The syntax of language

- How do we form sentences?
- Processing syntax.
- Language and the brain.

Productivity (again)

- We can combine words into new sentences
  - The brown dog ate some smelly food.
- If we know a word, we can use it in a variety of different sentences.
  - The smelly dog ate some brown food
  - How are we able to form these new sentences
- A limited set of basic units (words)
  - A set of rules for combining words (grammar)

Syntax

- The grammatical structure of a language
- Languages have a structure that determines how words are put together to form sentences
- Types of words
  - Nouns: Refer to objects, concepts and locations
  - Verbs: Refer to actions or states.
    - Verbs structure a sentence
  - Modifiers: Used to add information to nouns and verbs
  - Structural words: Prepositions, articles
    - These are *closed class words*

Forming sentences

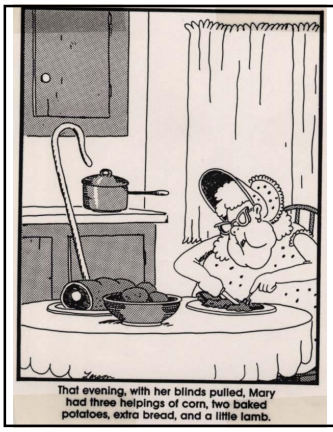
- Words are combined to form sentences
- English is a word order language
  - Syntax is based (mostly) on word order
  - Most languages are *case* languages
    - Prefixes and/or suffixes are added to words to indicate the role they play in a sentence.

Grammatical rules

- Most grammars involve *rewrite rules*
  - Here are some examples
- S = NP + VP
- NP = (Art) + (Adj) + N [A big dog]
- VP = V + NP [bought a dress]
- VP = V [sang]
- V = V + NP + PP [brought his friend to the party]

Sentence Production

- When speaking, create a sentence that follows the grammatical rules
  - Person must first have a thought
  - The thought is translated into language
- Sometimes different thoughts can lead to the same sentences



Mary had a little lamb...

Another example

- Sarah saw a man eating shark
- [[Sarah]$_{NP}$ [saw [a man]$_{NP}$ [{who was} eating shark]$_{S}$]$_{VP}$]$_{S}$
- [[Sarah]$_{NP}$ [saw [a man eating shark]$_{NP}$]$_{VP}$]$_{S}$
- The same sentence can be *parsed* into two different structures.
  - The structure influences the meaning
- The productivity of language leads to *ambiguity*
- We rarely notice this ambiguity (except in jokes)

How do we process sentences?

- We do not have a whole sentence in front of us to process
  - We hear one word at a time
- We hold a few words in working memory
  - We must parse a sentence as it comes in
  - As always, we use constraints
    - Our parser makes guesses about sentences

The cat sat on the mat.

Syntactic illusions

- Constraints can sometimes cause problems
  - *Garden Path Sentences*

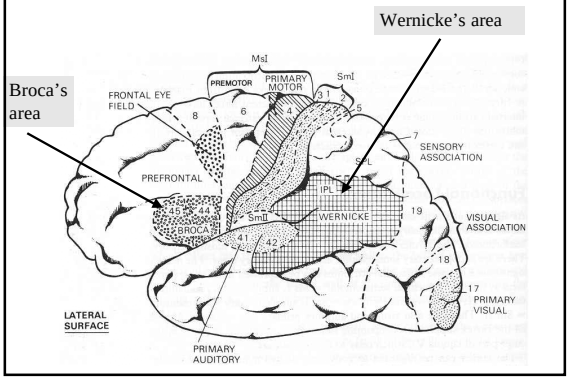
The horse raced past the barn fell.

- People do not typically produce sentences like this.

Language and the brain

- Many observations of language disruptions following brain damage.
- Language appears to be localized in the left hemisphere.
  - Some left-handed people are lateralized differently
- Types of language disruptions
  - Aphasia: Disruptions of language processing
  - Agnosia: Disruption of naming

Some important brain areas for language



Aphasia

- There are many types of aphasia
  - Each is characterized by particular deficits
- Two common types of aphasia
  - Broca's aphasia
    - Grammatical problems
    - Speech is telegraphic
    - English comprehension focuses on word order
  - Wernicke's aphasia
    - Fluent grammatical processing
    - Disruption of semantic performance
    - Speech is "word salad"

May involve too little activation in semantic network

May involve too little inhibition in semantic network.

Agnosia

- People have trouble naming objects
- Can be specific to particular categories
  - Vegetables, artifacts
- Prosopagnosia
  - Specific to faces
- Not a perceptual deficit
  - People can describe the objects
  - Can draw them accurately
  - The connection between the perceptual representation and the label is damaged.

Language and intelligence

- Williams syndrome
  - Preserved language abilities
  - Severely impaired cognitive abilities
- Suggests that the ability to learn words and form sentences is not just a component of general intelligence
- Language learning
  - We learn language differently from many other things
  - Language is learned incidentally
  - Language learning is worse in adults than in children
    - For most cognitive abilities, the opposite is true.

Summary

- Syntax allows languages to be productive
- Can characterize syntax as a set of grammatical rules
- Parsing (finding the syntactic form of a sentence)
  - Must be done “on-line”
- Language and the brain
  - Aphasia
  - Agnosia