# The Mental Lexicon

Ask anyone what the basic building blocks of a language might be - **Words**
This much is obvious, but the rest is a complete mystery.

We can start at the beginning by asking a simple question – **What is a word?**

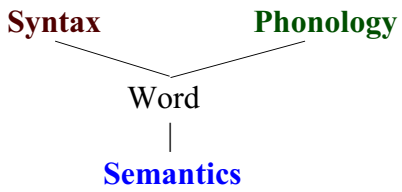
The Merriam-Webster online dictionary defines 'word' as:

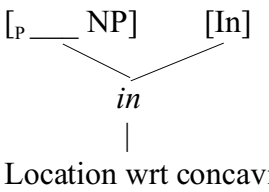
*1*
*a: something that is said*
*b plural (1): <putting one's feelings into words> (2): the text of a vocal musical composition*
*c: a brief remark or conversation <would like to have a word with you>*

*2*
*a (1): a speech sound or series of speech sounds that symbolizes and communicates a meaning usually without being divisible into smaller units capable of independent use (2): the entire set of linguistic forms produced by combining a single base with various inflectional elements without change in the part of speech elements*
*b (1): a written or printed character or combination of characters representing a spoken word <the number of words to a line> —sometimes used with the first letter of a real or pretended taboo word prefixed as an often humorous euphemism <the first man to utter the f word on British TV — Time> <we were not afraid to use the d word and talk about death — Erma Bombeck> (2): any segment of written or printed discourse ordinarily appearing between spaces or between a space and a punctuation mark*
*c: a number of bytes processed as a unit and conveying a quantum of information in communication and computer work*

Which of these definitions comes closest to the definition of 'word' in the textbook?
What is the linguistic definition of a word?

Words play in unifying information from different parts of the grammar.




Acquire a language by acquiring words & their associated grammatical features.

Because words connect sound and meaning, their properties can vary radically across different languages.

Linguists make rough distinctions between languages based on the number and types of morphemes contained in words. You can classify languages along a scale of **synthesis**, e.g.,

**Analytic** or **isolating** languages have few if any bound inflectional morphemes

Vietnamese

khi tôi đên nhà bạn tôi, chúng tôi băt dâù làm bài
when I come house friend I, PLURAL I begin do lesson
'When I came to my friend's house, we began to do lessons.'

**Synthetic** languages have bound inflectional morphemes. There are two types of synthesis:

**Agglutinating** languages are synthetic languages with clear boundaries between bound morphemes

Beja

tam-y-aa-n-ee-t
eat-3sing-past-plural-relative_clause-feminine_object
'(food) which they ate'

rih-y-aa-n-hook
see-3sing-past-plural-2per_object
'They saw you'

**Fusional** languages are synthetic languages in which a single morpheme encodes several functions

Russian

| Declension | **Ia**: stol 'table' | | **II**: lipa 'lime tree' | |
|---|---|---|---|---|
| | **Sing** | **Plural** | **Sing** | **Plural** |
| Nominative | stol | stol-y | lip-a | lip-y |
| Accusative | stol | stol-y | lip-u | lip-y |
| Genitive | stol-a | stol-ov | lip-y | lip |
| Dative | stol-u | stol-am | lip-e | lip-am |

**Polysynthetic** languages combine nouns, verbs, etc. into a single word

Siberian Yupik

angya-ghlla-ng-yuq-tuq
boat-augmentative-acquire-desiderative-3sing
'He wants to acquire a big boat'

Agglutinating and Polysynthetic languages typically use a single word to express what English and other analytic languages express as combinations of words in a sentence.

Words in analytic languages can contain many morphemes, e.g. deoxyribofuranose and

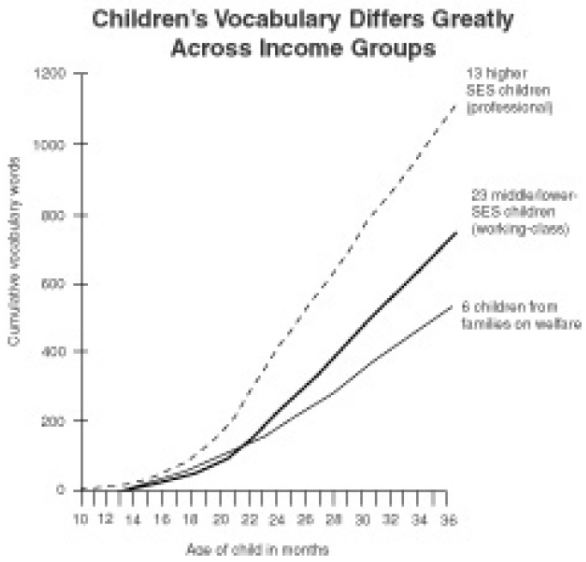
4-methylcyclohexanemethanol. These words are usually combined with other words to form a sentence in English, e.g. '4-methylcyclohexanemethanol (MCHM) is a chemical used to process coal.'

We'll investigate other properties of words later in the semester.
For now focus on general properties of our mental lexicons

## Size

Psychologists have long known vocabulary size is strongly correlated with measures of intelligence. Most intelligence tests rely heavily on measures of vocabulary size.

Hart and Risley (1995) studied the vocabulary of children growing up in 42 households in the Midwest. 13 of the families were upper socioeconomic status (SES), 10 were middle SES, 13 were lower SES, and six were on welfare. In words heard, the average child on welfare was having half as much experience per hour (616 words per hour) as the average working-class child (1,251 words per hour) and less than one-third that of the average child in a professional family (2,153 words per hour). A linear extrapolation from the averages in the observational data to a 100-hour week (given a 14-hour waking day) shows the average child in the professional families with 215,000 words of language experience, the average child in a working-class family provided with 125,000 words, and the average child in a welfare family with 62,000 words of language experience. These differences in exposure result in dramatic differences in the number of words that the children in these families produced.




Let's start with a simple question and ask **how many words do we know?**

5,000 10,000 50,000 100,000 500,000 1,000,000?

Bryson (1990: 140) states:

> Many scholars have taken the trouble (or more probably compelled their graduate students to take the trouble) to count the number of words used by various authors, on the assumption ... that that tells us something about human vocabulary. Mostly what it tells us is that academics aren't very good at counting.

Shakespeare is a favorite target of such research and shows that estimates can vary widely:

| | |
|---|---|
| Pei & McCrum | 30,000 words |
| Lincoln Barnett | 20,000-25,000 |
| Shipley & Cable | 17,677 |

How many words do you know? How would you find out?

One approach would be to check how many words you know in a dictionary.

Start by checking how many of the words on a page you recognize

No. of words = proportion of recognized words x no. of words in dictionary

(Seashore & Eckerson. 1940. The measurement of individual differences in general English vocabularies. J. of Educational Psychology 31.14-38)

What factors influence your result?

1. How does the size of our dictionary affect your estimate?

The size of English dictionaries has increased exponentially over the last 400 years

| | | | |
|---|---|---|---|
| Robert Cawdrey | Table Alphabeticall | 1604 | 2,500 words |
| John Kersey | New English Dictionary | 1702 | 28,000 |
| Samuel Johnson | Dictionary | 1755 | 40,000 |
| Noah Webster | American Dictionary | 1828 | 70,000 |
| Noah Porter | Dictionary of English | 1864 | 114,000 |
| Isaac K. Funk | New Standard Dictionary | 1913 | 450,000 |
| Revised Oxford English Dictionary | | 1989 | 615,000 |

(Bryson 1990: 139; Miller, 1991: 135)

2. **What counts as a word?** What does your dictionary count as a word?

Divide no. of words by no. of pages = average no. of words per page

How does this estimate correspond to what you find on the page?

Dictionary counts all boldface entries

*forget*, *forgot*, *forgotten*, *forgetting*, *forgettable*, *forgetter* & *forget oneself*
*forgetful*, *forgetfully* & *forgetfulness*

1. Should we count all of these? 2. Why are they arranged in two separate entries?

**Free form** / free morpheme

a. occur in isolation

b. separable from other words

Are all of the entries under *forget* free forms? Are they separate, but equal?

They are inflected forms of the word *forget*. Demonstrate various types of affixation:

| | |
|---|---|
| inflection | forg**o**t, forgott**en**, forgett**ing** |
| derivation | forgett**able**, forgett**er**, forget**ful**, forget**fulness** |
| compounding | **forget oneself** |

Reason to think these forms are stored differently in our minds
**inflection** does not change meaning significantly-predictable
**derivation** sometimes produces unpredictable semantic changes

compare *forgetter*; *walker*-2 entries; *teller* (bank)
exceptions *$a\ forget_N$ (c.f. $a\ report_N$); **unforget*; **reforget*
compounding usually results in unpredictable semantic change
*forget oneself*: lose self-restraint

**K'iche' Maya** compounds

| | |
|---|---|
| saqa b'ala:m | raxa:l q'ana:l |
| white jaguar = ocelot | greeness yellowness = glory |
| b'aqwach tap | rax te:w |
| eye crab = hangnail | green cold = malaria |

Inflected forms are predictable from their part of speech and meaning
In other words, they can be generated on the fly by the grammar

Many derived forms and most compounds have unpredictable meanings
They must be stored in the mental lexicon.

There are many other processes we use to make up new words:
**Conversion**, e.g., target (V) from target (N)
**Acronyms**, e.g., radar (from radio detecting and ranging)
**Abbreviations**, e.g., tv, id, wc, vd, oj, aids
**Blends**, e.g., spam (spiced/ham), smog (smoke/fog), spork (spoon/fork)
**Clippings**, e.g., Alex (from Alexander), doc (from doctor), rent (from parent)
**Backformations**, e.g., enthuse (from enthusiasm), donate (from donation), pea from pease
**Coinage**, e.g., xerox, kleenex
**Onomatopoeia**, e.g., meow, cheep, ribbit

3. Make a distinction between words we use and words we recognize
= production vs. comprehension lexicons

What do you know about the words that you recognize?
What is the difference between *rank* and *rancid*, *tall* and *high*?
Can you define the meaning of *the*, *is*, *incongruent*?

Words frequently have more than one meaning, e.g., *net*, *press*, *break*
Look up the meaning of *step*

1 a rest for the foot in ascending or descending
2 an advance or movement made by raising the foot and bringing it down elsewhere
3 a: the space passed over in one step
b: a short distance
c: the height of one stair

5 a degree, grade, or rank in a scale
6 a frame on a ship designed to receive an upright shaft;
7 an action, proceeding, or measure often occurring as one in a series
8 a steplike offset or part usually occurring in a series
9 an interval in a musical scale
10 step aerobics
11 a slight lead in or as if in a race <has a step on the competition>

Should we count these different uses as different words?

For all of these reasons, estimates of average vocabulary size vary considerably

Seashore & Eckerson: 58,000 basic words
1,700 rare basic words
96,000 derivatives and compounds
> 150,000 total

Nagy & Anderson 45,453 basic words
42,080 semantically opaque derivatives & compounds

estimate average high school graduate knows 45,000

Diller 1978 estimated ~ 250,000 total words for college students
Language Files (tenth edition, p. 381): 40,000-60,000

These estimates are 100 to 1,000 times greater than the most optimistic counts of animal signs. Underline the quantitative difference between human language & forms of animal communication

## Speed

Once we have an estimate of vocabulary size we can begin to estimate the speed of lexical look up

Imagine going through an unorganized list of words to see if it contains the word *boat*
You find the information faster in a dictionary, but this still takes time

Normally speak at a rate of 6 σs/sec ~ 3-4 words
Native speakers recognize a word in 200 msecs (1/5 of a sec) from the beginning of the word
Often well before all of the word is heard

A speech shadowing task is a traditional technique to test access speeds

Subjects repeat what they hear in headphones
Good shadowers can repeat with a delay of 250-275 msec
Subtract 50-75 msec for time to convert word to speech
-> 200 msec for word recognition (= 1/5 sec.)

Ask yourself whether *plid* is a word

Took my 90 MHz laptop about 2 secs to respond Its lexicon is much smaller than mine

Assuming that you have a basic vocabulary of 60,000 words
and search through them at the rate of 100 words/sec
It would take 10 minutes to search through your entire lexicon

The size of the average lexicon and the speed of lexical access
(I'll add the ease of lexical acquisition, too)
point to a systematic organization for the lexicon

There are tradeoffs between the size of the lexicon and access
Imagine trying to cram books into a room. Cram the maximum no. by simply stacking the room full. That technique won't improve access speed, though.

## Accuracy

We occasionally make mistakes in the retrieval process

Mistake nonwords for real words: *concision*

Confuse *reluctant* (unwilling) and *reticent* (unwilling to speak)
*deprecate* (disapprove) and *depreciate* (lower in value)
*foreboding* (ominous) and *forbidding* (dangerous)
*effect* (cause) and *affect* (influence)

Speech errors or slips of the tongue (or pen) show that lexical access isn't a simple mechanical search.

Most confusions due to similarities in pronounciation and/or meaning.

More frequently used words are accessed faster and more accurately

We are also constantly updating our lexical store to reflect the lexical environment
What do you put groceries into at Dillons (a bag or a sack?)
No computer has the power to invent new words: *spork* (spoon + fork)
We recognize the gaps in our dictionaries
starve s.o. out by denying them food; what about denying s.o. water?

Intelligently organized, dynamic store of lexical information
available to every user of a human language.

## Production

What do we know about the word production process?

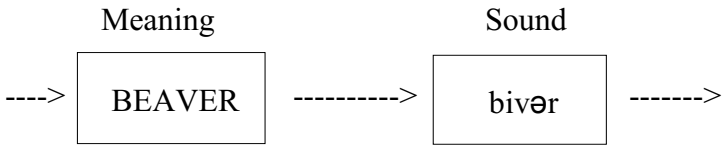
Evidence from slips of the tongue:

| | |
|---|---|
| MEANING | The *white* (=black) sheep of the family. |
| | They've *ended* (=started) the third week of their strike. |
| SOUND | A *reciprocal* (= rhetorical) question. |
| | The *audience* (ordinance) survey map. |

MEANING AND SOUND You're a *destructive* (= disruptive) influence.
Look at this *badger* (= beaver).

## The Stepping-Stone Model

Assume the parts of words are activated in sequence:



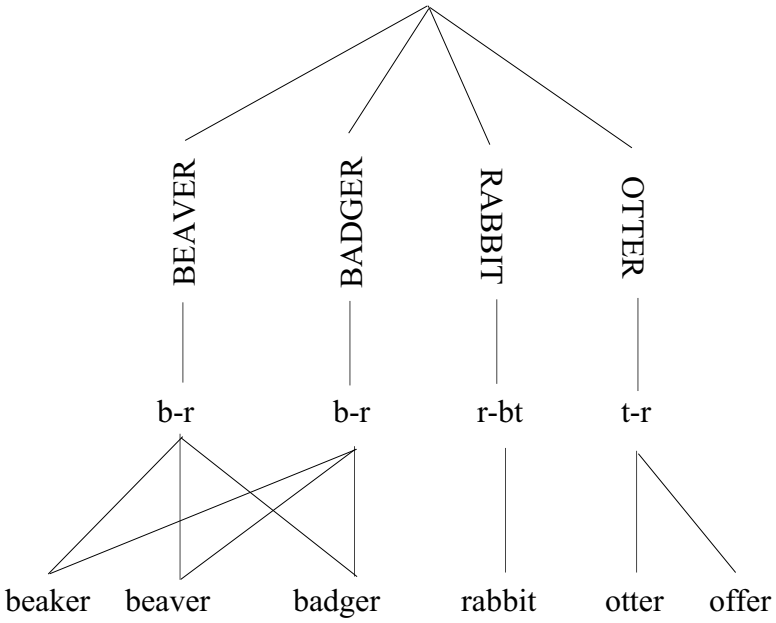

Assume multiple candidates are activated at each stage:

| | |
|---|---|
| OTTER | beaker |
| BEAVER | beaver |
| BADGER | badger |
| RABBIT | bearer |
| | begger |

The model predicts these errors will appear at each stage.
The model does NOT predict an interaction between meaning and sound
Most errors feature a similarity in meaning and sound.

## The Waterfall Model

The waterfall or 'cascade' model (McClelland 1979) makes all of the information from the semantic stage available to the phonological stage. Once a set of meanings has been activated, the information cascades down to the activation of sounds.




Problem: the waterfall model doesn't allow information to flow backwards. It's common to prompt people to recall a word by giving them an initial sound, e.g., think of a small woodland animal whose name begins with a *b*. The waterfall model shows how meanings activate sounds,

but not how sounds activate meanings.

## Neural Networks

The key to capturing lexical activation is allowing activation to spread in multiple directions: from meaning to sound and from sound to meaning. The progressive activation of possible candidates and the suppression of unlikely candidates continues until one word reaches a threshold. Frequently used words reach this threshold faster than infrequently used words.

## Comprehension

**The Cohort Model** provides one representation for the process of lexical recognition. It assumes lexical recognition proceeds in a left to right fashion sifting through all of the words which share the same initial sounds:

BEE
BEAVER ----------> BEAVER
BEETLE
BEGIN
bI vr

The Cohort Model is supported by word recognition studies that selectively erase sounds in the word. Erasing the initial sounds has a greater effect than erasing other sounds.

Psychologists have done most of the research on lexical access. Unfortunately, psychologists do not investigate lexical access in other languages. English has many suffixes and few prefixes. The root or base of English words almost always comes at the beginning of the word. Consider applying the Cohort Model to Navajo.

Navajo Verb (Young & Morgan 1987)

| Disjunct | | | Conjunct | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| ADV | ITER | DIST_PL | # DIR_OBJ | DEIC_SUBJ | ADV | MODE | SUBJ | CLASS STEM |
| a | <u>ná</u> | <u>da</u> | shi | ji | di | i | sh | 0 |
| ba | | | ni | ’a | hi | yi | ni | ɬ |
| ch’í | | | yi | <u>hwi</u> | li | ni | 0 | d |
| cha | | | bi | | si | si | iid | <u>l</u> |
| kéé’ | | | ha | | yi | <u>o</u> | <u>oh</u> | |
| k’í | | | ’a | | | | | |
| na | | | nihi | | | | | |
| so | | | <u>di</u> | | | | | |
| tá | | | | | | | | |
| ta’ | | | | | | | | |
| yá | | | | | | | | |

| | |
|---|---|
| ADVERBIAL | Manner, direction and indirect object |
| ITERATIVE | ‘over and over’ or ‘back again’ |
| DISTRIBUTIVE PLURAL | ‘each one separately’ |

| | |
|---|---|
| DIRECT OBJECT | Number and person |
| DEICTIC SUBJECT | Indefinite (‘someone’ or ‘people in general’) |
| ADVERBIAL | Adverbial/aspectual |
| MODE | Aspect (perfective, imperfective, progressive, optative) |
| SUBJECT | Person and number |
| CLASSIFIER | Voice and Transitivity |

In their introduction, Young & Morgan (1987) note that previous dictionary arrangements did not meet the needs of Navajo speakers, especially with reference to the treatment of verbs. Navajo verbs have many prefixes attached to their stems. Previous dictionaries would list the verb stem along with rules for deriving the full verb from the stem. Navajo speakers had difficulty isolating the stem and locating it in an alphabetical listing of stems in the dictionary, especially since many stems had alternative shapes.

The dictionaries provided meanings for the stems in terms of their closest English equivalents, but did not provide examples of the verbs used in actual sentences to illustrate their uses and their differences from English verbs. Verbs in Navajo and English rarely share the same semantic boundaries; they only approximate one another in meaning and use. An equivalent in one context may prove unacceptable in another.

Navajo has derivational prefixes and prefix complexes that function in combination with more than one stem set to derive lexical forms. These combinations allow speakers to generate many lexical items by a process of analogy. This process is a major source of new lexical entries.

Instead of listing the Navajo verbs by reference to their stems, Young & Morgan opted to list verbs in the first person singular of each Mode, using the Imperfective Mode as the principle entry form, abbreviated as (I), and followed by the Iterative Mode (R), the Perfective (P), the Future (F), and the Optative (O). They list Progressive (Prog) Mode forms separately, and translate the Navajo entries by English infinitives.

The lexical entries are followed by the stem classifier in parentheses, the definition, one or more examples showing the contexts of use of the form. They provide full verb paradigms with individual entries for constructions in which a given prefix or prefix complex occurs in less than three bases, and in tables where the derivational elements occur in a larger number of bases.

The Wikipedia article on the Navajo language provides some examples of Navajo verbs.

adisbąąs [‘a - di - sh - ł - bąąs] ‘I’m starting to drive some kind of wheeled vehicle along’
di’nisbąąs [di - ‘a - ni -sh - ł - bąąs] ‘I’m in the act of driving some vehicle (into something) & getting stuck’

Note how the ‘a- and di- prefixes switch positions between these two verbs.

## Dictionaries

Navajo speakers are frustrated by dictionaries that list words by stem without the inflectional prefixes. This frustration suggests that a speaker’s recognition lexicon may not correspond directly to the semantic lexicon. Documenting a spoken language requires sampling all of the words a speaker accepts as part of the language. What lexical domains need to be documented?

Lexical Categories in Kaufman and Justeson's Mayan Etymological Dictionary

Kinship and social organization
Thought and feeling/perception and evaluation
Color
Body arts and other parts; bodily processes
Animal parts
Location (place names)
Earth
Sky
Fire
Water and Liquides
Mammals
Birds
Reptiles
Turtles
Snakes
Lizards
Batrachians
Fish
Mollusks
Bugs
Speech and Interaction
Play, Dance, Music
Trade and Property
Manipulation
Tools
Buildings
Furniture
Containers
Clothing and Adornment
Agriculture
Plant Parts
Maize
Beans
Trees
Palms
Vines
Herbs
Grasses
"Pineapples"
Fungus
Eating
Taste
Life and Existence
Movement
Sickness
Magic
Quality

Shape
Quantity

Manner
Speed
Numerals
Names
Sounds (onomatopoeia)
Exclamations

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