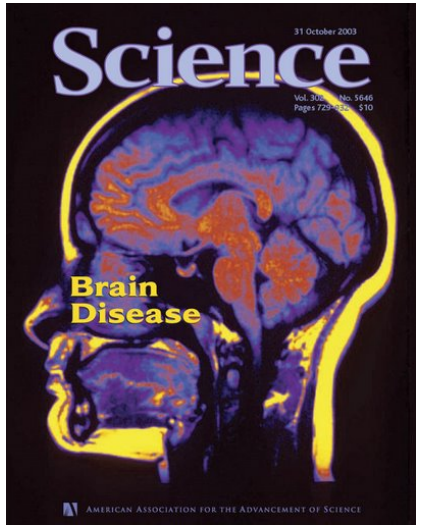
Chapter 1
Science, language and the science of language

The essence of SCIENCE



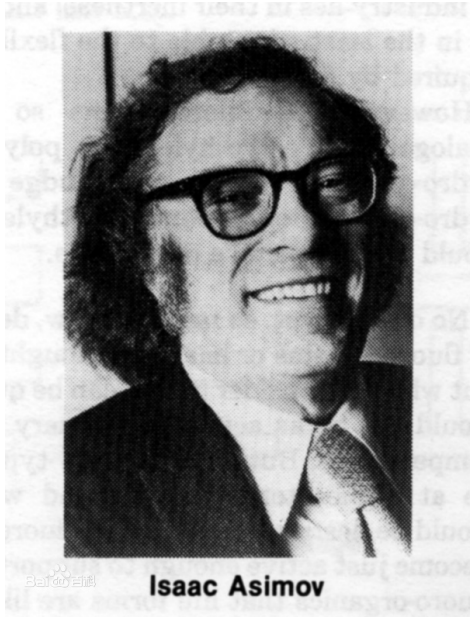
- "How do you know?" vs. "Which theory is right?"
  - Q1: Why does a book fall when you drop it?
  - Q2: **How do you know** it's gravity that makes things fall down?

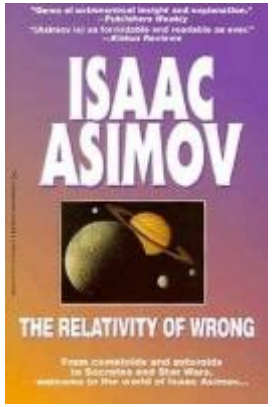
  (What's the evidence that makes you confident that gravity is better than other possible explanations --- "learn it, remember it, use it…"

- Is there RIGHT theory? What's the essence of science according to Asimov?

Issac Asimov

- *"when people thought the Earth was flat, they were wrong. When people thought the Earth was spherical, they were wrong. But if you think that thinking that the Earth is spherical is just as wrong as thinking the Earth is flat, then your view is wronger than both of them put together."*


Isaac Asimov



--- Isaac Asimov (1988). The relativity of wrong. In *The relativity of wrong: Essays on science*. New York, NY: Doubleday.

How much do we know about language?

(try search "science of language" (esp. in pictures)

TABLE 1.1 Some things people say about language (that are almost certainly wrong)
You can learn language by watching television.
People whose language has no word for a concept have trouble thinking about that concept.
English is the hardest language to learn.
Texting is making kids illiterate.
Some languages are more logical/expressive/romantic than others.
People speak in foreign accents because their mouth muscles aren't used to making the right sounds.
Some languages are spoken more quickly than others.
Saying "um" or "er" is a sign of an inarticulate speaker.
Failure to enunciate all your speech sounds is due to laziness.
Sentences written in the passive voice are a sign of poor writing.
Swearing profusely is a sign of a poor vocabulary.
Deaf people should learn to speak and lip-read in spoken language before they learn sign language, or it will interfere with learning a real language.
Speech errors reveal your innermost thoughts.
You can't learn language by watching television.

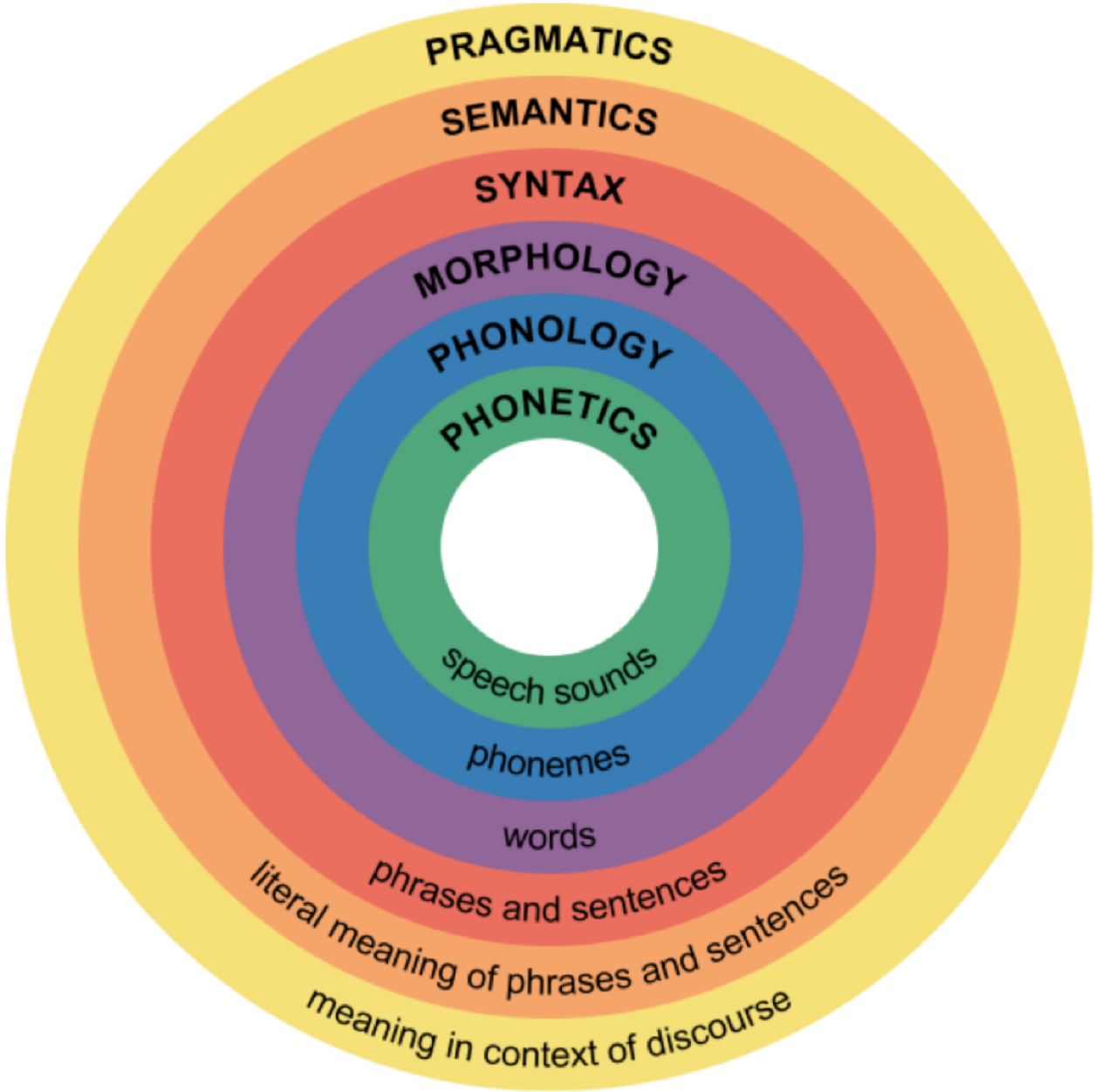
Language science is a team sport

Questions to contemplate:

- Why do we know so little about language?

- What kind of language scientists would you assemble in a team of researchers if you wanted to find out:
  - whether language disorders are more prevalent in English-speaking populations than in Mandarin-speaking populations, and if so, why?
  - determine whether parrots can really learn and understand language, or if they simply mimic it

  What would be the role of each specialist in the research project?


PRAGMATICS
SEMANTICS
SYNTAX
MORPHOLOGY
PHONOLOGY
PHONETICS
speech sounds
phonemes
words
phrases and sentences
literal meaning of phrases and sentences
meaning in context of discourse

A brief historical perspective

Introspectionist School

19th century (Wundt, Titchener)

Method of investigation: introspection (self-examination of thought processes)

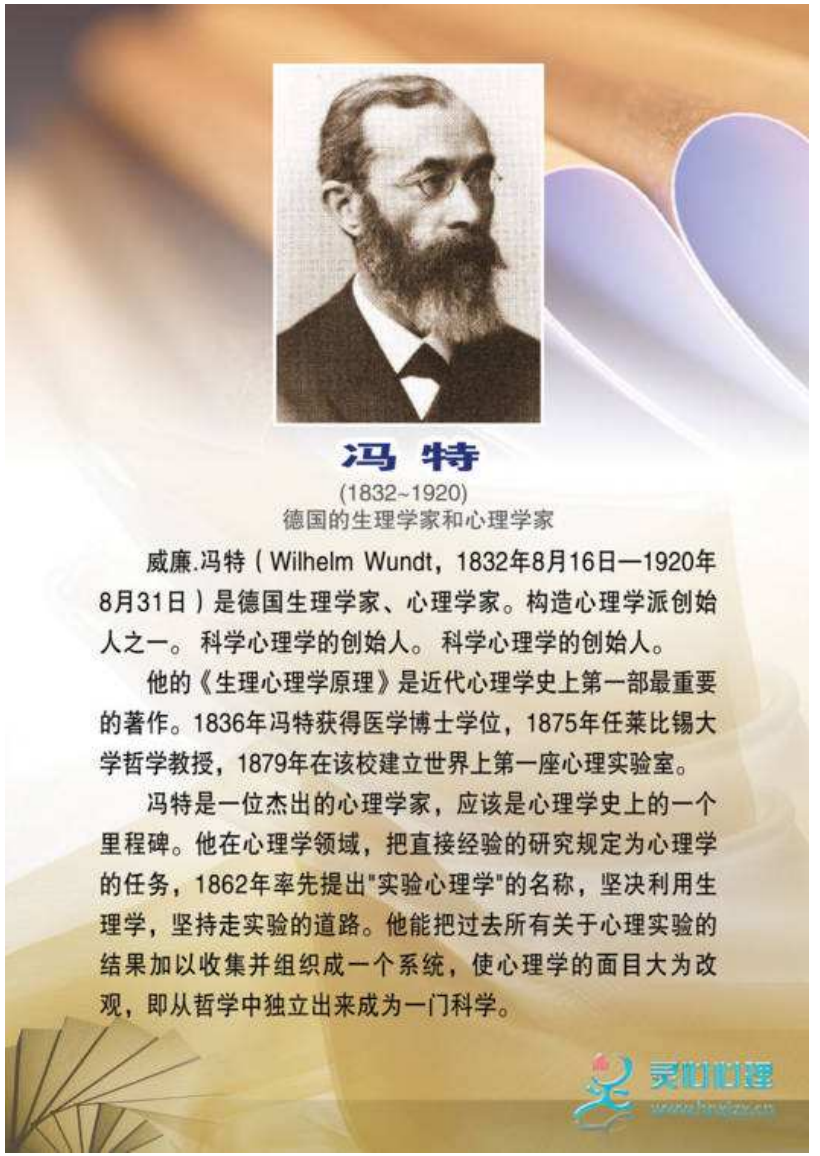
Problem: Could some mental processes be unconscious?

Typical issue: Imageless thought (can you think about a triangle without having a mental image?)

Problem: how do you test such a hypothesis?

Scientific method requires that somebody else must be able to carry out the same experiment. Observations must be objective and replicable.

Not possible with introspection.



More history

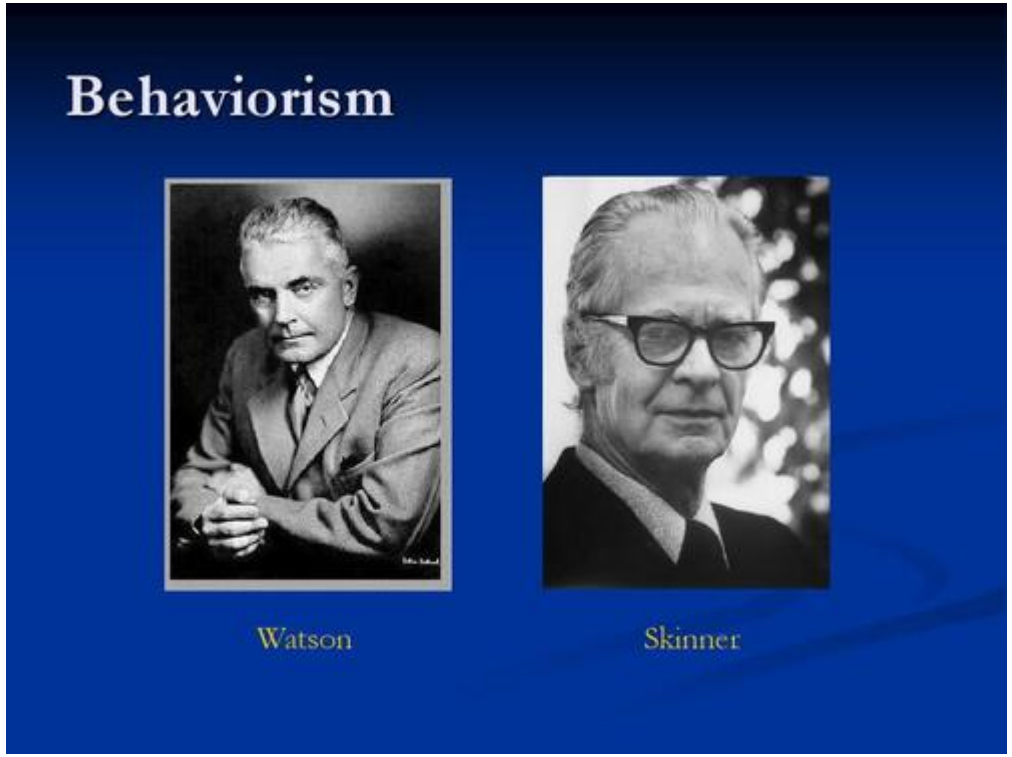
Behaviorism: Watson (1924) Hull (1943) Skinner (1953)

- rebellion against subjective approach
- non-observable processes are excluded
- emphasis on observable behavior and S-R connections

Why does a dog salivate when you pick up its food bowl?

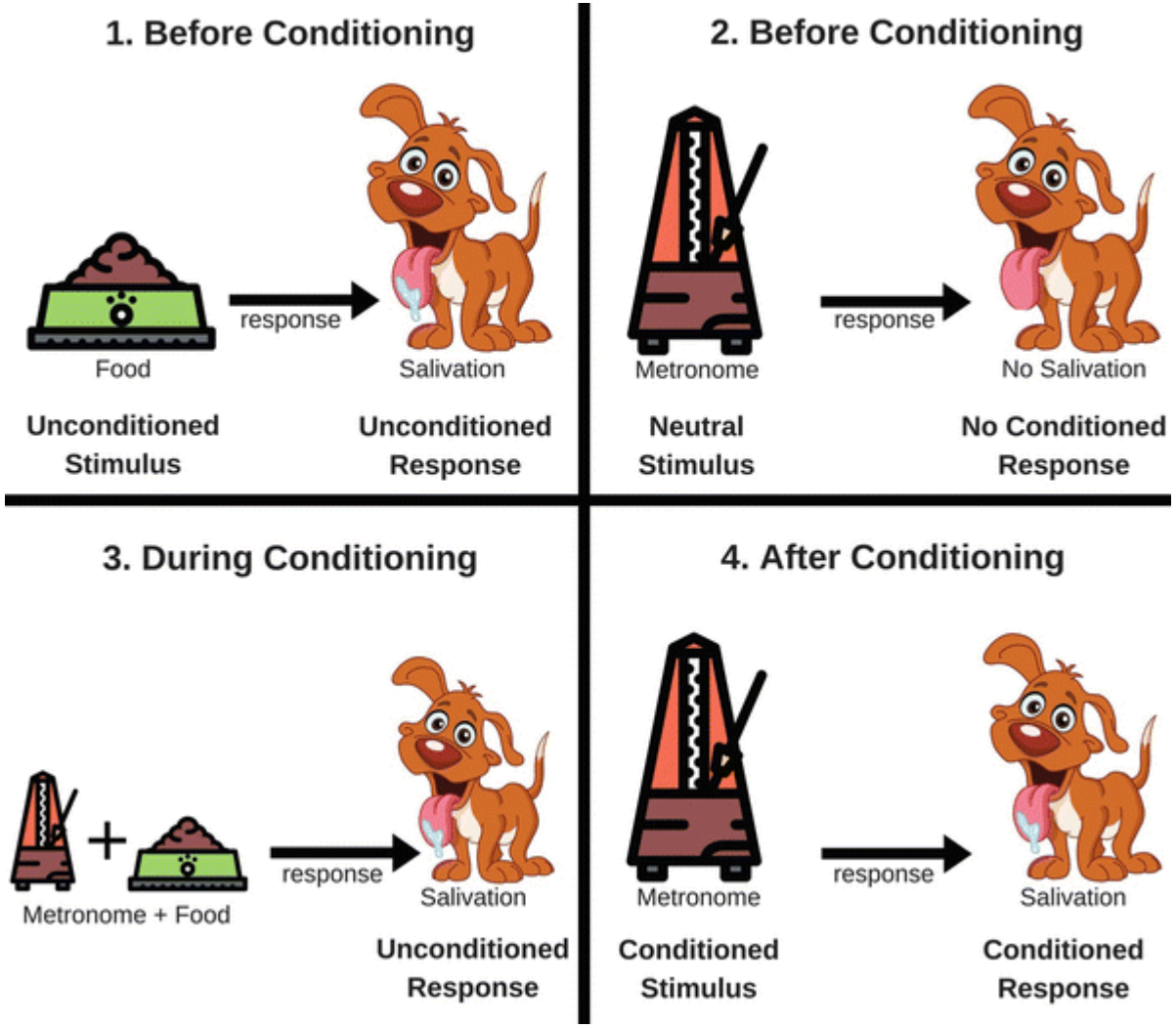
Because this stimulus has preceded delivery of food in the past. This forms an **association**.

No need to ask whether it is because the dog **expects** anything.



Ivan Pavlov

Conditioning process in dogs



https://www.youtube.com/watch?v=hhqumfpxuzI&ab_channel=BullyingNewsVideos

More history

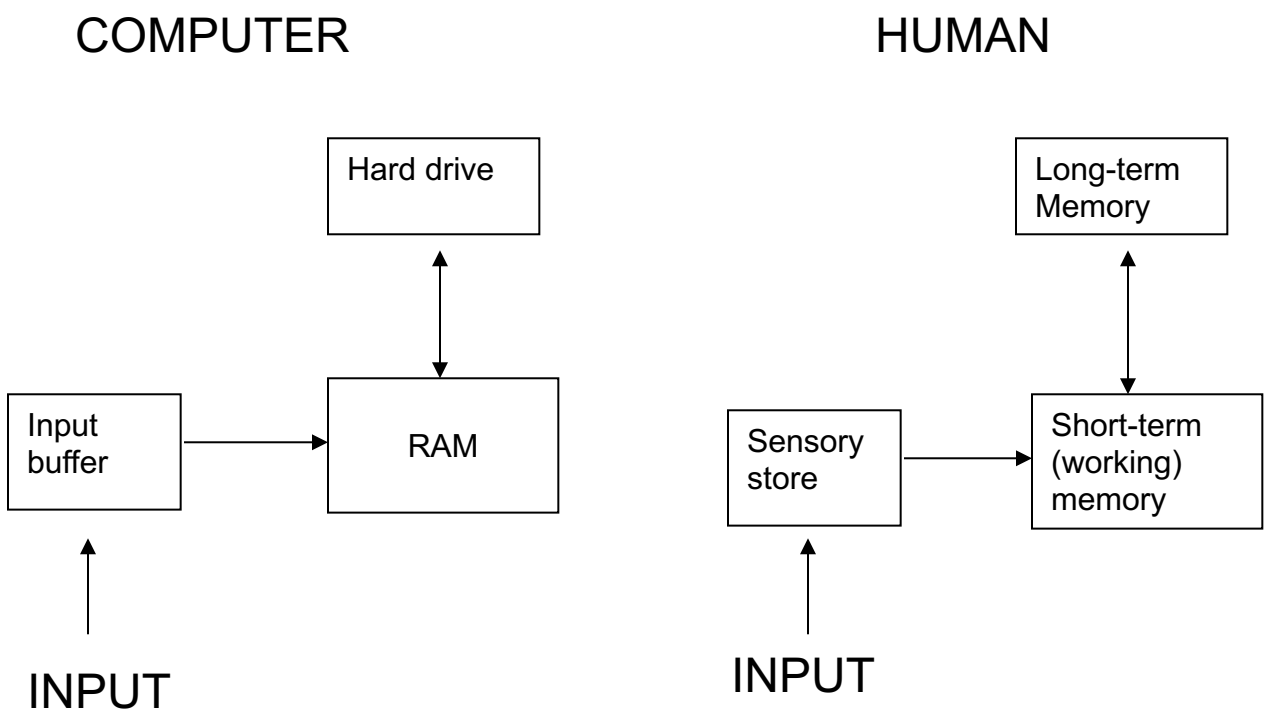
The Cognitive Revolution.

Miller, Galanter & Pribram (1960), Newell, Shaw & Simon (1958), Chomsky (1957)

- rebellion against S-R reflex approach
- behavior depends on how the organism interprets the stimulus
- non-observable (mental) processes are allowed
- emphasis on higher-order cognitive processes
- inspired by the analogy between computers and the brain

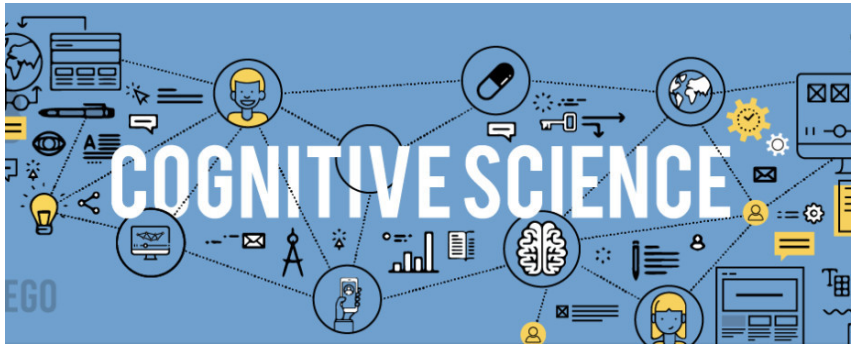
INFORMATION PROCESSING MODELS

Analogy with a digital computer with stored, modifiable programs.
Learning involves constructing new programs.

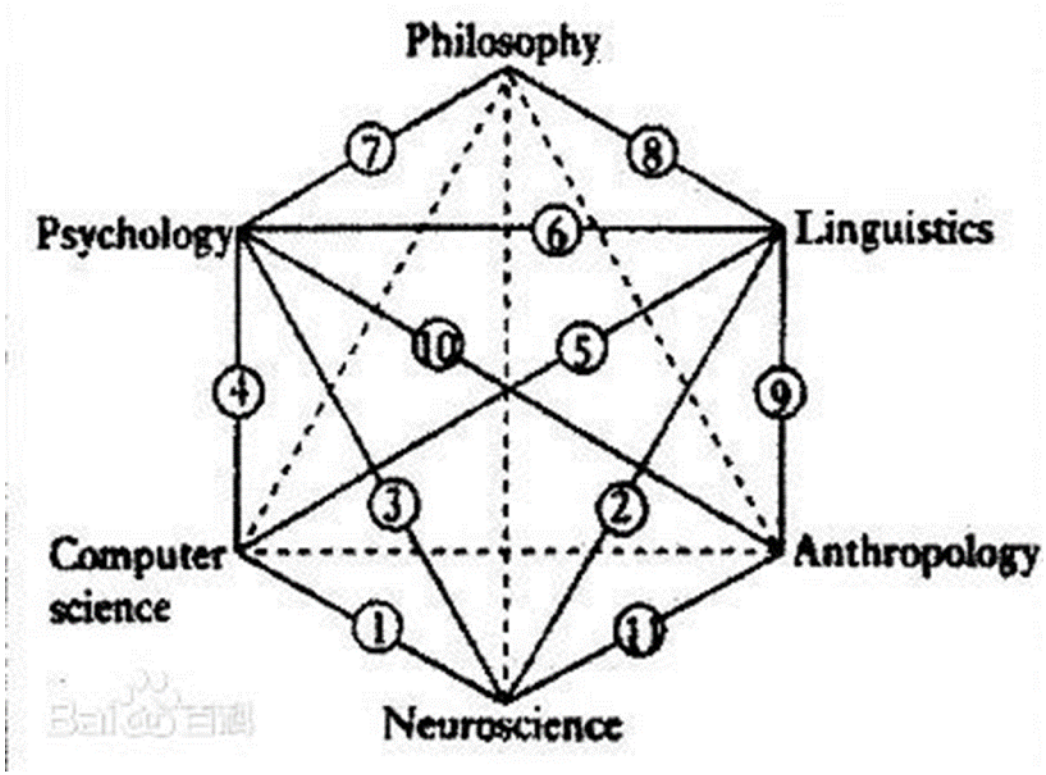


Information needs to be retrieved from permanent store and put into working memory before it can be used or processed.

Cognitive science



- Diverse and interdisciplinary
- Major question: What is cognition? How do people, animals, or computers “think” , act, and learn?
- 3 areas:
  - **Brain**: the neurological anatomy and processes underlying cognitive phenomena
  - **Behavior:** the cognitive activity of individuals and their interaction with each other and their sociocultural environment, including the use of language, information, and media
  - **Computation**: the capacity of mathematical and computer systems to model cognitive and neural phenomena and represent information, and the role of computers as cognitive tools



1. Control theory
2. Neurolinguistics
3. Neuropsychology
4. Cognitive simulation
5. Computational linguistics
6. Psycholinguistics
7. Mind and philosophy
8. Language and philosophy
9. Anthropological linguistics
10. Cognitive anthropology
11. Brain evolution

.....

What is NBIC?

- Nanotechnology
- Biotechnology
- Informational technology
- Cognitive science

“聚合技术（NBIC）以认知科学为先导。因为规划和设计技术需要从如何（how）、为何（why）、何处（where）、何时（when）4个层次来理解思维。这样，我们就可以用纳米科学和纳米技术来制造它，用生物技术和生物医学来实现它，最后用信息技术来操纵和控制它”

--- Converging Technologies for Improving Human Performance

(by NSF and Department of Commerce)

Chapter 2

Origins of human language

- No answer yet!

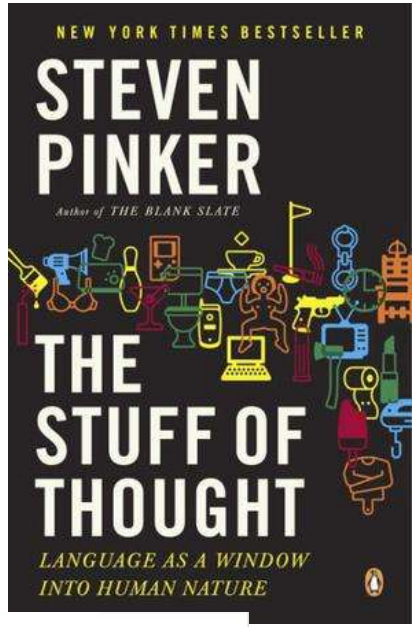
- Linguistic Society of Paris: no papers about the origins of languages were allowed to be presented at its conference (1866)
  ---Why? Too messy, waste of time, no answer until more known

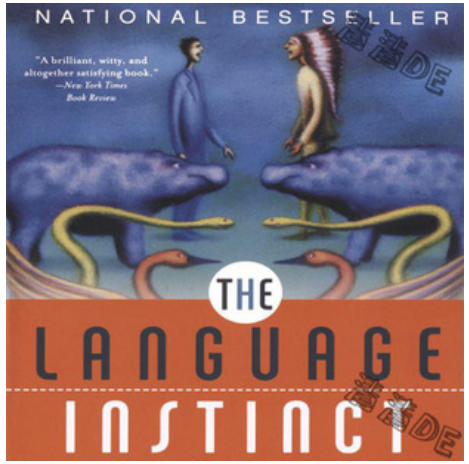
- Do we know more now? Maybe

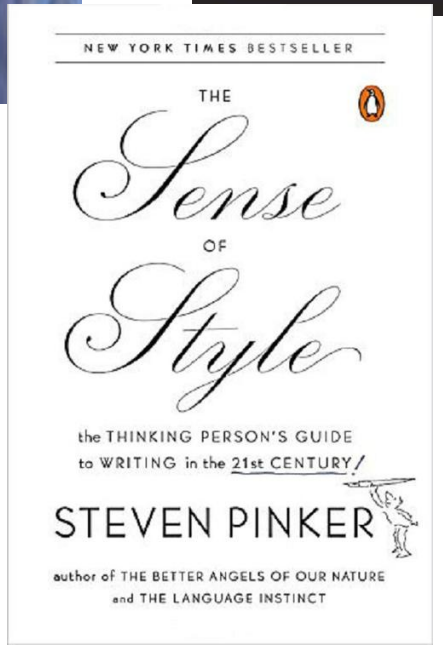
- Nativist view: Steven Pinker *The Language Instinct* (1994)
  - Our genes endow us with a general capacity for language
  - Particular aspects of language ability are also genetically specified

- Anti-nativist view: language is the by-product of our extensive cognitive abilities, including general abilities of learning and memory

- What' s your view??





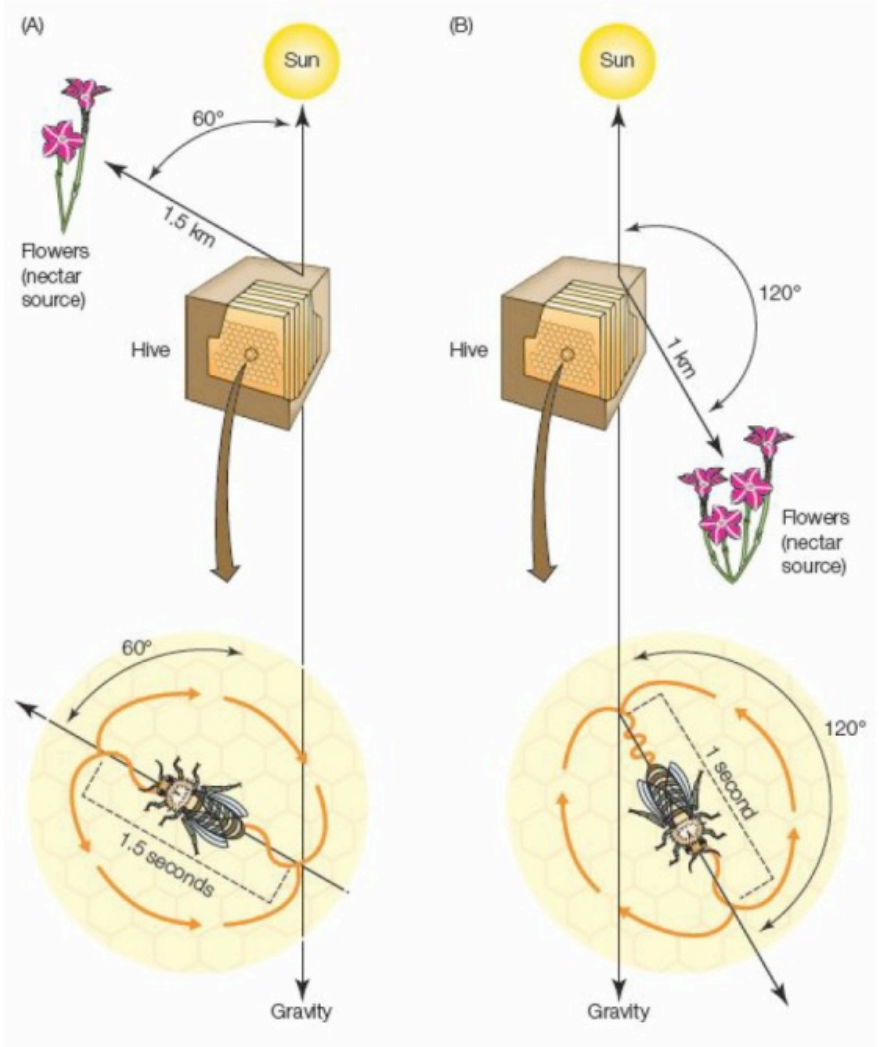


How about animals?

- Honeybee dance: Sec. 2.1. (Question #1)

  - The waggle dance of the honeybee:

  https://www.youtube.com/watch?v=bFDGPgXtK-U&ab_channel=GeorgiaTechCollegeofComputing



Hockett’ s design features of human language (Box. 2.1)

1. **Vocal–auditory channel** Language is produced in the vocal tract and transmitted as sound. Sound is perceived through the auditory channel.
2. **Broadcast transmission and directional reception** Language can be heard from many directions, but it is perceived as coming from one particular location.
3. **Rapid fading** The sound produced by speech fades quickly.
4. **Interchangeability** A user of a language can send and receive the same message.
5. **Total feedback** Senders of a message can hear and internalize the message they’ve sent.
6. **Specialization** The production of the sounds of language serves no purpose other than to communicate.
7 **Semanticity** There are fixed associations between units of language and aspects of the world.
8. **Arbitrariness** The meaningful associations between language and the world are arbitrary.
9. **Discreteness** The units of language are separate and distinct from one another rather than being part of a continuous whole.
10. **Displacement** Language can be used to communicate about things that are not present in time and/or space.
11. **Productivity** Language can be used to say things that have never been said before and yet are understandable to the receiver.
12. **Traditional transmission** The specific language that’s adopted by the user has to be learned by exposure to other users of that language; its precise details are not available through genetic transmission.
13. **Duality of patterning** Many meaningful units (words) are made by the combining of a small number of elements (sounds) into various sequences. For example, *pat*, *tap*, and *apt* use the same sound elements combined in different ways to make different word units. In this way, tens of thousands of words can be created from several dozen sounds.
14. **Prevarication** Language can deliberately be used to make false statements.
15. **Reflexiveness** Language can be used to refer to or describe itself.
16. **Learnability** Users of one language can learn to use a different language.

Adapted from Hockett, 1960, *Sci. Am.* 203, 88; Hockett & Altmann, 1968 in Sebeok, (ed.), *Animal communication: Techniques of study and results of research.*

How about chaser?

- Can language be taught to chaser?

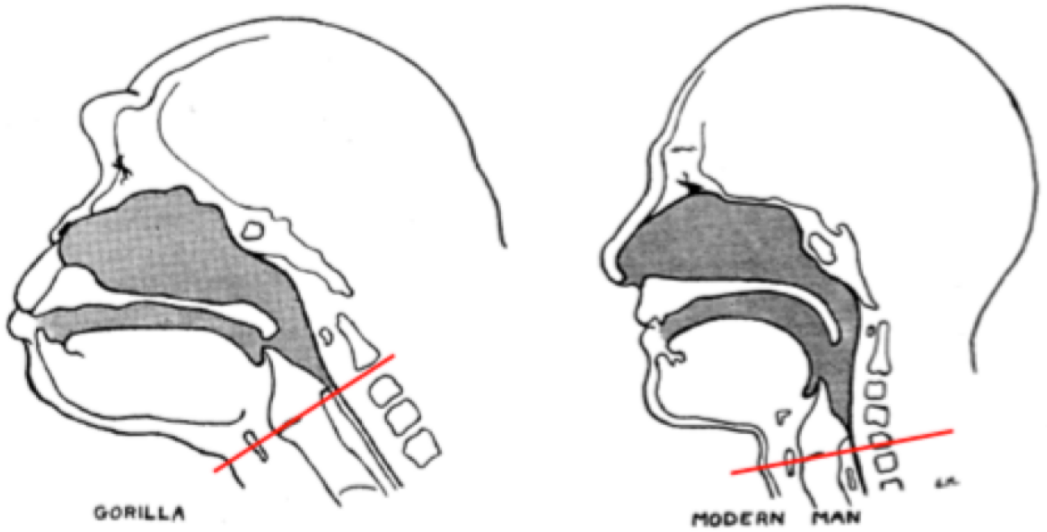
  http://www.youtube.com/watch?v=_6479QAJuz8

How about primates?

- Can language be taught to apes?
  - Kanzi and Novel Sentences:

  https://www.youtube.com/watch?v=2Dhc2zePJFE&ab_channel=IowaPrimate.LearningSanctuary

Primate vocalizations



How intelligent are apes?

- Several apes were able to understand “make the doggie bite the snake” , and “make the snake bite the doggie”
- They could also follow commands that involved moving objects to or from specific locations
- Sarah, a chimpanzee, could understand “if/then” statements

- Method 2.1. “Minding the gap between behavior and knowledge”

Interim summary

- Human-reared apes can learn
  - more words or symbols than they do in the wild

  - More importantly, they can also show some of the design features such as *productivity, displacement*

- Evolutionary adaptation
  - "If language-related capabilities evolved long before human diverged from other apes, then why do only humans make use of them in their natural environments?"

Something amazing!

- https://www.youtube.com/watch?v=zsXP8qeFF6A&t=10s&ab_channel=BBCEarth (Chimp vs Human! | Memory Test | BBC Earth)
  - Japanese researcher Tetsuro Matsuzawa of Kyoto University did this study
- human ancestors gave up much of this skill over evolutionary time to make room in the brain for gaining language abilities

(Elizabeth Lonsdorf, director of the Lester E. Fisher Center for the Study and Conservation of Apes at the Lincoln Park Zoo in Chicago, Illinois)

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The social underpinning of language

--- the ability to understand communicative intent

Tomasello (2006)

- Why don’ t apes point?
  - Apes ignore the pointing that intents to help them

  - But they do understand intentions and goals

    e.g., if the human intends to touch the food but cannot, apes can understand the intention ,and infer there is food

  - What’ s the difference?

    Tomasello (2006): (helping) pointing involves an *intention* to *communicate*

Tomosello (2009)

- *Why We Cooperate?*
  - Chimps are less altruistic than humans

- ***Joint attention***: the awareness between two or more individuals that they are paying attention to the same thing
  - No clear evidence that chimps participate in situations where Chimp A knows that Chimp B knows that Chimp C is … (e.g., staring at the same thing)

  - Evidence from human babies: Morales et al., (2000) at Researchers at Work 2.1. (p. 24, or ebook p.36-37)

A sample study

Source: follow APA style

Question and Hypothesis: very concise (more likely use your own words)

Source: M. Morales, P. Mundy, C. E. F. Delgado, M. Yale, D. Messinger, R. Neal, & H. K. Schwartz. (2000). Responding to joint attention across the 6- through 24-month age period and early language acquisition. *Journal of Applied Developmental Psychology* 21, 283–298.

Question: Does the ability to engage in joint attention support language development in young children?

Hypothesis: Toddlers who are better able to respond to adults' overtures of joint attention will go on to develop larger vocabularies

Test A: Children's ability to respond to joint attention was tested at 6, 8, 10, 12, 15, 18, 21, and 24 months of age. An adult (the child's parent at 6 months, a researcher at older ages) sat across from the child. After getting the child's attention, the adult looked and pointed at a target object that was either 90 degrees to the right or left of the child or 180 degrees behind the child, while saying the child's name (see **Figure 2.3**).

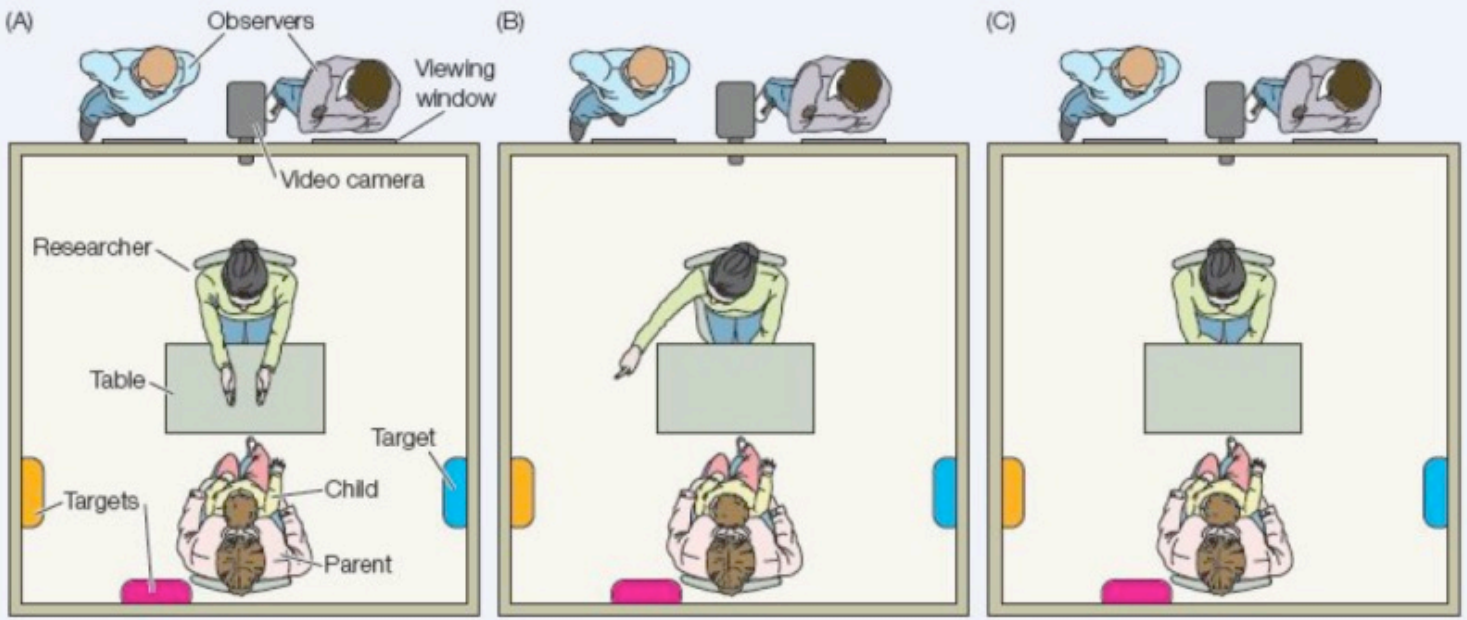

Figure 2.3 Testing a child's responsiveness to an overture of joint attention. An adult researcher sits across from the child (seated in the parent's lap). The researcher first gains the attention of the child by clapping and singing (A), then turns her head to look at and point to a target object while saying the child's name. (B). Between trials, the researcher returns her gaze back to the child (C). A videotaped record is later coded to determine where the child looks in response.

Depending on the age of the child, either three or six such trials were presented. The child's response was videotaped and later coded by three separate coders who judged the child's direction of gaze; the coders were not aware of the results of the subsequent vocabulary assessments.

Methods:

Using pictures/videos

- Clear
- Creative
- Vivid

Reader-friendly to researchers, as well as plain readers

Test B: Children's vocabulary was assessed at 24 months and again at 30 months by having their primary caregivers fill in a standardized vocabulary checklist (the MacArthur Communicative Development Inventory, MCDI), indicating which of the listed words their child could produce. In addition, the children were tested in the lab at 30 months using standardized tests to assess which words they could produce (the Peabody Picture Vocabulary Test, PPVT) or understand (the Expressive Vocabulary Test, EVT)

Results: Statistical tests confirmed an association between joint attention skills and vocabulary size: the more frequently children looked at the correct object in response to the adult's joint attention overture, the larger their vocabularies tended to be (see **Table 2.1**). Joint attention skills between 6 and 18 months were especially predictive of later vocabulary size, after which age there was less variation in joint attention abilities.

Conclusion: Babies' ability to engage in joint attention predicts their vocabulary size as much as 2 years later, suggesting that this social skill is important for learning new words (you will read more about this in Chapter 5). But, like all studies that look for *correlations* between two variables, it's not possible to draw a definite conclusion that joint attention skills play a *causal* role in word learning. It could be that both of these variables are themselves due to a third causal variable—for example, it could be that both joint attention and word learning depend on higher general intelligence, or that both skills depend on how much parents interact with the child on a daily basis.

Questions for further research

1. What kind of study could you design that would allow you to be more confident about concluding that joint attention plays a causal role in word learning?
2. Do joint attention skills in non-human primates predict their ability to learn words?
3. Are joint attention skills related to other aspects of language development besides word learning?

TABLE 2.1 Associations between joint attention and vocabulary measures

Vocabulary level	Performance[a] on joint attention test, at age in months								Aggregate score
	6	8	10	12	15	18	21	24	
MCDI (24 months)	**0.43**	0.07	–0.22	**0.46**	0.28	–0.25	0.02	0.24	0.33
MCDI (30 months)	0.57	0.18	0.30	–0.06	0.35	0.16	–0.19	0.22	**0.55**
EVT (30 months)	0.09	0.41	**0.46**	0.01	0.35	**0.48**	–0.12	–0.38	**0.66**
PPVT (30 months)	**0.44**	**0.45**	**0.59**	0.06	0.24	0.29	–0.05	–0.11	**0.65**

Adapted from Morales et al., 2000, *J. Appl. Dev. Psych.* 21, 283.

[a]*Performance* is represented by correlation scores (from Spearman rho analyses); 0 represents no correlation at all between the two variables (vocabulary level and assessed joint attention level), 1 would be a perfect correlation between variables in the same direction, and –1 would be a perfect correlation in opposite directions. Scores reaching the threshold of statistical significance (i.e., less than 5% likelihood to have arisen by chance) are indicated in **bold type**.

Interim summary

- Being able to take part in complex social activities that rely on mutual coordination is closely tied to the emergence of language

- But the deeper question: is it from our biological evolution history or cultural heritage? We don’ t know yet.

- Other skills involved? Yes.