Cognitive Neuropsychology: An Introduction
What is cognitive neuropsychology?
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- It is a branch of cognitive psychology
What is cognitive neuropsychology?

• It is a branch of cognitive psychology

• Its aim is to try to learn more about the normal processes of cognition by studying the ways in which particular cognitive processes break down or fail to be acquired normally
Brain damage and cognitive psychology
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Surely such results must be telling us a lot about cognition?
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• It has its own journal:
What is the difference between cognitive neuropsychology and cognitive neuroscience?
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- **Cognitive neuropsychology** is all about **mental processes**. It is a branch of cognitive psychology.

- **Cognitive neuroscience** is all about **neural processes** (the brain processes which cognition depends on). It is a branch of neuroscience.
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• Both are important things to do: but they are different fields of science.
What is developmental cognitive neuropsychology?
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Developmental cognitive neuropsychology is the study of developmental disorders of cognition as a way of learning more about how specific cognitive abilities are normally acquired by children
What is cognitive-neuropsychological assessment?
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• Object recognition: the BORB battery (Birmingham Object Recognition Battery)
What is cognitive neuropsychiatry?
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The basic methods of cognitive neuropsychology.

I will illustrate these by going through a detailed example.
a 26-year-old woman in Scotland, in hospital 11 days after giving birth, complained of numbness in her left arm, and next day was drowsy & unresponsive: almost certainly a stroke.

Bramwell (The Lancet, 1897)
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- Let US think what that means
she can understand environmental sounds such as clocks ticking, but she can’t understand speech. Why?

Bramwell (The Lancet, 1897)
she can understand environmental sounds such as clocks ticking, but she can’t understand speech. Why?

here’s a diagram to help us think about this:
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**BOX** = a cognitive store of information, or a system that processes cognitive representations.
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BOX = a cognitive store of information, or a system that processes cognitive representations

ARROW = pathway of communication between cognitive information stores or information processors
Bramwell (The Lancet, 1897)
there is a single system of knowledge about meaning (semantics) used for understanding all kinds of input

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even though spoken words and nonspeech sounds are both auditory stimuli, they use different pathways to the semantic system

even though spoken words and printed words are both word stimuli, they use different pathways to the semantic system

Bramwell (The Lancet, 1897)
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but this diagram is inadequate
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nonspeech sounds and spoken words need to be processed by hearing mechanisms prior to getting to meaning
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so processors that do the job of processing auditory stimuli must be added to the diagram
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so processors that do the job of processing auditory stimuli must be added to the diagram
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Diagram:
- All auditory stimuli
- Early Auditory Processing
- Semantic System
- Printed Word
this diagram does not show any communication from Early Auditory Processing to Semantic System
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if there were only one pathway between these two systems how could there be a person who understands environmental sounds but not speech?
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so there must be two pathways here
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This diagram could account for Bramwell’s patient: her brain damage affected the system at point X.
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this has to be fixed
Bramwell (The Lancet, 1897)

Diagram: Nonspeech sounds and Spoken words are processed by the Early Auditory Processing module. This module outputs two unknown variables, one for nonspeech sounds and one for spoken words, which are then input into the Semantic System. Additionally, Spoken words are processed to Printed words.
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but can we say anything about what the processors labelled ? might actually do?
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here we need to distinguish between RECOGNITION and COMPREHENSION
Bramwell (The Lancet, 1897)
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Here we need to distinguish between RECOGNITION and COMPREHENSION.
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the processors labelled ? do the job of RECOGNIZING.
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the Semantic System does the job of COMPREHENDING
a LEXICON is a store of the auditory or visual forms of familiar stimuli
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RECOGNITION = finding an item in a lexicon

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Bramwell's patient could understand environmental sounds but not speech. Where was her system damaged?
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Bramwell’s patient could understand environmental sounds but not speech. Where was her system damaged?

Not here (she could understand sounds)

Was it here?

Not here (she could understand sounds)
Bramwell’s patient could understand environmental sounds but not speech. Where was her system damaged?

Not here (she could understand sounds)

Was it here?

Or here?

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Bramwell (The Lancet, 1897)
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A VERY SUBTLE point: When asked to write to dictation the sentence “Do you like to come to Edinburgh?” she did so correctly. So she must have correctly recognized the spoken words “come” and “Edinburgh”. These are irregular words and could not be correctly spelled unless they were recognized correctly. So . . .
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**Diagram:**
- Nonspeech sounds
- Spoken words
  - Early Auditory Processing
    - Sound Input Lexicon
    - Phonological Input Lexicon
      - Printed words
      - Semantic System
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- Not here
- Not here
- So her damage MUST be here
Their patient could not understand environmental sounds but could understand spoken words. Where was his damage?

Albert et al., (Cortex, 1972)
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- associations, dissociations and double dissociations
- modular modelling of cognition

Each of these will now be discussed a little further
Characteristic features of cognitive neuropsychology
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- The object of study is not the syndrome but the symptom; why?
Characteristic features of cognitive neuropsychology.

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![Diagram showing the relationship between print, letter, visual word, semantic, spoken word production, letter-to-sound rules, and speech.]
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- The object of study is not the syndrome but the symptom: why?
- This is a very simple model of the reading system, with only 13 boxes or arrows
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- The object of study is not the syndrome but the symptom: why?

- This is a very simple model of the reading system, with only 13 boxes or arrows.

- But if brain damage can affect any box or any arrow, there will be $2^{13} - 1 = 4095$ different possible syndromes of acquired dyslexia.
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- The object of study is not the syndrome but the symptom: why?

- This is a very simple model of the reading system, with only 13 boxes or arrows.

- But if brain damage can affect any box or any arrow, there will be $2^{13} - 1 = 4095$ different possible syndromes of acquired dyslexia.

- Aim therefore cannot be to investigate syndromes, because there are too many of them, even with such a simple model.
Characteristic features of cognitive neuropsychology.

- The object of study is not the syndrome but the symptom: why?

- This is a very simple model of the reading system, with only 13 boxes or arrows.

- But if brain damage can affect any box or any arrow, there will be $2^{13} - 1 = 4095$ different possible syndromes of acquired dyslexia.

- Aim instead: to test model by seeing how well it can explain symptoms of patients with acquired reading disorders.
Characteristic features of cognitive neuropsychology.

- Research typically consists of single case studies, not group studies: why?
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- Research typically consists of single case studies, not group studies: why?
- Because patients will almost always be unique: if there are 4095 different possible patterns of acquired dyslexia it is highly unlikely that you will ever come across two patients with the same pattern of reading impairment.
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• Research typically consists of single case studies, not group studies: why?

• Because patients will almost always be unique: if there are 4095 different possible patterns of acquired dyslexia it is highly unlikely that you will ever come across two patients with the same pattern of reading impairment.

• If every patient is different from every other one, it makes no sense to treat any set of patients as a single group and to average results across the group.
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- Emphasis on dissociations rather than associations of impairments - and especially double dissociations. Why?
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- When a patient exhibits two symptoms A and B, this may be because a single cognitive system X is impaired, and this impairment is generating the two symptoms.
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• Emphasis on dissociations rather than associations of impairments - and especially double dissociations. Why?

• When a patient exhibits two symptoms A and B, this may be because a single cognitive system X is impaired, and this impairment is generating the two symptoms.

• Alternatively, when a patient exhibits two symptoms A and B, this may be because two cognitive systems X and Y are impaired, symptom A coming from impairment of X and symptom B coming from impairment of Y. The reason systems X and Y are both impaired is that the brain regions they depend on are close together, so when one is damaged the other is likely to be.
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- So associations of symptoms don’t allow strong inferences about cognition to be made.
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  - impaired writing
  - impaired ability to calculate
  - right-left disorientation
  - impaired ability to identify their fingers
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- Does that mean there’s a single cognitive system that is used for writing, calculating, telling left from right and identifying fingers?

- No. There are four different cognitive systems. All located in adjacent regions of left parietal lobe
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• When a patient is impaired on task A but normal on task B, can we conclude from this dissociation that the two tasks depend on different cognitive systems?
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- Emphasis on dissociations rather than associations of impairments - and especially double dissociations. Why?

- When a patient is impaired on task A but normal on task B, can we conclude from this dissociation that the two tasks depend on different cognitive systems?

- No. Instead, it could be that these two tasks depend on the same cognitive system, but task A is harder for the system to perform than task B, and so when the system is partially damaged, task A will suffer but task B can still be done.
Characteristic features of cognitive neuropsychology.

- Emphasis on dissociations rather than associations of impairments - and especially double dissociations. Why?

- When a patient is impaired on task A but normal on task B, can we conclude from this dissociation that the two tasks depend on different cognitive systems?

- No. Instead, it could be that these two tasks depend on the same cognitive system, but task A is harder for the system to perform than task B, and so when the system is partially damaged, task A will suffer but task B can still be done.

- So single dissociations between symptoms don’t allow strong inferences about cognition to be made.
Characteristic features of cognitive neuropsychology.

- Emphasis on dissociations rather than associations of impairments - and especially double dissociations. Why?
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• This is a double dissociation between tasks A and B. It can’t be explained on the basis that there is just one cognitive system responsible for both tasks. It strongly supports any model that says that the two tasks depend on two separate cognitive systems
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- So double dissociations between symptoms do allow strong inferences about cognition to be made
Characteristic features of cognitive neuropsychology.

- Models are highly modular. It is assumed that any one module can be impaired by brain damage with all the other modules remaining unimpaired.

- The many remarkably selective impairments of cognition that have been discovered by cognitive neuropsychologists provide powerful evidence that cognitive systems are indeed highly modularized:
  - not only as parts of the mind,
  - but also as regions of the brain
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Reading List


