

# Psychology

In COGS 200

# Early Psychology

- Wilhelm Wundt (1832-1920)
- William James (1842-1910)

Psychology distinguishes itself from:

- Anthropology
- Philosophy
- Psychiatric Medicine

“The first, or metaphysical, definition [of psychology] belongs to a period of development that lasted longer in this science than in others. But it is here too forever left behind, since psychology has developed into an empirical discipline, operating with methods of its own; and since the ‘mental sciences’ have gained recognition as a great department of scientific investigation, distinct from the sphere of the natural sciences, and requiring as a general ground-work an independent psychology, free from all metaphysical theories.”

(Wundt, 1897, p. 1)

# Agenda for Early Psychology:

- Plot curves of learning and forgetting.
- Measure the ‘span of attention’.
- Give a basic taxonomy for emotions.
- Give a catalogue of the most elementary mental operations.
  - What is the smallest catalogue of basic faculties, such that every mental operation can be explained by the operation of some subset of them?

# Titchener

- A student of Wundt.
- Wrote a manual of training exercises in introspection.
- When using introspective data, Wundt preferred data from subjects who had made upwards of 10,000 laboratory introspections.

- In 1958, Tapia and colleagues report that 9% of patients (in a non-psychiatric hospital) report dreaming in colour.
- (Compared to 12% of neurotic men and 21% of neurotic women)
- But earlier sources (Aristotle, Epicurus, Freud, Descartes) seem always to assume that dreams are coloured.

### Schwitzgebel's Hypothesis:

- We have very little idea what our dreams are like, and so are highly influenced by our experience of, e.g., black and white films.

# Introspection in Psychology

- In general, introspection proved to be a fruitless method in psychology....
- ... And so psychologists were happy to embrace a philosophical position that made introspection dispensable.

# Logical Positivism

- The meaning of a term cannot outrun the conditions for its application.
- We learn to apply mental state terms on the basis of behaviour. ...
- ...so there is no sense (or no point) in looking beyond that behaviour in order to confirm any hypothesis about the mental.

# Behaviourism

- A properly scientific approach to intelligent behaviour should explain it by reference to (publicly observable) stimulus/response contingencies.
- B. F. Skinner, *Verbal Behavior* (1957)



# Donald Broadbent

1926-1993

# The Cognitive Revolution

- Broadbent (1958) (and others).
- The scientific method *doesn't* require you to mention nothing but publicly observable entities.
- “When dealing with macroscopic events statements about unobservables are not necessarily mystical or scientifically useless.”  
*Perception and Communication* p. 303

# Marr's Levels (1982)

1. The **function** to be computed.
2. The **algorithm** by which it is computed.
3. The **mechanism** by which that algorithm is implemented.

- A psychological theory can make reference to data structures, and information processing.
- There is a question about how the claims made by such a theory relate to the claims that can be tested by direct observation of the brain.
- For a scientific psychology, what we need is publicly observable data to provide evidence about those kinds of things.

# Approaches to cognitive psychology

- Experimental psychology
- Computer modelling
- Cognitive neuropsychology

# Experimental methodology

- Notice a phenomenon or behavior
- Create a controlled environment or task in which to observe that behavior
- Select which aspect of the phenomenon is of interest
- Change something about that aspect
- Observe any change in behavior

# Experimental methodology

- Note a phenomenon or behavior
  - Memory for numbers
- Create a controlled environment or task in which to observe that behavior
  - Group of subjects
  - Set list of numbers to remember, program them to display on a computer, set an amount of time for subjects to study them, etc.
  - Note how well they remember the numbers
- Select which aspect of the phenomenon is of interest
  - For example, length of the numbers
- Change something about that aspect
  - Make the numbers longer or shorter
- Observe any change in behavior
  - Note change in ability to remember the numbers

# Experimental methodology

- Note a phenomenon or behavior: **Often builds on previous research**
  - Memory for numbers
- Create a controlled environment: **To what extent is this possible?**
  - Group of subjects
  - Set list of numbers to remember, program them to display on a computer, set an amount of time for subjects to study them, etc.
  - Note how well they remember the numbers
- Select aspect of interest: **Hypothesis**
  - For example, length of the numbers will affect a person's ability to remember them.
- Change something about that aspect: **Independent variable**, manipulated by the experimenter
  - Make the numbers longer or shorter
- Observe any change in behavior: **Dependent variable**, or what changes *depending upon* the change in the independent variable
  - Note change in ability to remember the numbers

# Experimental psychology

- Examine outward behavior presumed to result from underlying mental processes
- *Differences* in outward behavior result from *differences* in those mental processes
- Replicable
- Can manipulate many variables
- Cons
  - Group behavior; no attention to individual differences
  - No way to understand the *nature* of the underlying processes
  - Mental processes may not have behavioral consequences that are measurable in these ways

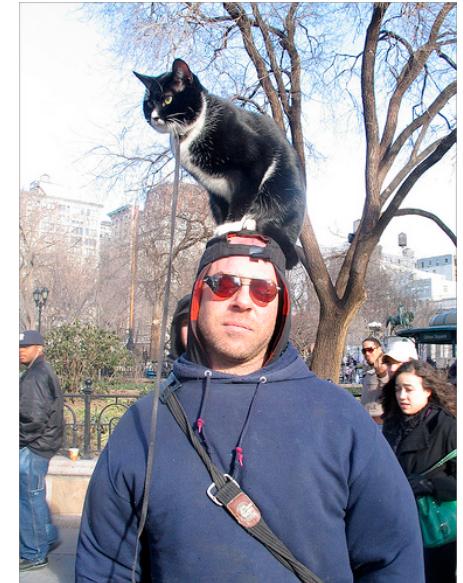
# Experimental psychology: Past tense

- Phenomenon: Our ability to form the past tense
- How could you investigate this?

# Experimental psychology: past tense

Berko, 1958

"This is a man who knows how to spow /spau/. He is spowing. He did the same thing yesterday. What did he do yesterday? Yesterday he \_\_\_\_."



"This is a boy who knows how to rick /rIk/. He is ricking. He did the same thing yesterday. What did he do yesterday? Yesterday he \_\_\_\_."

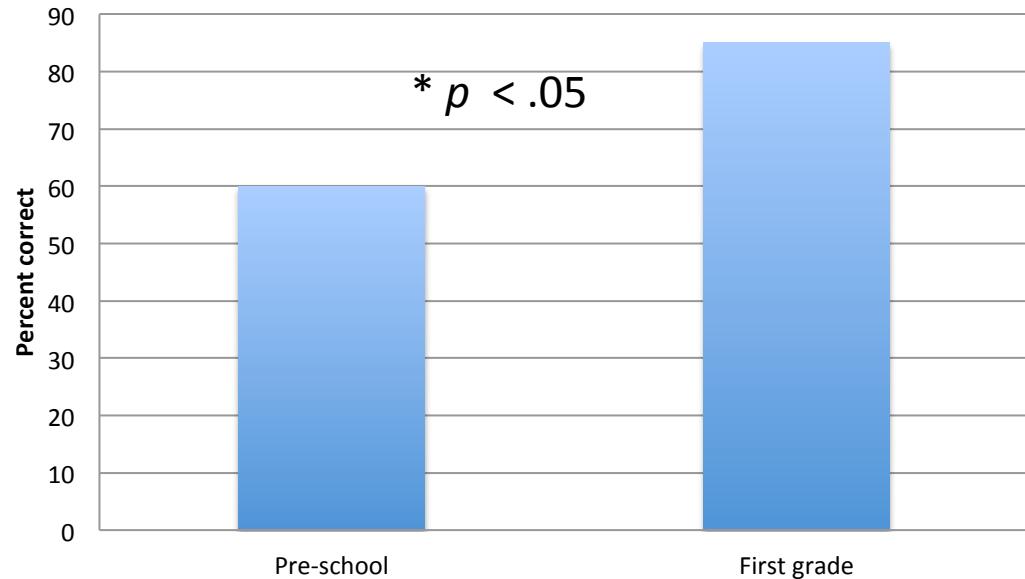


# Experimental psychology: past tense

- Two age groups: pre-school; Grade 1
- List of questions with nonsense words of different types
  - ~ *ing*, e.g., *bing*
  - ~ *t*, e.g., *gat*
- Recorded answers
- Coded answers as correct or incorrect
- Independent variable?
- Dependent variable?

# Results

Past tense: *binged*



- What conclusion can you draw?
- How did they do it?
- Same mental processes at each age?

# Computational cognitive science

- Mind as computer: both process information
- Create a detailed computational model that simulates a mental process
  - Test bed: allows manipulation of components and testing
  - Computer solutions suggest cognitive solutions
- Cons
  - Does it reveal actual mental processes?
  - Does it predict beyond the training set?

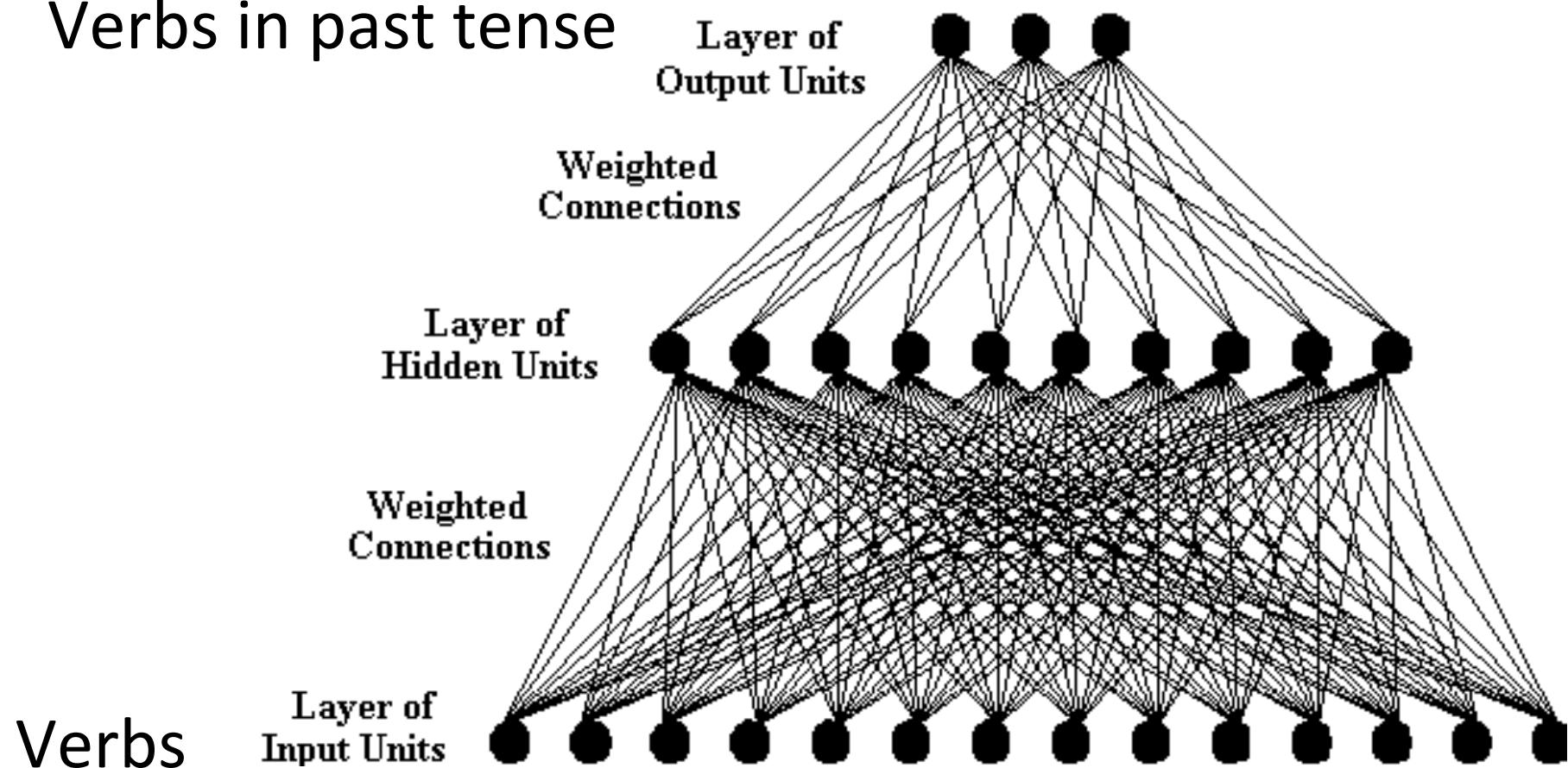
# Computational model: past tense

McClelland, Rumelhart, & Hinton, 1986

- Parallel distributed processing model (connectionism)
- Mechanism that learns pairings between presented items
- Present pairs: words and their past tenses
  - *walk* “goes with” *walked*

# Computational model: past tense

Verbs in past tense



# Computational cognitive science

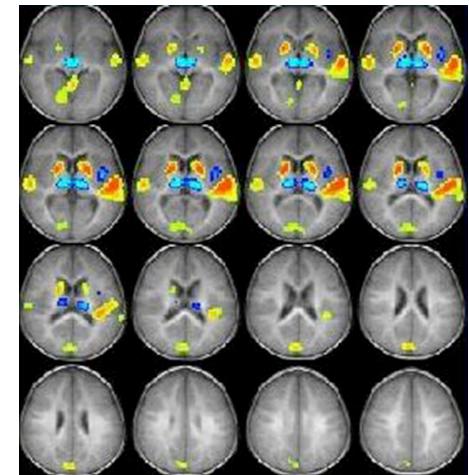
- Results
  - Given word, produces past tense form
  - Eventually, for new items as well
    - *spow* “goes with” *spowed*
  - A robust level of accuracy
  - Pattern of errors: similar to those made by children
- Are mental processes connectionist?
  - Claim: at least have shown that mental processes don't *have* to be in rule form

# Cognitive neuroscience

- Understanding neural functioning can inform our understanding of mental processes
  - Neuroimaging
  - Lesion studies: extent and location of lesion related to changes in behavior
- Neural underpinning of information processing
  - Configuration of neural firing for mental processing
  - Changes in type, strength, placement, timing of activation as processing unfolds
- Cons: each technique has weaknesses
  - Brain is always active—is “right” activity being tapped?
  - Correlation is not causation
  - Often small samples
  - Variation in lesion characteristics, brain morphology

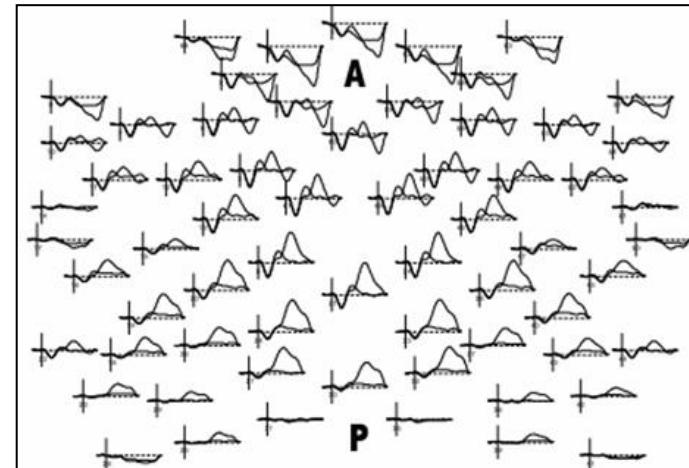
# Neuroimaging techniques

- “Watch” brain activity while brain is engaged
- **Functional magnetic resonance imaging (fMRI)**
  - More neural activity = more blood used
  - Measures magnetic characteristics of blood
  - Compare activity of interest to baseline activity
  - Accurate *location* of response



# Neuroimaging techniques

- **Event-related potential (ERP)**
  - More neural activity = more electrical output
  - Measures electrical changes in neurons
  - Accurate *timing* of neural response



# Brain damage

- Examine patients with damage to brain
- Locate damage
  - Post-mortem autopsy
  - Neuroimaging
- Observe deficits
- Link damage to deficits
- Reveals location (maybe),  
but not processing



# Past tense in Broca's aphasia

- Damage to Broca's area
- 9 months since stroke
- Note tense formation problems
- <http://www.youtube.com/watch?v=1aplTvEQ6ew&noredirect=1>

# Converging evidence

- Each technique/approach has pros and cons.
- Evidence from one approach alone will be incomplete.
- Converging evidence paints a somewhat more complete picture.
- Past tense formation:
  - **Behavioral experiment** shows children can form novel past tense forms, and improve significantly over time.
  - **Computer modeling** shows this does not have to be due to rule-learning.
  - **Cognitive neuroscience** shows damage to Broca's area in patients with deficits in past tense formation.