

This supplemental reading is on a topic we do not have time to cover, and would require a couple of weeks to do it justice. It is only for you few that might be interested in thinking about the “meaning” in the “signal.”

The Nature of Language—Implications for SETI

[We will NOT cover this material, from here to the end of this set of notes, on the next, last exam because of time constraints. I am including this material in case you are interested—from the key terminology and issues, you can search for additional information (and many, many opinions).]

PROPERTIES OF HUMAN LANGUAGE

(Notice that this list is bound to be subjective)

- Uses **representational symbols** to stand for, or *represent*, something else—objects, places, actions, feelings, ...
Not simply *signals* (as in most animal calls? e.g. warning calls) but *representations* of objects or actions.
Also, these symbols are *arbitrary* – most bear no similarity to the objects or actions they represent.
- **Displacement** – can talk about things not physically present in space and time (or even imagined things).
- **Grammaticity** – words can be sorted into different grammatical categories, e.g. nouns, verbs, adjectives, ...
grammar = rules of combination that *generate* acceptable (i.e. grammatical) strings or sentences and none of the ungrammatical ones.
Notice that a sentence can be grammatically correct but meaningless ("Colorless green ideas sleep furiously" is Chomsky's famous example) or grammatically incorrect but make sense ("This sentence no verb"). Are grammar and meaning really independent? What is "meaning"? etc.
- Knowledge of these rules is **implicit** – most native speakers cannot tell you what the rules are. e.g. phonetic rules when pluralizing nouns. [Ironic that implicit knowledge of grammar is so easily achieved by most people in childhood, yet modern *theories* of grammar are so complex that they take many years to learn. Telling us something?]
- **Generativity** – no limit to number of different sentences we can produce or understand. Even if only one kind of sentence, e.g. "Article noun verb article noun" ("The person threw the ball"), could still generate a large number of sentences. But we achieve much greater "generativity" by the use of
 - a. **grammatical items** (as opposed to "lexical items" that have some kind of demonstrable referent), that express relations (e.g. above,...before,...many), possibility (...can, might,...), contingency (unless, until, although,...), agency (by), purpose (for), necessity (must), existence (be—a wierd one!), nonexistence (no, none, not),... More than half of words in sentences are gr. items. Note how very abstract, conceptual, and unconscious these are! Also, why only small fraction of possible relations in the world grammaticized?
 - b. **hierarchical** (nested) structure:
phonemes – (15-70; e.g. *rat, bat; not* letters or graphemes)

- >morphemes – (smallest units of meaning, e.g. dog, -s,-ed, un- ,...)
- >words – (in English, about 10,000 speaking, 100,000 reading)
- >phrases ———> sentences

Is there a biological, human-specific, brain module or circuit for language? A “language organ”?(This is the underlying theme in much of the language development and cognition literature.)

1. Phases of development of language in children

Apparently independent of social and economic conditions, cultures.

Suggests that neural "hookups" must be in place before succeeding steps occur.

But evidence now accumulating that *conceptual* development precedes language development; e.g. image schemas (notions derived from spatial structure, like container (in–out), trajectory, up–down,...See J.M. Mandler, *Amer. Scientist* vol.78, p.236, 1990), and "numerosity" (counting, adding,... in infants).

2. Vocal accents

Children in multilingual communities don't have detectable accents. All adults do. Suggests neural substratum already fixed early in life.

But there are a few contrary, mostly anecdotal, claims. And besides, aren't many things like this? If you don't learn it as a child, it's nearly impossible to become really proficient as an adult; e.g. riding a bicycle, swimming, playing a musical instrument. Most conventional theoretical linguists would *barf* at such a comparison, since we obviously aren't born with a bicycle-riding module.

3. Brain localization of language function

* Broca's area, Wernicke's area—these are usually interpreted in terms of localization, but now realized that they are merely part of a complex circuit of brain connections that are essential for most aspects of language understanding and expression.

* Brain damage cases.

But when brain injury involving language areas occurs in young children, other parts of brain often take over, suggesting great *plasticity*, at least before ages 12-14 years.

Current work: PET, MRI —> language neural circuits (not so localized!)

But also find neural circuits for *many* functions. Consider writing: suggests that major functional circuits can develop (evolve) *very* rapidly! What is the limit (if any)?

General implication of these 3 considerations: If biological substrate for language, then perhaps "uniquely human". But rather than its crowning achievement (traditional interpretation), this suggests that the human nervous system *limits* the interpretation of linguistic messages; humans may be *prohibited*, by the organization of their bodies and nervous systems, from learning certain concepts or types of concepts, or ways of "thinking" that do not even rely on "concepts".

But maybe our neural "circuits" are so plastic (modifiable) that we are capable of a wide range of (mostly unexplored) modes of thought, *if* we knew how to break our conditioning. Maybe an "advanced" alien civilization should be expected to have done so.

In either case, this suggests that finding *meaning* in an ETI message, once detected, may be the most formidable problem.

What else could be relevant to understanding of alien messages?

- Timescale – e.g. aliens with huge lifespans.
- Length – human ideas emerge at level of phrase or sentence. In human prose, length about 10-30 words. Could be much different?
- Discreteness – why a *discrete* pattern of *words* ? Maybe more continuous? (Think music.)
- Vocabulary size – aliens with much finer discriminatory perception, or much greater diversity in environmental conditions, or emotions, etc. Could have *huge* vocabulary (say, greater than a billion words, *if* words).
- If images, what kind of "meaning" is possible? (Consider "meaning" in visual arts)
- Arrangement – hierarchical structure is expected by most people, but that could be partly because we use such a structure (one of many antropomorphisms we have encountered). If this is correct, then maybe one could interpret an extraterrestrial hierarchical signal as "A complex cognitive entity is here." (Maybe not.)

Sapir-Whorf hypothesis – linguistic relativity and determinism. Currently evidence it was too strong in original (strong) form.

"Language is not a way of expressing thought, but a mold that shapes our thoughts, that directs the particular way we perceive and structure the world." (Whorf) [Note: idea is very old– Heroditus, Nietzsche,...] This is an appealing idea to many people, and, although the evidence continues to grow that the effects of language on thought are slight, I will summarize some of the key issues and results.

Really 2 propositions:

1. Linguistic relativity – there are differences in cognition associated with differences in language.
2. Linguistic determinism – language actually *causes* these differences.

Notice that extreme forms of linguistic relativity/determinism would have *serious* implications– "would close the door to objective knowledge once and for all."

Falling-out with academics, the discrediting, came in the 1960s due to: **a.** Rise of cognitive sciences, emphasizing commonality of human cognition; **b.** Piaget's school–universals of human development; **c.** Chomsky (1965) – case for language universals, computational theory; **d.** Developments in linguistic anthropology – discovery of universals in color cognition, ethnobotanical nomenclature, and (maybe) kinship terms.

More recent change in regard of Whorfian idea: shift toward relativism in many disciplines (esp. in anthropology; also "connectionism" in cognitive science and linguistics), more attention paid to differences.

Some evidence (pro and con) and problematic examples:

[Note: you can find hundreds of recent papers arguing the interpretation of these and related issues. Here they are merely being listed.]

1. "Intertranslatability" – Can statement in one language be translated into a statement in another language? General consensus is "yes", although length may differ greatly. Argues against S-W. But a thought easily expressed in one language might never be expressed in another. (e.g. in Kiriwina language of New Guinea, "mokita" means "truth everybody knows but nobody speaks".)
2. Color terms and color cognition– Berlin and Kay's 1969 study (20 languages) supported cultural universality in color categorization and addition, despite huge differences in color terms. *But* color is something that depends primarily on peripheral sensory apparatus. [Hundreds of papers on this subject since then; one of authors has apparently retracted her former interpretation of the results, and there are many more later studies.]
3. Noun/verb emphasis – Hopi; Navaho (now discredited to some extent?)
4. Temporality – e.g. Hopi tenses (now generally discredited)
5. Gender markings – e.g. no gender markings for Chinese pronouns, etc., effects of forced reference to gender.
6. Interpersonal communication – Japanese, reduction of I/you distinction through precedence of social relationships over individual
7. Metaphorical nature of our whole conceptual system? (Lakoff and Johnson, *Metaphors We Live By*, e.g. "Time is money", "Argument is war",...)