pole,
AMG = amygdala,
HIP = hippocampus)
II. Clinical Separation (cont)

B. Studies of H.M. (cont.)
Post surgery studies of H. M. changed the way researchers viewed memory functioning in the brain:
profound anterograde amnesia (failure to learn new information)
Example: His father died in 1967, his mother 1977, in 1986 he thought he was still living with his mother and was unsure if his father was alive (see Parkin, 1993)
However, he had intact memories of his childhood, and had knowledge of world events prior to 1953.
normal I.Q (pre-surgery 104, post-surgery 112)
normal digit span (7)

Studies of H.M. (cont.)
Interpretation: No transfer from STS to LTS
In addition, H.M. could learn new skills (e.g., mirror tracing) without memory for having learned the skills.
Supported the distinction between episodic memory and procedural memory.

C. Clive Wearing
“The Man with the 30 sec Memory”
British musicologist, conductor, and keyboardist.
Suffers anterograde and retrograde amnesia.
On March 27, 1985, he contracted Herpes simplex encephalitis (HSE), a severe viral infection of the central nervous system.
He remembers little from before 1985; he knows he has children but cannot remember their names. He lives with his wife Deborah, whom he married a year prior to the onset of his illness.
Clive Wearing video

Separating STS & LTS (cont)

D. Working Memory Impairment

Subject: K.F.: left parietal-occipital fracture

K. F. (continued)

When first observed, such a repetition defect is most striking. Over a series of trials, on each of which just two digits were presented to KF, he could reliably give back only the first. Thus on a trial during which, say, 4 & 7 are spoken to the patient a second apart, he might well respond: '4...I've forgotten the other.' As he could almost always repeat one digit reliably, Warrington thought that the deficit might well be arising from a problem of memory rather than of perception or production. As KF had a normal long-term memory, she thought it possible that the impairment was specifically related to short-term memory.

(Shallice, 1988, p 41)
K. F. (continued)

Conclusions:
Normal on some subscales of I. Q. tests (overall average I.Q)
memory span = 1 digit or word!
Interpretation: severely damaged verbal STS

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Separating STS & LTS (cont)

E. Korsakoff Syndrome
“Korsakoff syndrome, or Korsakoff psychosis, involves impairment of memory and intellect/cognitive skills such as problem solving or learning… The most distinguishing symptom is *confabulation* (fabrication) where the person makes up detailed, believable [or not] stories about experiences or situations to cover the gaps in the memory.”
http://www.ami-med.com/mhc/top/000771.htm

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D. Korsakoff Syndrome (cont)

Profound amnesia associated with chronic use of alcohol.
Damage to diencephalon, hippocampus, amygdala, and some to frontal cortex.
Korsakoff’s Syndrome (cont)  
(From Cermak, Naus, & Reale, 1976)

Separating Cognitive Systems

Method: Functional Dissociations  
Two Kinds of Dissociations: Single & Double  
Two Examples:  
Serial Position Effect  
Brain Damage