LINEARIZATION. A VIEW FROM SIGN LANGUAGES

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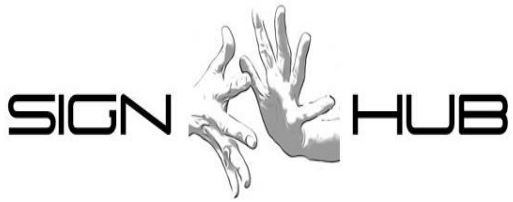

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Trends in (sign) language research

(i) The same set of analytical categories (historically derived from spoken language linguistics) applies to both sign and spoken languages because they are the output of the same biological faculty.

(ii) Spoken and sign languages require a different set of analytical categories because the visuo-spatial dimensions allow things that are impossible in the acoustic modality (say, iconicity, language embodiment etc.).

(iii) The same set of analytical categories (largely derived from *sign* language) applies to both sign and spoken languages because the former allows us to discover linguistic properties that are hidden but well active in the acoustic modality (say, iconicity, language embodiment etc.).

My tackle on this issue

The aim of this talk is defending option **(i)** but at the same time starting accounting for some sign languages properties that seem to elude linguistics as it evolved based on spoken languages data.

(i) The same set of analytical categories (historically derived from spoken language linguistics) applies to both sign and spoken languages because they are the output of the same biological faculty.

Today's talk

PART I. Chomsky hierarchy and sign languages.

When 'spoken language linguistics' turns out to be what you need.

PART II. Simultaneity and linearization.

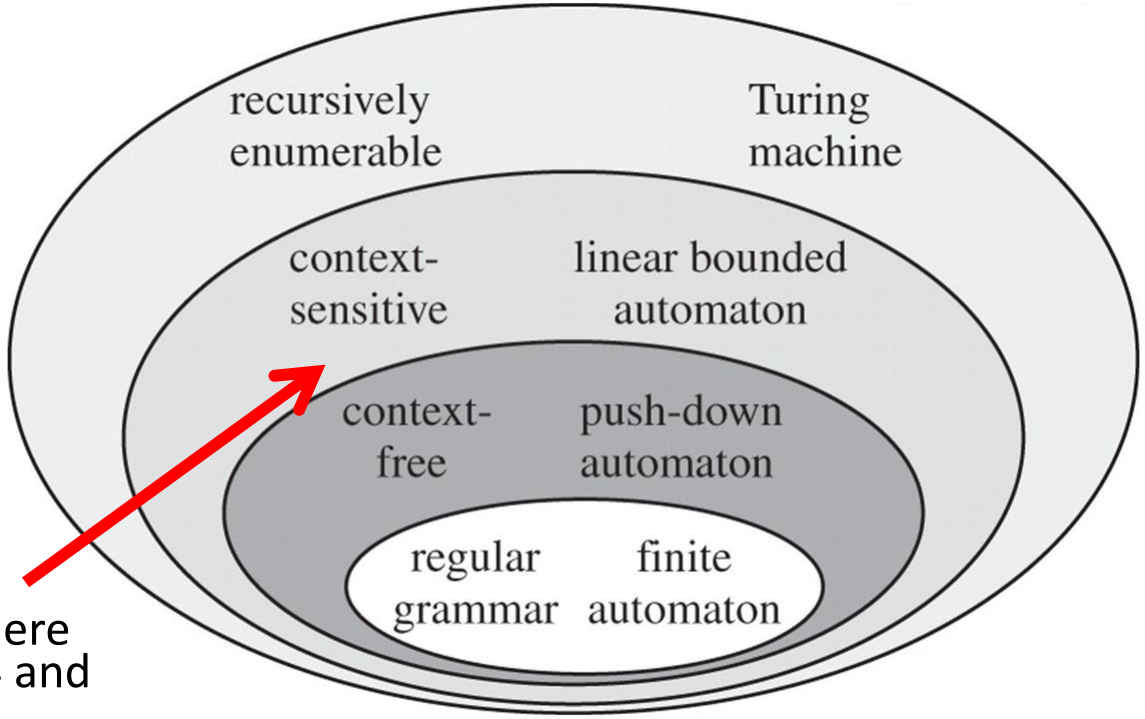
When 'spoken language linguistics' is challenged.

PART I.

CHOMSKY HIERARCHY AND SIGN LANGUAGES

Back to the origins

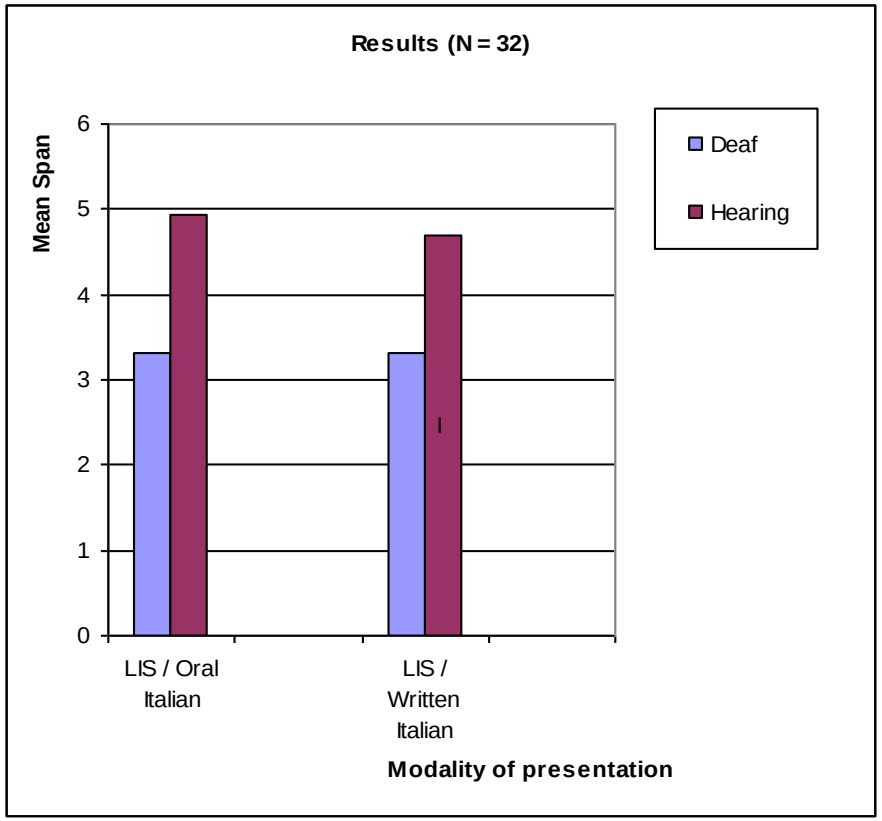
Each level of Chomsky hierarchy is defined by a corresponding automaton, namely a device which is able to recognize the strings produced by grammars at that level of the hierarchy. Each automaton is defined by its memory requirement, starting from the weakest automaton (the finite automaton, which knows the present state and next permissible states but does not 'remember' past steps) until Turing machine (irrelevant for natural languages).



Natural spoken languages are here (cf. Culy, 1985, Huybregts 1984 and Shieber 1985).

Where are sign languages in Chomsky hierarchy?

Asking what is the position of sign languages in Chomsky hierarchy is motivated by a solid finding from cognitive psychology, namely that short term memory for signs is much lower than short term memory for words (this has been replicated for many sign languages, with different methodology, different populations. etc.)



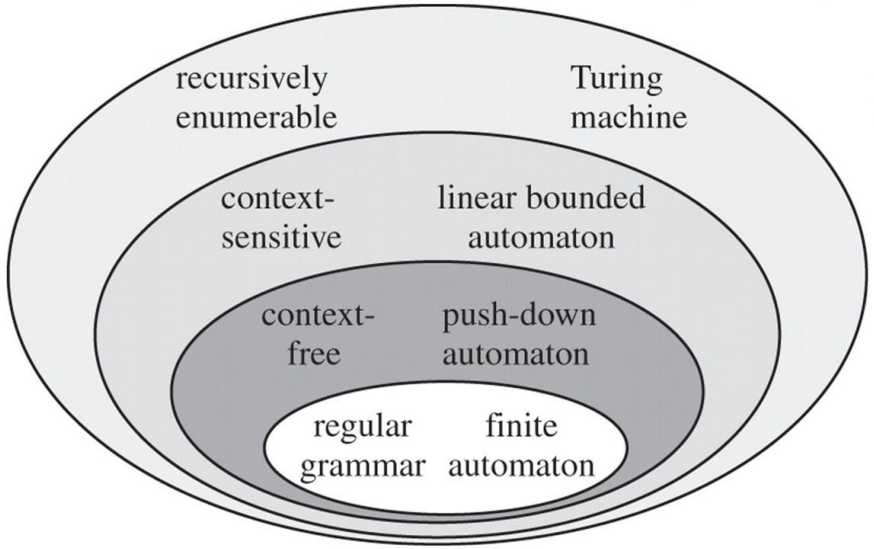
From Geraci, Gozzi, Papagno & Cecchetto (2007)

Where are sign languages in Chomsky hierarchy?

If the level of a given language in Chomsky hierarchy is identified by the memory requirement of the associated automaton, assuming the metaphor that language users are the relevant automata who compute the sequences produced by the grammar (“sentences”), a lower memory capacity for signs might correspond to a lower level in the hierarchy for sign languages.

Initial evidence that sign language are lower in the hierarchy?

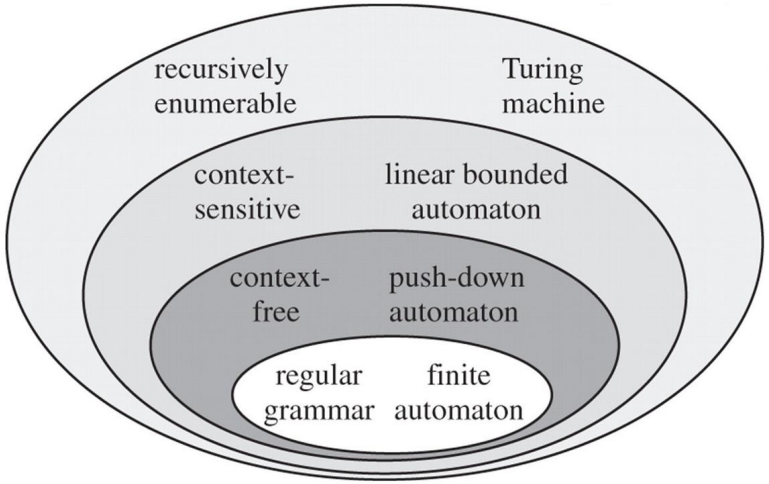
In fact, configurations like center embedding, which require context-free grammars, are exceedingly rare in sign languages (Cecchetto, Geraci & Zucchi 2006, Geraci & Aristodemo 2016). This applies also to a single level of center embedding, which is OK with general population of spoken language users.



Where are sign languages in Chomsky hierarchy?

Of course, center embedding configurations are not the only configurations that indicate that the grammar of a given language is not regular. Another configuration that does the same job is self-embedding of the X-within-X type.

I propose a test to identify this configuration also in relatively understudies languages. I call it the *prefer*-test.



Towards the *prefer*-test

(1) The dress that I bought that I never use (is that one)

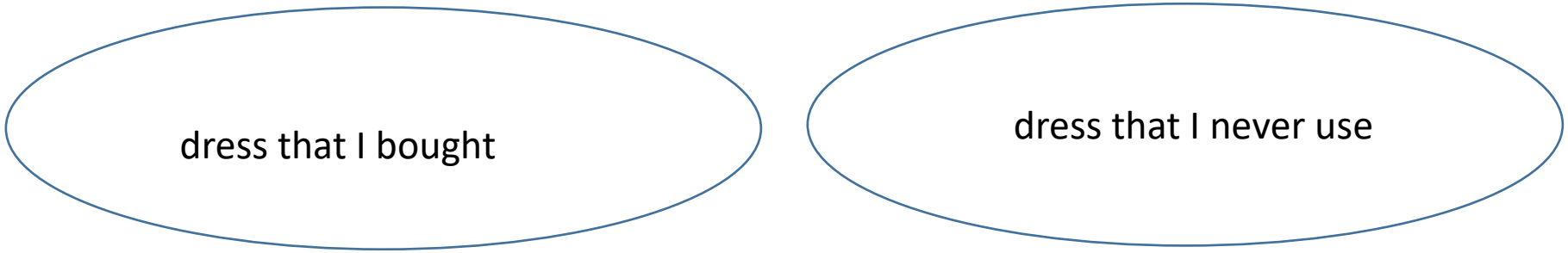
In the schematic representation (1’), two separate and independent operations of relativization target the noun ‘dress’ (across-the-board-extraction).

(1‘) the dress [that I bought ~~dress~~] [that I never use ~~dress~~]

This might be akin to coordination:

‘The dress that I bought *and* the dress that I never use (is that one)’

Relatively flat structure with no self-embedding underlies (1’).



Towards the *prefer*-test

(1) The dress that I bought that I never use (is that one)

In the schematic representation (1’’), relativization is applied to a category with label N (the noun ‘dress’) and the nominal constituent which results (the NP1 ‘dress that I bought’) is the input of a second application of the same relativization operation.

(1’‘) the [$_{NP2}$ [$_{NP1}$ dress [that I bought ~~dress~~]] [that I never use t_{NP1}]]

This analysis in (1’’) posits a case of self-embedding recursion that creates a complex hierarchical structure.

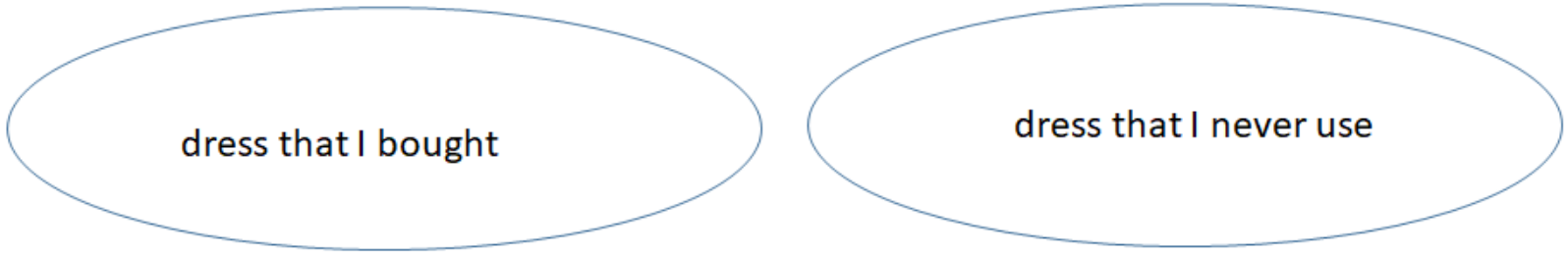
Towards the *prefer*-test

Given the meaning of sentence (1),

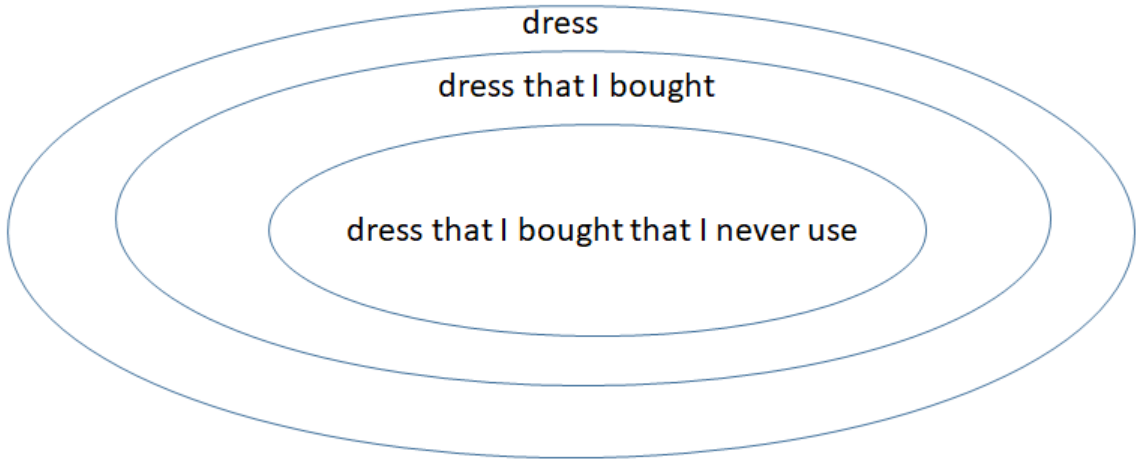
(1) The dress that I bought that I never use (is that one)

it is difficult to choose between the flatter coordination structure (1’) and the more complex hierarchical structure (1’’).

(1’)



(1’’)



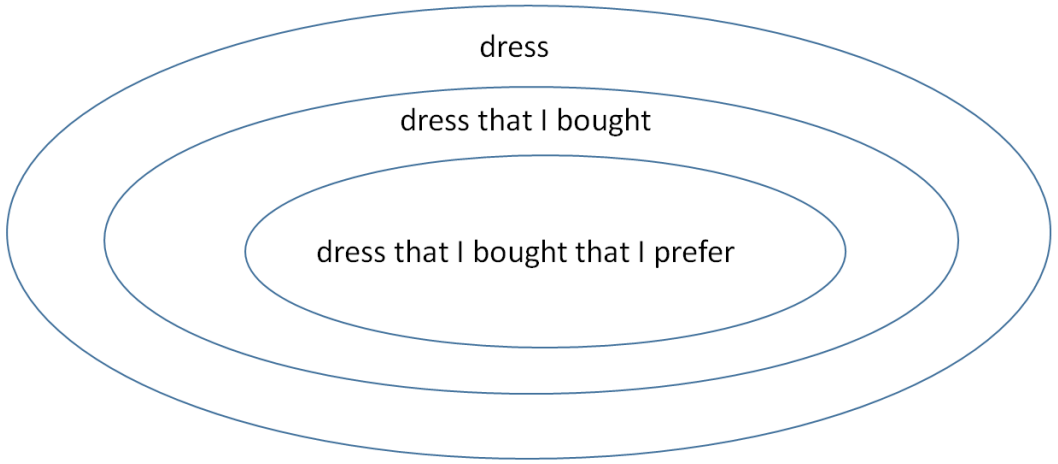
The *prefer*-test

(2) The dress that I bought that I prefer (is that one)

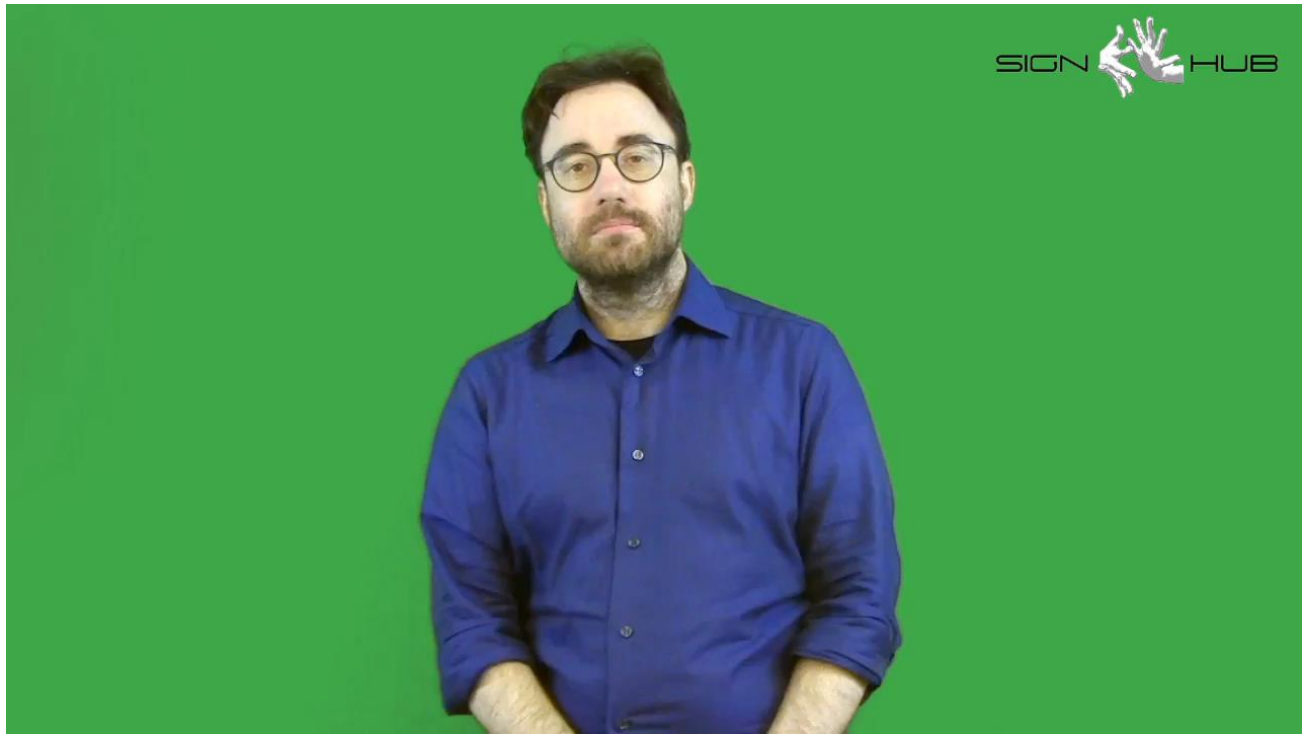
However, given the lexical meaning of the verb ‘prefer’, by uttering (2) I pick out the dress that I prefer *among the ones that I bought*, namely the structural analysis in (2’’) is forced

(2’) $[_{NP2}\ [_{NP1}$ dress $[_{CP}$ that I bought $t_{dress}]]\ [_{CP}$ that I prefer $t_{NP1}]]$

Given the analysis in (2’), (2) is correctly predicted to be true also in a situation in which the dress that I prefer among the ones that I bought is not the dress that I prefer in absolute terms.



LIS relatives



_____re
(3) [YESTERDAY CHILD++ CAKE EAT PE] (THEY) TODAY STOMACH_ACHE
'The children that yesteday ate the cake today have stomach ache'
(Video from Branchini 2020a)

In LIS the head is internal to the relative clause (**CHILD**) and a relative sign, glossed **PE**, marks the right edge of the relative clause. The relative clause precedes the main clause and co-occurs with a specific non-manual marking, namely raised eyebrows, indicated as 're'.

The *prefer*-test in LIS

In (4) there are two relative clauses as indicated by a double occurrence of the relativizer **PE**. The complex NP ‘The dress that I bought yesterday that I prefer’ is the subject of the copular clause (the copula is null in LIS).

_____re

(4) DRESS CLASS IX_1 BUY YESTERDAY **PE-PLUR** IX_1 LIKE-MORE **PE** IX

‘The dress that I bought yesterday that I prefer is that one’

The *prefer*-test in LIS

_____re

(4) DRESS CLASS IX_1 BUY YESTERDAY **PE-PLUR** IX_1 LIKE-MORE **PE** IX

'The dress that I bought yesterday that I prefer is that one'

The *prefer*-test in LIS

Given its meaning, (4) is a case of self-embedding recursion that creates a complex hierarchical structure.

_____re

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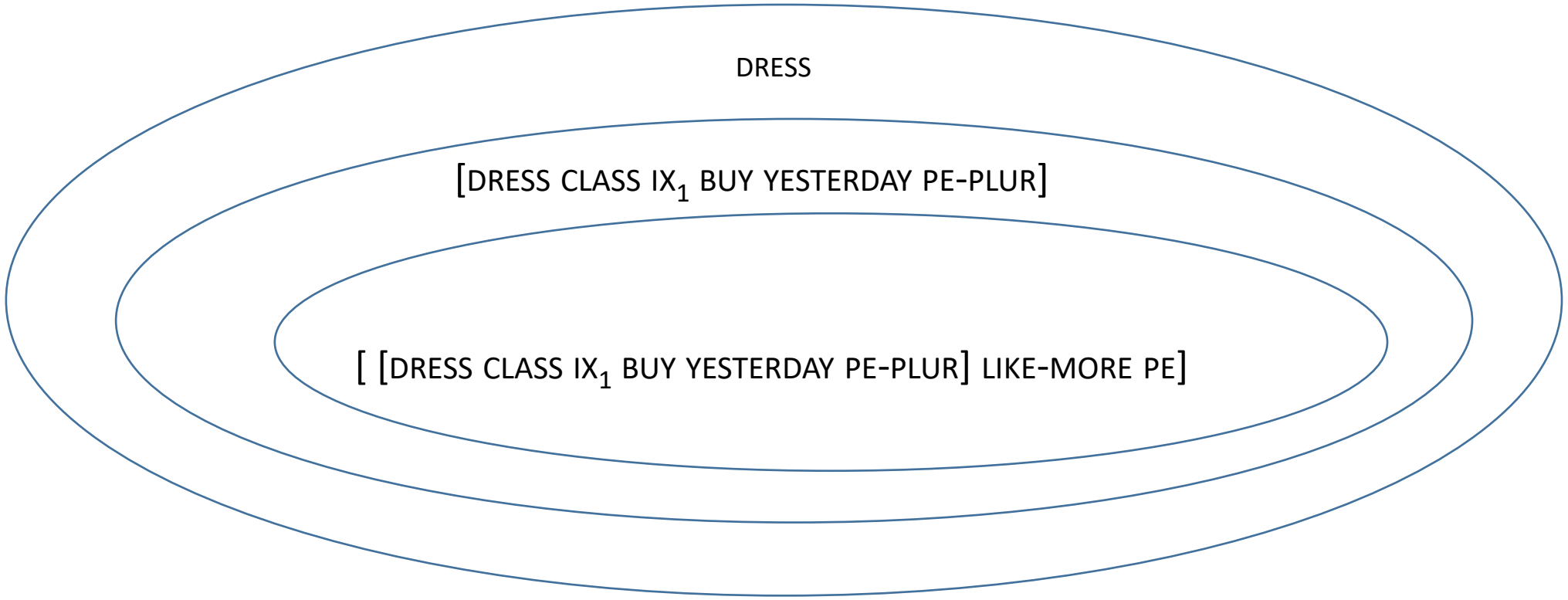


The *prefer*-test in LIS

The complex hierarchical structure underling sentence (3) shows that LIS is (at least) at the context-free level of Chomsky hierarchy.

Constraints due to modality (weaker short term memory capacity for signs) do not impact on the level of complexity of natural languages, arguably because the deepest properties of the language faculty is determined biologically.

Still, modality might be relevant in other respects..

Part II.

Simultaneity and linearization

Linearization and concatenation in spoken languages

In spoken languages, morpheme are concatenated to form words and words are linearized to form sentences. Simultaneous expression of grammatical information does exist (suprasegmental phonology) but it seems fair to say that it has a somewhat marginal role in syntax.

Simultaneous expression of multiple characters

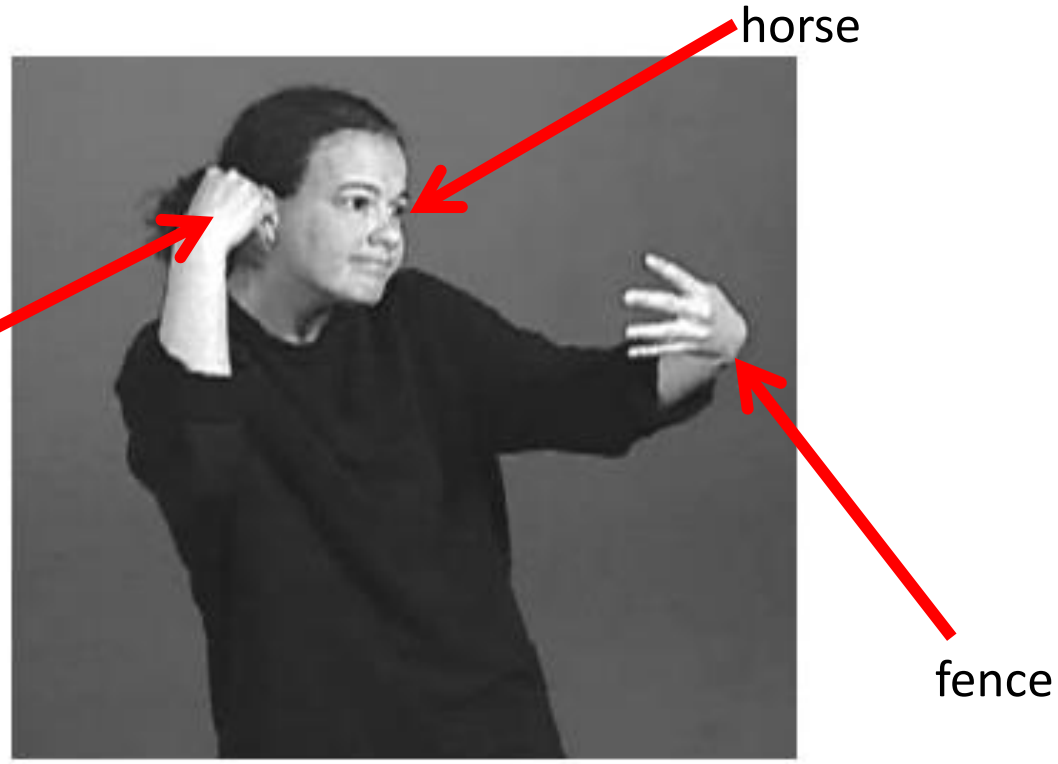
It is a common observation in the sign language literature that the simultaneous use of the two hands can serve the function of personifying two different characters and their interaction.

From: Sallandre (2007)

Simultaneous expression of multiple characters

Eye gaze + facial expression + mouth gestures + body posture represent a horse. The dominant hand represents a bird looking at the horse. A fence is expressed by the non-dominant hand.

‘A bird is looking at a horse that is in front of a fence’



From: Sallandre (2007)

Simultaneous expression of multiple characters

In principle the simultaneous use of the two hands to personify two different characters might be a pantomimic use embedded in a linguistic utterance.

However, some cases of simultaneity, like that involving reciprocity, seems to be clearly grammaticalized.

Reciprocity, Sequential Strategy

$IX_{3a+3b}\ {}_{a}HELP_{b}\ {}_{b}HELP_{a}$

‘They help each other’

Video from: Branchini 2020b

Reciprocity, simultaneous strategy

Video from: Branchini 2020b

IX_{3a+3b} dom: $_{a}HELP_{b}$

n-dom: $_{b}HELP_{a}$

‘They help each other’

Simultaneous strategy as co-articulation of two sentences

IX_{3a+3b} dominant hand: $_{a}HELP_{b}$

non-dominant hand: $_{b}HELP_{a}$

‘They help each other’

I propose to analyze this as a case of simultaneous production of the two sentences:

‘person 1 is helping person 2’

‘person 2 is helping person 1’

CODA production

The simultaneous production of the two sentences is not really surprising if one look at the production of CODA (hearing Children Of Deaf Adults). The relative independence of the sign language and spoken language articulators allows them to simultaneously produce two phrases or even two full clauses in the two languages. This happens even when the sentence in the two languages has diverging word orders (cf. Branchini & Donati 2016).

Two complete simultaneous sentences in Italian and LIS

It:	Cosa	ha	mangiato	la	rana?
what	have. 3SG		eat-PTCP	the	frog
			_____wh		
LIS:	FROG	EAT	WHAT		

'What did the frog eat?'

Courtesy of Chiara Branchini and Caterina Donati, cf. Branchini and Donati (2016).

CODA production

These production by CODA show that there is no absolute cognitive blocking against simultaneous production of two sentences.

If articulatory constraints allow this, because a spoken and a sign language are involved, two sentences can be uttered simultaneously.

Back to reciprocals

IX_{3a+3b}	dominant hand:	$_aHELP_b$
	non-dominant hand:	$_bHELP_a$

Linearization is due to articulatory constraints, as hierarchical structures cannot be externalized in their original shape. But in sign languages multiple articulators can work with a degree of independence that is not observed in spoken languages. This allows simultaneous expression of grammatical information that in spoken language is typically distributed in different categories that are spelled-out sequentially. Therefore, I propose, two sign language sentences can be uttered simultaneously.

Co-articulation limitated to coordination?

IX_{3a+3b} dominant hand: $_{a}HELP_{b}$

non-dominant hand: $_{b}HELP_{a}$

In the case above, the two co-articulated sentences can be analyzed as coordinated, namely they are independent.

Are there cases in which the two co-articulated clauses are in relation of embedding? Probably not, I go back to that at the end of the talk.

Co-articulation at a smaller scale

I will now concentrate on potential cases of co-articulation at a smaller scale, which might be examples of simultaneous production of two constituents in the same sentence.

However, prima facie these cases admit a different analysis in terms of incorporation. So, I will have to compare the co-articulation and the incorporation analysis.

Incorporation as opposed to co-articulation

Object and verb

In many SLs, the verb can be modified to indicate the size and shape of the internal argument: the special way the verb ‘lift’ is articulated indicates that the theme is a heavy box.

‘Lift a very heavy box’

Images from:
Fornasiero (2020)

Adverb and verb

Manner adverbs can appear as an independent sign or the adverbial meaning can be expressed by modifying how the verb is articulated.

MARIA MEAT EAT QUICKLY
'Maria eats meat quickly'

MARIA MEAT EAT-QUICKLY
'Maria eats meat quickly'

Videos from: Cecchetto, Checchetto, Geraci, Santoro & Zucchi (2015)

Incorporation and polysynthetic languages

Object incorporation is well-attested outside the realm of sign languages. Adverb incorporation is rarer but attested (Rivero 1992). Therefore, the incorporation analysis in principle *is* viable.

Given this hypothesis, a single sign, the verb, expresses the information that is typically widespread through the entire clause (as in polysynthetic languages).

The incorporation hypothesis would make sign languages akin to polysynthetic languages but for the fact that the information conflated on the verb is is realized simultaneously in sign languages and sequentially in polysynthetic languages.

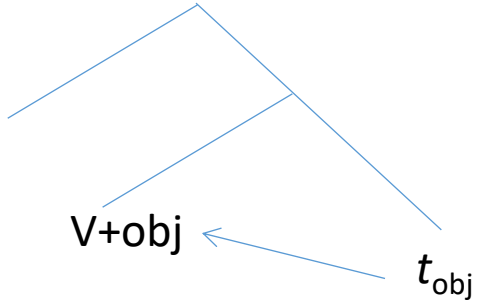
Co-articulation?

According to the co-articulation hypothesis the sign glossed as EAT-QUICKLY is the result of co-articulation of two independent signs, namely the verb EAT and the adverb QUICKLY with no need to postulate any operation like incorporation.

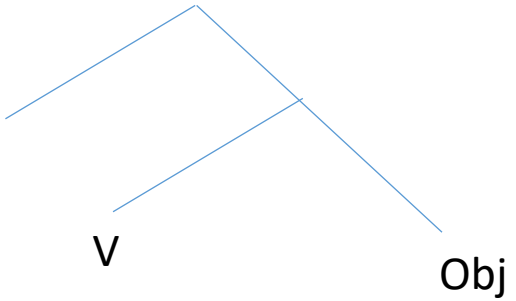
Similarly for the case where object and verb are expressed by a single sign.

The incorporation hypothesis as opposed to the co-articulation hypothesis

The incorporation hypothesis represents simultaneity directly in the syntactic representation (by head movement).



According to the co-articulation hypothesis, simultaneity is *not* reflected in the underlying linguistic representation but it only emerges at the moment of spell-out.



How to choose?

A candidate for language universal (which holds in polisynthetic languages as well, cf. Baker 2009) is the Verb-Object Constraint, which states that verb and object form a minimal constituent that excludes the subject.

According to the Verb-Object Constraint, a subject cannot incorporate into the verb, even more if the verb has not previously incorporated the object.

How to choose?

I propose to use the Verb-Object Constraint to evaluate (and ultimately discard) the incorporation hypothesis. This is the logic: I will present a configuration (action role shift) that prima facie might be interpreted as a case of incorporation. However, if an incorporation analysis were adopted, this configuration would be a patent violation of the Verb-Object Constraint. Therefore, I will opt for the co-articulation analysis.

Role shift and the Verb Object Constraint

Role shift, rough definition

Role shift is a strategy by which the signer assumes the perspective of (“becomes”) a character involved in the event that is described instead of being external to it. The signer typically does that by doing a body shift toward the position in the signing space which is associated to the character whose perspective he or she is adopting.

Non-manual markers of role shift include:
(a) body shift or change in body posture,
(b) Movement of the head
(c) change in the direction of eye gaze
(d) altered facial expressions in order to mark that the signer is adopting somebody else's perspective.

Action role shift (also called constructed action)

$\overline{\text{}}^{\text{rs-i}}$

GIANNI$_i$ ARRIVE BOOK 1-GIVE-2
'When Gianni arrives, he will give you a book '

The verb GIVE starts from the signers' body. Since the signer shifts into Gianni's role, the sentence means that *Gianni* will give you a book, not that *the signer* will give you a book.

Video from: Cecchetto, Checchetto, Geraci, Santoro & Zucchi (2015)

Pronominalization through pointing

In sign languages, a pronoun is a pointing sign.

This pointing can establish a new referent (for example, if the pronoun is deictic) or can have an anaphoric function (if the signer points to a position in space already associated to some referent). In the sentence below, the signer, instead of using a pronoun to indicate the position associated to GIANNI, shifts his body towards that position.

GIANNI$_i$ ARRIVE _____rs-i
BOOK 1-GIVE-2
'When Gianni arrives, he will give you a book '

Role shift as co-articulation

I propose to analyze action role shift in the sentence below as a case of co-articulation of the pronominal subject of the embedded clause (a pointing sign) with the verb phrase. The morpho-phonological realization of this co-articulation process is body shift towards the position that the pronominal index would point to.

GIANNI$_i$ ARRIVE BOOK 1-GIVE-2
——————————rs-i

'When Gianni arrives, he will give you the book as a present'

Role shift as subject incorporation

In principle, role shift might be analyzed also as the result of incorporation of subject into the verb (phrase).

This is when the Verb Object Constraint becomes relevant. According to this constraint, the subject cannot incorporate into the verb unless the verb has previously incorporated the object.

Assessing Verb Object Constraint

GIANNI$_i$ IX$_1$ HATE.

_____RC-i _____RC-i

PEOPLE WEAK LOOK-WITH-COMTEMPT, PEOPLE STRONG LOOK-WITH-FEAR

‘I hate John. He despises weak people but he fears strong ones’

Assessing Verb Object Constraint

GIANNI$_i$ IX$_1$ HATE.

_____RC-i

PEOPLE WEAK LOOK-WITH-COMTEMPT

‘I hate John. He despises weak people….’

A Verb Object Constraint violation

If Role Shift involved subject incorporation, the sentence below would be a Verb Object Constraint violation since the subject GIANNI would be incorporated while the object (WEAK PEOPLE, STRONG PEOPLE) would not. Given that Verb Object Constraint is a well motivated constraint, I would abandon the subject incorporation analysis.

GIANNI$_i$ HATE.

——————————RC-i ——————————RC-i

PEOPLE WEAK LOOK-WITH-COMTEMPT, PEOPLE STRONG LOOK-WITH-FEAR

‘I hate John. He despises weak people but he fears strong ones’

Consequences and open issues

Constraining co-articulation: smaller scale co-articulation

Allowing co-articulation is dangerous as it can lead to massive overgeneration. This mechanism must be constrained.

Tentative constraint for co-articulation of two signs in the same sentence:

Two categories can be co-articulated when they would be adjacent if they were articulated independently.

In turn this makes co-articulation indirectly dependent on the linearization algorithm.

Constraining co-articulation: two full sentences

Hypothesis: two full sentences can be co-articulated only of if they are coordinated.

Hypothetical example of simultaneous subordination: someone jumps in order to grasp a grape and grasping is the goal of jumping. In English this situation can be described by a purpose clause embedded under a matrix clause:

‘The man jumped to grasp a grape’

In sign languages, in principle, one hand might express the jumping action (‘main clause’), while the other hand might simultaneously express the grasping action (‘purpose clause’).

Testing co-articulation and embedding

In order to express a purpose meaning, the actions of jumping and grasping must be expressed sequentially (even if two hands are involved).

MAN_i IX_i GRAPE JUMP(Dominant Hand) GRASP(Non Dominant Hand)

Where is linearization determined?

Two proposals.

1. Kayne's (1994) Linear Corresponding Axiom: asymmetric c-command imposes a liner ordering of terminal nodes. Hierarchical structures are inherently linearized. Kayne (2020) modulates this by assuming that core syntax involves, partial, not total linear order.

2. Merge (core syntax) is unordered. Order is imposed only as late as at the PF interface (Chomsky 1995).

General conclusions

Linearization can be suspended when articulatory constraints allows this. This suggests that linearization is not *automatically* determined by asymmetric c-command.

General conclusions

More specifically, given my analysis of Role Shift, the subject NP asymmetrically c-commands the verb it is co-articulated with in Role Shift sentences, still the two are not linearized. A special case for sign language should be made in antisymmetric approaches.

General conclusions

My proposal, and possibly the co-articulation pattern in sign languages in general, is more consistent with Chomsky's (1995) claim that linearization takes place at the PF interface, while core syntax is pure hierarchy (with no intrinsic order).

Thanks to:

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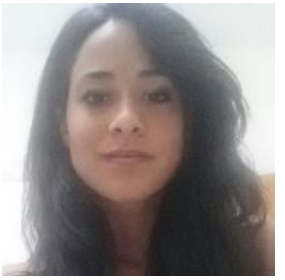


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