

From Holistic to Combinatorial Word Structure in Language Evolution: Evidence from Sign Languages

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Problems: 1) How did human languages come to have the form they do?

2) Can we identify key stages in the evolution of human language?

Contemporary lgs can't be traced back to ancestral lgs more than ~10,000 yrs ago (max).

What human language was like in its earliest stages is inaccessible to us.

Humans have *combinatorial abilities* to combine words into phrases, phrases into sentences.

Human lg (an infinite number of possible messages) vs. known animal communication systems

The problem of evidence on lg evolution: 1) No other species to compare with 2) No fossils

Argued here: Sign languages can provide evidence of both kinds.

What is the difference between sounds and words?

How many distinct sounds can a human make & discriminate? How many words in a human lg?

sat, bat, fat, cat, pat, mat

sit, bit, fit, kit, pit, mitt

sad, bad, fad, cad, pad, mad

Meaningless speech sounds are combined in different ways to produce meaningful words.

Words are not holistic. A *combinatorial phonological system* gives words *internal structure*:

1) Inventory of meaningless speech sounds

2) Only *combinations* of them have meaning.

Different languages have different inventories of speech sounds, different ways of combining them, and associate different meanings with particular combinations of speech sounds.

In most cases it is arbitrary which combination of speech sounds expresses a given meaning.

No limit on word length. Hence no upper bound on vocabulary size.

Did the earliest stages of what came to be human language have combinatorial phonology?

Possible source of evidence: The much younger sign languages indigenous to Deaf communities
American Sign Lg (ASL) evolved internal to Deaf communities in US & Canada (1817-present).

One of many mutually unintelligible sign languages around the world. Independent of English.

[Antecedent languages of ASL: French Sign Language, Martha's Vineyard Sign Language]

ASL has been shown to have all key properties of spoken language except speech.

Initial impression: Signs are *iconic*: DRINK, BIRD, HOUSE, COW

What is the difference between gestures and signs?

Like the words of spoken languages, signs consist of smaller meaningless parts that are combined in different ways to produce different signs with different meanings (Stokoe 1960).

To discover the sign-internal units, find signs that differ in only one respect:

Handshape: CHANGE/TRANSLATE/INTERPRET; NOTICE/PICTURE

Location: BIRD/PRINT/TWENTY

Orientation: NAME/CHAIR; SHORT/TRAIN

Movement: NAME/SHORT/KNIFE/EGG

A combinatorial phonological system:

1) An inventory of handshapes, locations, orientations, & movements that combine to form signs.

2) Each sign consists of handshape, location, orientation, and movement components.

Sequences of signs' internal phonological components: REMOVE, MAGIC, DESTROY

Signs, unlike gestures, result from a combinatorial phonological system, as in spoken languages.

The difference between gestures and signs: Signs result from a combinatorial phonological system.

Holistic Hypothesis: At an earlier stage, ASL (or its antecedent lgs) had no combinatorial phonological system. Holistic gestures with heavy reliance on iconicity. Some ASL signs that evolved from iconic holistic gestures to signs are “fossils” from that earlier stage. As signs, they are subject to phonological principles that may result in full or partial loss of iconicity.

BIRD, DRINK appear to be iconic holistic gestures. Evidence they are not holistic:

Handshape: BIRD, PRINT, TWENTY

Handshape: DRINK, LOOK-FOR, PICTURE

Location: BIRD, DRINK, FAMOUS

Partial fossils: COW, HOUSE, HEART (older form), THINK

Evidence they are not holistic in contemporary ASL:

COW: WRONG, NEW-YORK

HOUSE: BLUE, QUIET

HEART: SMART, FEEL

THINK: BLACK, NOTICE

Iconic elements of *partial fossils* as fossils of iconic gestures:

COW: Handshape, Location, Orientation

HOUSE: Handshape, Movement, Orientation

HEART (older form): Location, Movement

THINK/KNOW: Location

Why do ASL signs become less iconic over time (Frishberg 1975)?

Explanation: Because they become *combinatorial*.

HEART loses its unique iconic movement; it now shares mvmt of FATHER, MOTHER, FINLAND

ASL signs of iconic origin: 1) are fossils of holistic iconic gestures; 2) change from holistic to combinatorial, 3) becoming less iconic. This suggests an earlier stage in the history of ASL (or its antecedent lgs) with no combinatorial phonology and heavy reliance on holistic iconic gestures.

Prediction of the Holistic Hypothesis: The hypothesized early stage of ASL, with no combinatorial phonology & reliance on holistic gestures, is a possible human language.

Confirmation: Al-Sayyid Bedouin Sign Language (ABSL), not descended from any pre-existing language. [Sandler, Aronoff, Meir, & Padden 2005] No combinatorial phonology & reliance on holistic gestures. It also shows viability of a language without phonology for communication.

Key differences from ASL: Age of the language and size of the community

There are no known *mature* natural languages without a combinatorial phonology.

Prediction: ABSL will undergo the same kinds of changes ASL has and evolve one.

Comparative (cross-species) evidence: Language experiments with chimpanzees: The Gardners & Fouts signed with their chimpanzees for many years. Claims that chimpanzees have “learned ASL.” [But cf. Terrace et al.] Analysis of 22 hrs. of videotape by Rivas (2005)
 Rivas eliminated imitations of what the caregiver had signed in the previous 5 seconds.

	No. of diff “signs”	4 most frequent
Washoe	43	58%
Moja	55	45%
Tatu	55	46%
Dar	38	41%

Why are their vocabularies so small? Learning ASL combinatorial phonology, as human children do, would give the chimps much larger vocabularies.

Compare these figures with the vocabulary of a human child learning ASL or any other language.

Explanation: The chimps learned no signs at all - only a small set of *holistic gestures*.

A deeper explanation: Chimpanzees lack the combinatorial abilities to learn the combinatorial phonological system on which the vocabulary of a mature human language is based.

Three pieces of evidence that chimpanzees *can* learn (a small set of) *holistic* items:

- 1) Savage-Rumbaugh’s Kanzi was able to learn lexigrams that have no internal phonological structure.
- 2) Matsuzawa’s chimpanzees have learned to distinguish the Chinese characters for numbers and colors, which likewise have no internal phonological structure.
- 3) Data from the four chimpanzees cited above indicate they have learned from 38 to 55 items.

My claim: They have learned these as holistic gestures, not signs with internal phonological structure.

Conclusion: Chimpanzees can learn a small set of holistic items but lack the combinatorial abilities to learn a combinatorial phonological system.

Hypothesis: The last common ancestor of humans and chimpanzees could learn holistic items but lacked the combinatorial abilities needed to learn and use a mature modern human language.

Suggests an early stage of lg with no combinatorial phonology, as hypothesized for sign lgs.

Summary

A. Evidence for a stage in the development of sign languages with holistic iconic gestures and without a combinatorial phonological system:

- 1) “Fossil” evidence internal to ASL suggests an earlier holistic and largely iconic stage.
- 2) ABSL confirms the prediction that the hypothesized holistic stage is a possible language.
- 3) ASL signs of iconic origin illustrate the evolution from holistic to combinatorial.

B. How sign languages shed light on the evolution of language:

- 1) Chimpanzees’ ability to learn holistic items but not a combinatorial phonological system suggests a common ancestor with similar abilities, which suggests that language went through a stage without a combinatorial phonological system when words were holistic entities.
- 2) ABSL shows such a holistic lg is viable for communication, at least in a small community.
- 3) If human language went through a holistic stage, ASL signs’ evolution from holistic gestures to signs based on a combinatorial phonological system mirrors that of human language itself.
- 4) The evolution from holistic to combinatorially based words was a key step in the evolution of language. This step made it possible for languages to develop vocabularies of any size.