Week 2
Study of human cognition
9/5/2018
Roadmap

• Early research on cognitive science
• -ISMs in cognitive science
• Chomsky’s view of language
• Research methods in cognitive science
Early thinking by philosophers

- Plato: memory storage and retrieval

- Aristotle

- Locke: mental association of ideas
Empiricism

• Knowledge built upon one’s own experiences and senses

• Acknowledges genetic differences but emphasizes the role of learning
Nativism

• Emphasizes native (or innate) ability

• Individual differences coming from differences in cognitive abilities
Structuralism

Wilhelm Wundt (1879)

• Tries to identify a set of “mental elements”
  A combination of
  ➢ Mode: visual, auditory, tactile, olfactory
  ➢ Quality: color, shape, texture
  ➢ Intensity
  ➢ Duration

• Tries to explain mental states by *introspection*

• Studies *what* instead of *why* the mind works the way it is.
Functionalism

William James

• Not interested in the elements of mental states
• Studies *why* instead of *what* the mind works the way it is.
  → *the functions of the mental operations*
• Studies mental phenomena in real-life settings
Gestalt psychology

• Gestalt: “configuration or shape” in German
• Psychological phenomena should be studied in their entirety

![Gestalt figures](image)
Behaviorism

• Classical conditioning (Ivan Pavlov)

(source: Wikipedia)

(source: schoolworkhelper.com)
Behaviorism

• Opposes the idea of introspection
  - Why?

• John Watson: Mental phenomena reducible to behavioral and physiological responses

• Operant conditioning (B. F. Skinner)
  https://www.youtube.com/watch?v=l_ctJqjlrHA
Interim summary

• Empiricism
• Nativism
• Structuralism
• Functionalism
• Behaviorism
• Gestalt Psychology
Chomsky’s view as a challenge on psychology

• Opposes behaviorism – reinforcement not required for acquisition

• Innateness
  o Innate ability to learn the structure (or grammar) of a language and use it without difficulty
  o Generative grammar
    - Rules to generate words, sentences, etc.
    - Speakers not necessarily aware of the rules or patterns
      e.g., Can you tell if the “p” in “sport” is the same as that in “pet”? Also, is there a “t” sound in “written” as in “tea”?
Chomsky’s view as a challenge on psychology

• Opposes behaviorism – reinforcement not required for acquisition

Child: Nobody don’t like me.
Mother: No, say, “Nobody likes me” [eight repetitions of this dialogue]
Mother: No, now listen carefully; say, “Nobody likes me.”
Child: Oh! Nobody don’t likes me.
Is human a limited-capacity processor?

• The Magic Seven (plus or minus two) (Miller 1956)

  Let’s try it - How many digits can you repeat after me?
  Now try it backwards!

• What are the possible factors that may affect your recall?
Chomsky’s view as a challenge on psychology

• If our brain is a limited-capacity processor, how do we acquire complex linguistic knowledge?

• Generative grammar
  ➢ Sentence generator
    ➢ Unlimited possible sentences
    He is writing an essay.
    He is writing an essay about linguistics.
    He is writing an essay about linguistics for his final paper.
    ...

Does our mind (or brain) really need the rules in order to produce and understand language? Or do we store all the instances of what we heard to learn a language? Or both rules and instances? How do we find evidence?
Main research methods in cognitive science

• Computational
• Experimental
• Observation
Experimental method

• Observation of a phenomenon of interest
• Research questions
• Hypotheses
• Define conditions (experimental and control)
• Actual data → Dependent variables
• What will influence dependent variables? → Independent variables
Experiment design

Think about:
1. What do I want to compare?
2. What are the conditions I want to manipulate?
3. What is my target population?
4. What kind of data do I want to collect?
Between-subject vs. within-subjects design

Between-subjects:
• Compare behavior between two groups

Within-subjects:
• Compare if a person behave differently in two different conditions
Practice: identify between-subject vs. within-subjects design

• Comparison of working memory capacity between Alzheimer’s patients and normal population

• Comparison of aphasic patients’ sentence comprehension performance in noisy and quiet environment

• Comparison of first and second language speakers’ perception of accent
Practice: identify dependent and independent variables

Two groups of participants, old and young adults (50% male and 50% female), are asked to press a button when they see a dot on the screen. In one condition, the dots appear in a pre-arranged order. In another condition, the dots can appear anywhere on the screen. In addition, in both conditions, half of the dots are filled, and the other half are not filled. Participants’ reaction times are collected.
Practice: identify dependent and independent variables

Two groups of participants, old and young adults (50% male and 50% female), are asked to press a button when they see a dot on the screen. In one condition, the dots appear in a pre-arranged order. In another condition, the dots can appear anywhere on the screen. In addition, in both conditions, half of the dots are filled, and the other half are not filled. Participants’ reaction times are collected.

- Between-subject or within-subject?
- Dependent: reaction time
- Independent: age, gender (?), dot location, dot types.
Practice: identify dependent and independent variables

One group of participants are asked to memorize two lists of words. In the first list, words are all related in meaning (e.g., book, read, text, etc.) In the second list, words are all unrelated (e.g., car, piano, kale, etc.) Participants are then presented a word and asked to determine if the word appears in one of the lists. A week later, participants are asked to do the recognition task again. Their reaction time and response accuracy are collected.
Practice: identify dependent and independent variables

One group of participants are asked to memorize two lists of words. In the first list, words are all related in meaning (e.g., book, read, text, etc.) In the second list, words are all unrelated (e.g., car, piano, kale, etc.) Participants are then presented a word and asked to determine if the word appears in one of the lists. A week later, participants are asked to do the recognition task again. Their reaction time and response accuracy are collected.

- Between-subject or within-subject?
- Dependent: reaction time (RT) and accuracy
- Independent: relatedness of meaning, time lapsed (one week), and even word length (number of letters)