Where’s linearity?
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0 Introduction
[1] The title of this paper was inspired by Anderson’s (1982) paper “Where’s morphology?”

[2] The central question which I will be trying to answer here is where principles governing the linear organization of linguistic constituents “belong” in a standard componential model of grammar.

[3] I will specifically defend a model which is schematized below in figure 1.

![Figure 1: A model for the place of linearity in grammar](image)

[4] In order to defend this model, I will:

[4a] Introduce some relevant terminology for linear relations and discuss some previous models of linearity.

[4b] Provide evidence for the autonomy of linearity (i.e., evidence for the existence of the inside of the linearity box).

[4c] Provide evidence for a “conspiracy” wherein linear relations behave similarly in phonology, morphology, and syntax (i.e., evidence for the arrows coming out of the box).

[5] All I have to offer, at this point, is a model. I am not trying to offer anything like a theory of linearity or an explanation of it.

[6] Disclaimer: Any claims made here are intended only to be applicable to spoken languages.

1 Some terminology for linearity
[7] Linear relations: A set of relationships between linguistic constituents which specifies how they are realized in linear order. This term is meant to be construed broadly, encompassing both prominent linear relations, like word and morpheme order, and less prominent ones, like stress placement.

[8] Linearity domain: A linguistic constituent whose immediate subconstituents bear (potentially non-exhaustive) linear relations with one another.

[9] There appear to be three major types of linearity domains in the standard architecture of grammar.

[10] The first type are morphosyntactic linearity domains wherein morpheme and word order is determined more or less by semantic scope.


[12] Below, I exemplify these two types of linearity domains using an English sentence.


**Syntactic tree**

```
S
 PP S
 P NP NP VP
 On he V NP PP
 Wednesday told Det N P NP
 the stories to Det N
 the children
```
The following tree is also taken from Hayes (1990:86). The label abbreviations can be expanded as follows: W = word, C = clitic group, P = phonological phrase, I = intonational phrase, U = utterance.

Prosodic tree

On Wednesday he told the stories to the children

The syntactic and prosodic constituents seen in the above sentences would all be classified here as weak linearity domains.

Weak linearity domain: A linearity domain in which the linear relations among constituents can be predicted from their constituency relations via a general algorithm.\(^1\)

Strong linearity domain: A linearity domain in which some aspects of the linear relations among constituents must be specified independently of their constituency relations.

I will discuss strong linearity domains in more detail below. First, it will be helpful to have one example: In English, lexical strings can constitute strong linearity domains as linear minimal pairs like pat, tap, and apt indicate.\(^2\)

The distinction between strong linearity and weak linearity here is taken to correspond to the idea of autonomous linearity “inside the box” (strong linearity) and interfaces between the linearity component and the other components (weak linearity).

\(^{1}\) For discussions of general algorithms for predicting prosodic constituency, see Inkelas and Zec (1995).

\(^{2}\) This is not to say that lexical strings could be strong linearity domains in all languages. Yip (1989) has suggested otherwise for Cantonese, for example. In that language the size of morphemes and their syllable structure mean that, given a set of segments associated with a lexical item, their order can be predicted.

## 2 Thinking inside the box: Strong linearity

In order to defend the existence of a linearity component, it will be necessary to show the presence of strong linearity at a range of different levels of grammatical structure.

A point which holds true here, and throughout, is that strong linearity is always an artifact of analysis—so, for a given analysis involving strong linearity, an analysis making use of only weak linearity will probably also be available.

### Strong linearity in phonology: Syllable phonotactics

While many aspects of syllable phonotactics can be analyzed via the sonority hierarchy, which can be properly located in the phonology component, there will always be language-specific phonotactic statements.

For example, given the set of consonants p, n, and y, the sonority hierarchy could predict that they must appear in the given order in an onset. However, it could not predict that *pn onsets are disallowed in English.

Also relevant, Croft and Vihman’s (2003) Radical Template Phonology where a template is a device which “describes word-sized patterns at all levels of phonological organization…”

### Strong linearity in morphophonology: CV-templates

CV-templates are good candidates for morphophonological strong linearity. The data below comes from Northern Sierra Miwok and is taken from Freeland (1951:94–5).

<table>
<thead>
<tr>
<th>STEM I</th>
<th>STEM II</th>
<th>STEM III</th>
<th>STEM IV</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>tuyá:ŋ</td>
<td>tuyáːŋ</td>
<td>tuyːːŋ</td>
<td>tůŋŋa</td>
<td>“jump”</td>
</tr>
<tr>
<td>polá:ŋ</td>
<td>poláːŋ</td>
<td>pólːaŋ</td>
<td>póŋŋa</td>
<td>“fall”</td>
</tr>
<tr>
<td>tōpə:ŋ</td>
<td>tōpəːŋ</td>
<td>tópːon</td>
<td>tōpno</td>
<td>“wrap”</td>
</tr>
<tr>
<td>hūtːel</td>
<td>hūtːel</td>
<td>hūlːel</td>
<td>hūːlːe</td>
<td>“roll”</td>
</tr>
<tr>
<td>tēlːy</td>
<td>tēlːy</td>
<td>tēːlːy</td>
<td>tēːlːye</td>
<td>“hear”</td>
</tr>
<tr>
<td>CVCV:C</td>
<td>CVCVC:</td>
<td>CVC:VC</td>
<td>CVCCV:</td>
<td></td>
</tr>
</tbody>
</table>
Northern Sierra Miwok contains data readily analyzed as exhibiting a hallmark of templates—insertion of a “dummy element” to fill out an obligatorily active position.

<table>
<thead>
<tr>
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<th>STEM IV</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>hámːe</td>
<td>hámːeʔ</td>
<td>hámːeʔ</td>
<td>hámːe</td>
<td>‘bury’</td>
</tr>
<tr>
<td>lìwːa</td>
<td>lìwːaʔ</td>
<td>lìwːaʔ</td>
<td>lìwːa</td>
<td>‘speak’</td>
</tr>
<tr>
<td>nánːʔ</td>
<td>nánːʔ</td>
<td>nánːʔ</td>
<td>nánːʔ</td>
<td>‘find’</td>
</tr>
</tbody>
</table>

CVC:V  CVC:V  CVC:V  CVC:V  CVC:V

Strong linearity in morphosyntax: Position-class templates

Position-class, or slot-filler, morphology has been attributed to a number of languages.

Hoijer (1971:125) gives the following pan-Athabaskan position-class template.

1. Zero, one or more adverbial prefixes.
2. The prefix for the iterative paradigm (lacking in some languages).
3. A pluralizing prefix.
4. An object pronoun prefix, found only in transitive verbs and some passives.
5. A deictic subject prefix.
6. Zero, one or two adverbial prefixes.
7. A prefix marking mode, tense, or aspect.
8. A subject pronoun prefix.
9. A classifier prefix.
10. A stem.

Position-class templates have come under some criticism—even for the complex Athabaskan verb. Arguments against a position-class analysis of Athabaskan can be found in Rice (1993, 2000), Speas (1984, 1990:240–280), and McDonough (1990, 2000).

However, the following quote from Rice (2000:395) is relevant here.

Any model of the Athabaskan verb must account for several things: the scopal principle is an overarching principle that consists of interacting subprinciples. Syntactic, morphological, and phonological principles also play a role in determining morpheme order. In addition, mechanisms are required to situate non-interacting material and to account for the variability associated with it. The best model for capturing all of this is the topic of another piece of work. (Rice 2000:395)

Strong linearity in the syntax: Second-position clitics

The name “second-position” clitics implies there is something linearly odd about these items.

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Conclusion: There are good candidates for strong linearity in a wide range of types of linguistic constituents. These are taken to provide evidence for the inside of the linearity box.
3 Sandwiched between the boxes: Weak linearity

[27] The next step in defending the existence of a single linearity component is establishing that there is a consistent set of principles governing weak linearity in phonology, morphology, and syntax.

[28] I will argue here that weak linearity is governed by the following two general principles:

[a] Isthmus Concatenation Principle: Linearity domains tend to be built up by the non-overlapping concatenation of linearity domains. When linearity domains overlap, they tend to overlap completely. Edges of linearity domains are more accessible in non-concatenative linearization than interiors.

[b] Adhesivity Principle: Given two linearity domains of different sizes, the subconstituents of the smaller linearity domain will be more tightly bound than the subconstituents of the larger linearity domain. The linear bonds between constituents can be broken, but this is generally minimized.

[29] At this stage, I can do little more than to simply treat these principles as unexplained primitives of the linearity component.

[30] Example of hypothetical language violating these principles: Ultra-Arabic (non-concatenative syntax)

<table>
<thead>
<tr>
<th>LEXICAL ITEM</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>tgr</td>
<td>‘tiger’</td>
</tr>
<tr>
<td>rkn</td>
<td>‘raccoon’</td>
</tr>
<tr>
<td>uioe</td>
<td>‘see’</td>
</tr>
<tr>
<td>Tugir roken.</td>
<td>transitive sentence template</td>
</tr>
</tbody>
</table>

[31] Why is non-concatenative morphology attested but non-concatenative syntax is not?

[32] Based on the principles above, Ultra-Arabic is worse than Arabic for two reasons.

[a] First, it is a worse violation of the Isthmus Concatenation Principle than Arabic since the vocalic linearity domain must be interspersed between two other linearity domains instead of just one.

[b] Second, it is a worse violation of the Adhesivity Principle. Arabic morphology involves the breakup of morphemes only within the word. Ultra-Arabic requires that a morpheme be broken up across two words.

[33] The Isthmus Concatenation Principle and the Adhesivity Principle are, in a certain sense, expected and obvious, and they probably reflect some true universal, or universals, of spoken language.

[34] We can imagine languages which violate them in all sorts of baroque ways, but we tend not to since languages generally follow them fairly closely.

[35] I won’t have time to talk about suprasegmentals, like tone, in any detail. However, it’s worth pointing out that, even though they do not concatenate in the “simple way”, they tend to respect isthmus boundaries.

[36] Evidence for these two principles comes from a range of different, intra-componential theoretical devices which have been developed and which adhere to them.

[37] The Strict Layer Hypothesis (Selkirk 1984)

[a] A prosodic hierarchy (Selkirk 1984:26)

5 Intonational Phrase
4 Phonological Phrase
3 Prosodic Word
2 Foot
1 Syllable

[b] “… a category if level $i$ in the hierarchy immediately dominates a (sequence of) categories of level $i−1$…” (Selkirk 1984:26)

[c] This ensures that prosodic constituents are built up in accordance with the Isthmus Concatenation Principle.

[38] Lexical Phonology (Kiparsky 1982)

[a] The model of word formation which is used by Lexical Phonology follows the Isthmus Concatenation Principle and, in fact, uses this principle to assist in morphophonological analysis.

[b] Words are built up based on an initial isthmus of a root, and then affixes are added in a way consistent with the Isthmus Concatenation Principle.
Lexical Phonology then makes some additional theoretical claims, like each isthmus can be the domain for phonological rules.

The convention of bracket erasure, generally employed in Lexical Phonology is consistent with the Adhesivity Principle.

The Mirror Principle Baker (1985)

“Morphological derivations must directly reflect syntactic derivations (and vice versa).” (Baker 1985:4)

From a linearity perspective, this is taken to result in the fact that the order of morphemes in a stem should reflect their semantic scope.

The idea that the Mirror Principle should have a linear reflex, only makes sense if we assume an isthmus concatenation model.

That is, we must envision morphology as essentially agglutinative since this makes its linear behavior fairly close to linearization in syntax which is also, basically, “agglutinative”.

Consider this Swahili example and a deep structure for it adapted from Baker (1988:398–400).

A-li-ni-fung-\textit{ish-}a mtoto wangu mlanga.

3\text{-}PAST-1S\text{-}close-C\text{\footnotesize{AU}}\text{\footnotesize{S}}-APP-FV child my door

“He had my child close the door for me.”

There is also a sense in which the Mirror Principle crucially relies on the Adhesivity Principle.

The leading idea behind Baker’s analysis is that affixes have to be morphologically hosted in some way, which causes them to appear in non-canonical positions given their syntax.

This idea can be understood as a reflex of the Adhesivity Principle. As bound morphemes, these units are embedded within word-level (or, in the Bantu case, stem-level) linearity domains, which are, in turn, embedded in phrasal linearity domains of their own.

This means that, from the perspective of linearity domains, these morphemes should be fairly tightly bound with respect to the sentence, which keeps them from appearing in a position which is more “faithful” the position assigned to them in a syntactic structure.

These earlier views could be paraphrased as “morphology can override syntax.” The view taken here would refine this statement as “morphological linearity domains can override syntactic ones.”

General comments on syntax

In some syntactic frameworks, a distinction between PF (“phonological form”) and LF (“logical form”) has been exploited to various ends.

“By hypothesis, linear ordering is not a property of syntactic representations but is imposed at PF in virtue of the requirement that speech be instantiated in time…” (Embick and Noyer 2001:562)

Practically, however, since the possible structures of trees are so severely limited both in PF and LF, the linear possibilities for a PF structures associated with some syntactic structure are severely limited. (Aspects of this idea are insightfully explored, with different terminology, in McCawley (1999).)

For example, syntactic representations are often assumed to be expressible as tree structures. Trees are “acyclic graphs”—that is, they do not allow loops in their structure.

Acyclic graphs can be trivially linearized via isthmus concatenation.

Cyclic graphs are perfectly conceivable as linguistic structures, as in the example below—a plausible representation of a sentence meaning Mary saw a picture of herself.
However, a linearization algorithm consistent with isthmus concatenation is not immediately apparent for acyclic structures.

Mary saw a picture of herself.

The cyclic principle

An example of the cyclic principle at work, taken from McCawley (1998:167–8):

Passivization must precede Wh-movement in the above examples.

I use the term cyclic principle here in the sense of McCawley (1998:29): “when one domain to which transformations can apply is contained in another, the applications of transformations to the smaller domain precede the applications of transformations to the larger domain.”

From a linearization stand point: the linearization of a smaller linearity domain becomes “frozen” before the linearization of a larger linearity domain containing the smaller linearity domain becomes “frozen”.

The cyclic principle is consistent both with the Isthmus Concatenation Principle and the Adhesivity Principle.

It implies that syntactic constituents become linearized from small units to larger ones. This is very much in line with the idea of isthmus concatenation.

By “freezing” the linearization of smaller units before the linearization of larger ones, it also abides by the Adhesivity Principle.

In using both the cyclic principle and Lexical Phonology in order to argue for a linearity component, I am recycling the generalization encoded in the double use of the term “cycle” in phonology and syntax.

Cyclic syntax is alive and well—though the cycle has been reconceived and renamed the “phase” in its latest incarnations.

Conclusion: Weak linearity is governed (at least partially) by a similar set of principles regardless of the component in which weak linearization is taking place.

4 Conclusion

There is good evidence for strong linearity at many different levels of linguistic constituency.
There is evidence that there is something consistent about weak linearity across phonology, morphology, and syntax.

Therefore, there is evidence that the model of grammar in figure 1 usefully reflects an important set of generalizations about linearity in spoken language grammar.

Further directions

A restrictive theory of strong linearity (see Good (2003))

Models for the interfaces of linearity with phonology, morphology, and syntax

A more precise formulation of the Adhesivity Principle

Coming to some understanding of the relationship between linearity and the lexicon—lots of questions here: Why are nouns and verbs usually bigger than adpositions? Why do certain grammatical categories tend towards becoming inflectional morphemes (which, typically, are linearly small and dependent)? Etc.

Developing a parallel model of spatiality for sign languages (en route to the real prize: putting together a general model of grammar which clearly separates modality-dependent phenomena from modality-independent ones)

References


McCawley, James D. 1999. Why surface syntactic structure reflects logical structure as much as it does, but only that much. Language 75:34–62.


McDonough, Joyce M. 1990. Topics in the phonology and morphology of Navajo verbs. Amherst, Mass.: University of Massachusetts, Ph.D. Dissertation. (Distributed by the Graduate Linguistic Student Association.).


