Philosophy of Cognitive Science

Chomsky's Linguistics

I. BACKGROUND

Noam Chomsky

- Born, 1928
- Ph.D. at the University of Pennsylvania, studying under Zellig Harris
- Hired at MIT in 1955
- In 1957 publishes *Syntactic Structures*, which builds on transformational grammar and develops "generative" grammar.
- A generative grammar is a (unconscious) mechanism comprised of a finite set of rules for generating all the grammatical sentences of language.
- Generative grammar ultimately revolutionizes the field of linguistics:
    - *Inner States.* Argues for contribution of inner rules and representations.
    - *Universals over Differences*. Differences between languages are only important because they reveal the range of possible settings for universal rules.
    - *Mechanisms over Taxonomy*. Tries to formally describe the mechanisms of language production rather than making taxonomy of sentences in a particular language.
- Chomsky has also been an influential critic of U.S. foreign policy

II. OVERVIEW OF CHOMSKY'S CRITIQUE OF SKINNER

1. Skinner's view of language

- Language learning occurs through behavioral reinforcement, and can be analyzed using the same concepts used in conditioning studies of animals
- Verbal behavior is lawfully dependent on external stimuli

2. The Dilemma Posed by Chomsky

Horn 1. If we restrict the terms 'stimulus' and 'response' to cases in which they are lawfully related (as they are used in animal studies), Skinner's analysis will fail to subsume most linguistic behavior.

Horn 2. If we use the terms 'stimulus' and 'response' to cover any event that impinges on an organism and any linguistic behavior, there will be no lawful relationship between stimuli and responses.

> To escape from this dilemma (to secure a more law-like relationship between stimuli and responses), Skinner must covertly reintroduce mental states.

3. Supporting Arguments

In animal studies, behavior is under law-like control of stimuli and histories of reinforcement. A response will be strong if it has been reinforced by external conditions in the past.

Chomsky thinks this can't be true for linguistic behavior, because:

Objection: **Response Variability**

- The sentences we produce in response to a given stimulus can vary dramatically (seeing a red chair can make some one say "red" or "chair" or any number of other things)
- **Covert Mentalism.** To reply, Skinner might argue that the stimuli affecting us are not whole objects and events, but subtle properties of objects and events (e.g., the chair's redness on one occasion and its chairness on another). This surreptitiously re-introduces the mind: the property that a person responds to is a function of what she attends to, notices, has interest in, likes, etc.

Objection: **Absent Reinforcers**

- In animal studies, reinforcers are always real events that occur prior to the behavior they reinforce
- Factors that reinforce linguistic behavior need not impinge on the organism (e.g., writer reinforced by response of readers centuries later)
- They need not even exist (e.g., writing a book that no one ends up reading)
- **Covert Mentalism**. In linguistic behavior, 'reinforcement' is really a cover-term for mental notions such as 'likes' and 'wants'

4. Summary and Conclusion

- Stimulus and reinforcement can only determine linguistic behavior if they are interpreted mentalistically. E.g., a 'stimulus' can be defined as what a speaker notices, and 'reinforcement' can be defined as what a speaker wants to mention.
- To explain linguistic behavior, we must embrace mentalism and develop a detailed theory of the mental factors and conditions that determine speech.

III. CHOMSKY'S POSITIVE VIEWS

1. Facts to Be Explained

Linguistic Creativity

- There is an unbounded number of possible sentences

    Greta ate one worm

    Greta ate two worms

    Greta ate sixty million four hundred and twelve worms ...

The worm that the man squashed died

The worm that the man that wears gloves squashed died

The worm that the man that wears gloves that glow in the dark squashed died ...

She said the he is a moron

She said that he said that he is a moron

She said that he said that she said that he is a moron...

- Most sentences have never been uttered before, and will never be uttered again
- We achieve these unbounded abilities with a finite resource: the brain.

Grammaticality Judgments

- We can judge whether completely novel and even nonsensical sentences are grammatical

Colorless green ideas sleep furiously.

Vs.

Furiously sleep ideas green colorless.

Also consider apparent grammaticality of:

'Twas brillig, and the slithy toves

Did gyre and gimble in the wabe:

All mimsy were the borogoves,

And the mome raths outgrabe.

(from Lewis Carroll's "Jabberwocky")

- We can, in principle, determine the grammaticality of sentences that are arbitrarily long and complex (though, this might be impossible in practice, because of fatigue, memory limitations, and limited life times)

Going Beyond Appearances (Abstractness of rules)

- - Sentences that are superficially alike have different underlying structures

- E.g., Structurally ambiguous sentences

They are visiting relatives.

Flying planes can be dangerous.

- E.g., these look alike:

Natasha expected Boris to kill Rocky.

Natasha persuaded Boris to kill Rocky.

But only the first preserves meaning in passive:

Natasha expected Rocky to be killed by Boris.

Natasha persuaded Rocky to be killed by Boris.

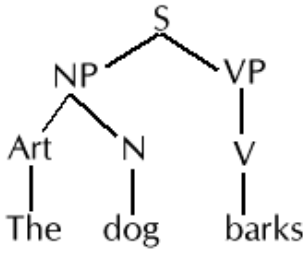
2. Mental Grammar

- To understand and produce novel grammatical sentences, we must use generative rules (rules that generate novel sentences from finite means).
- Chomsky calls a system of such rules a "grammar"
- He calls the set of sentences that a grammar can produce a "language"
- A "grammar" will contain:
- *A syntactic component*: rules for generating phase structures (and for transforming one phrase structure into another, e.g., active to passive)
- *A semantic component*: rules for determining meanings
- *A phonological component*: rules for determining sounds

2. Phrase Structure Trees

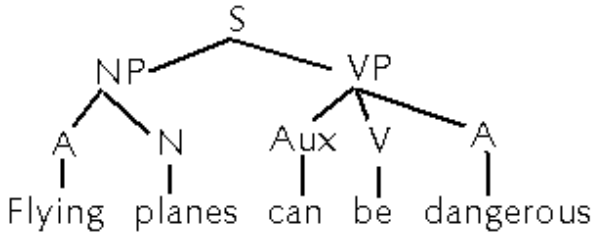
We mentally represent the grammatical structure of sentences, not just the sequence of words. (The following trees are highly simplified; they are designed to give a flavor of one of the kinds of representations that generative grammarians invoke)

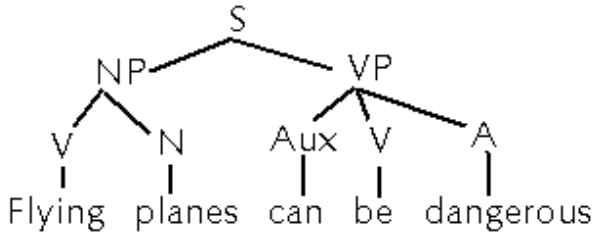
The dog barks



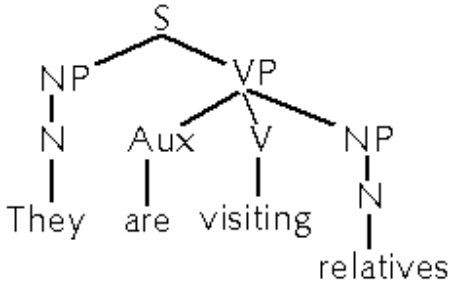
Structural Ambiguities

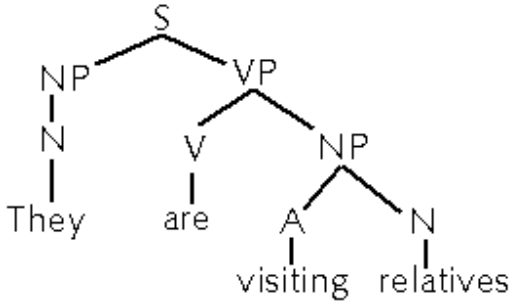
Flying planes can be dangerous





They are visiting relatives

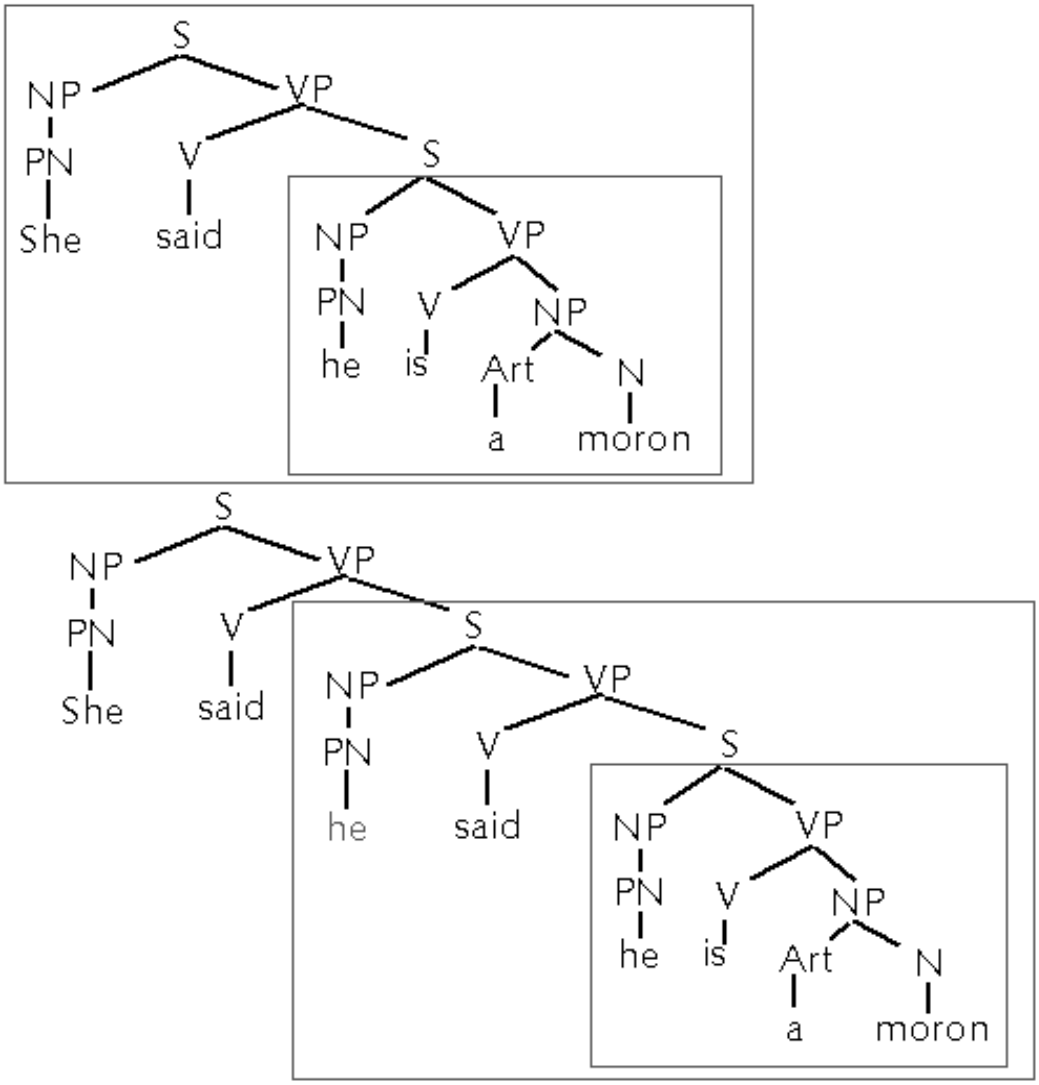




Unbounded Production

She said he is a moron

She said he said that he is a moron ...



Going beyond Superficial Similarities

These look alike:

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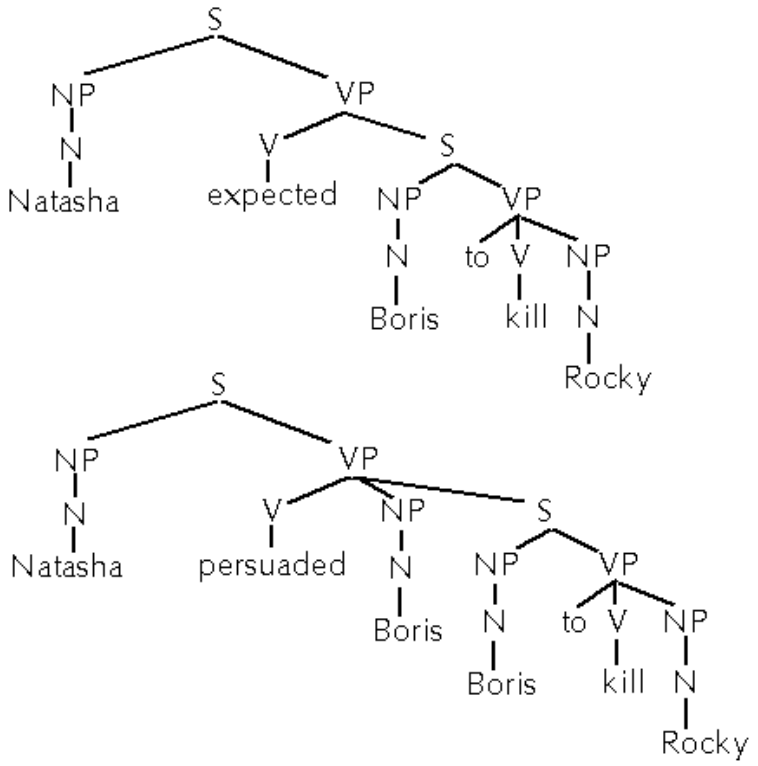

4. Some of Chomsky's Methodological conclusions:

- Linguistics should study the nature of mental grammar (I-language)

- In recent writings, Chomsky has introduced the term, I-Language for the mental grammar.
  - E-Language corresponds to the languages we speak and share
  - "Correct" use of E-language depends on the community. It is a sociopolitical construct.
  - "Correct" use of I-language can only be measured relative to an individual. Does a particular sentence that I produce conform to the rules in my head.

- *Competence vs. Performance*
  - Chomsky distinguishes the underlying knowledge of language (the generative rules that can produce all possible sentences) from the way language is actually used in practice (e.g., the way we produce or interpret a particular utterance on a particular occasion).
  - He calls these 'competence' and 'performance', respectively
  - Language performance may be affected by such things as attention, stamina, memory, and beliefs about our interlocutors. All of these things lie outside of a theory of grammar proper.
  - Therefore, a theory of language should be a theory of competence.
  - Once a full theory of competence is developed, it can be integrated into a theory of performance, which will take into consideration what we know about other cognitive abilities.

- • Skinner (and others before Chomsky) failed to make this distinction and focused prematurely on linguistic performance.

III. NATIVISM: HISTORICAL BACKGROUND

Rationalists:

Plato

Descartes, Leibniz

Empiricists:

Locke

Behaviorists

Moral dimensions of Empiricism

- o Locke on religious tolerance (religious beliefs not innate)
- o Behaviorists contra eugenics (intelligence and personality not innate)

IV. CHOMSKY'S NATIVISM

1. Chomsky's Nativist Thesis:

Humans are born with an innate mechanism for acquiring an understanding language. This consists in a universal grammar (UG), which establishes the set of possible grammars, and a language acquisition device (LAD), which allows one to select a particular grammar from that set based on limited data.

This innate endowance is:

- *Domain specific* (designed specifically for language)
- *Modular* (not affected by other cognitive systems)

Contrast with historical nativism:

- Historically, innate logical and religious principles were emphasized
- Eugenics emphasizes innate intelligence and personality
- In contrast, Chomsky emphasizes linguistic rules
- No obvious moral price tag.

2. Chomsky's View of Linguistics

1. Goal.

The linguist should try to characterize UG and LAD.

2. Constraints.

In constructing a theory of the UG and LAD, the linguist must account for:

- The range of languages people can speak
- The speed and data limitations under which languages are acquired

Satisfying 1 and 2 can be regarded as an engineering problem.

Principles and Parameters

In recent work, Chomsky has conceived of the innate endowance as a set of universal principles, shared by all languages, and a set of universal parameters, with different possible settings.

Parameter example: prepositions can either come before nouns (English) or after nouns (Japanese) in a prepositional phrase.

V. CHOMSKY'S ARGUMENTS FOR NATIVISM

Poverty of the Stimulus:

1. Minute Sample. Children are only exposed to a minute sample of sentences, and these are consistent with numerous possible rules that the child never entertains.

a. John expects the class *to* end soon.

b. The class is expected *to* end soon.

c. John expects the class *will* end soon.

d. The class is expected *will* end soon.*

2. Degraded Sample. Those sentences are often degraded (i.e., ungrammatical), and ungrammatical sentences uttered by a child are often approved.

Child: her curl my hair [said while the mother curls her hair]

Mother: Yes, that's right [approved because of true content]

(from a study by Roger Brown)

Linguistic Universals

3. Universals. The are linguistic universals, which can't be explained by 'common descent'. (E.g., syntactic categories, phonological features, grammatical principles.)

Inadequacy of Empiricist Learning Theories 1: Domain Specific Learning Rules

4. Intelligence Independence. Vast differences in intelligence have only small effect on linguistic competence.

5. Early Acquisition. Language is acquired when a child's other mental capacities are limited.

6. Species Specificity. Great apes and other non-human creatures can't learn language.

Inadequacy of Empiricist Learning Theories 2: Learning Goes beyond Superficial Properties

7. Structure Sensitive Rules. The grammatical rules we use are not simple extrapolations from the superficial properties of sentences. Instead they are sensitive to underlying structure.

The man is insane ® Is the man insane?

Rule 1 (simplest): find first *is* in the sentence and move it to the front.

Rule 2 (complex and structure sensitive): find the *is* that is in the highest clause in a tree representing the sentence's structure and move it to the front.

The man who is insane is running for office ®

Is the man who insane is running for office? (Rule 1) *

Is the man who is insane running for office? (Rule 2)

8. Creativity. Linguistic creativity precludes empiricist theories of language acquisition, because many novel sentences are cannot be generated by imitating sentences that have been experienced.

9. Abstractness. Language understanding goes beyond superficial properties of sentences; therefore, sentences cannot be represented as mere copies of experience.

Who is leaving?

Harry appeared to Sally to leave

Harry appealed to Sally to leave

(See also earlier examples)