Evolution of the speech code:

higher-order symbolism and the grammatical Big Bang

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Abstract: As our ancestors innovatively juxtaposed one meaning-bearing sound to another, a huge increase in the inventory of speech sounds was triggered. Still, sporadic semantic ambiguity required deeper structural analyses in order for listeners to extract intended meanings, culminating in the emergence of compositional, post-compositional, and ultimately hierarchically-arranged and recursive constituent structures. These primordial pressures and their yielded structures, in remarkably similar function and form, continue to constrain, shape, and change the speech code to this very day. The early juxtaposition of two meaning-bearing sounds was thus both necessary and sufficient for full-blown grammatical complexity to evolve, triggering a grammatical "Big Bang".

18 • ***First-order symbolism***: one-to-one correspondence between (arbitrary)
19   symbol and meaning, a consequence of single vocal symbols produced in
20   isolation.

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22 • ***Second order symbolism***: evolves from first-order symbolism as two vocal
23   symbols are juxtaposed. It triggers a breakdown of a one-to-one symbol-
24   meaning correspondence, culminating in many-to-one and one-to-many
25   correspondences between symbol and meaning.

26

27 • ***Third-order symbolism***: evolves from second-order symbolism, as a
28   consequence of string-medial phonetic content being of sporadically
29   ambiguous affiliation between our two juxtaposed symbols, thus triggering
30   this ordered string's analysis into a hierarchical constituent structure, and
31   paving the way for recursion.

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34 **1.** *Zero-order symbolism*: the iconic manual gesture

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2. ***First-order symbolism*** **in the speech code: one-to-one correspondence between sound and meaning**

- The four "A"s: Articulation, Aerodynamics, Acoustics, Audition

pu, ti, ka   "Run!", "Kill!", "Sex!"

42 • Despite this move toward a speech-based semiotic system, this one-to-one

43 correspondence between event and meaning is perhaps characteristic of

44 almost all animal sound communication systems.

45 • *We are far from grammar*.

3. *Second-order symbolism* in the speech code: one-to-many and many-to-one correspondence between sound and meaning

pu-pu, pu-ti, pu-ka, ti-pu, ti-ti, ti-ka, ka-pu, ka-ti, ka-k a .

| pu-ti | "Run! Kill!" |
| ti-pu | "Kill! Run!" |

"Run if you don't want to get killed!" *OR*, instead, "Run to kill that animal!"

- **pu-ti**: As a consequence of coarticulation, the end of the first sound is systematically modified by the immediate succession of the second, and likewise, the second sound is systematically modified by the immediate precedence of the first.

- **-ti** when immediately preceded by **pu-** is systematically phonetically distinct—though semantically non-distinct—from **ti** in isolation, or **ka-ti**.

- **pu-** when immediately followed by **-ti** is systematically phonetically distinct (though semantically non-distinct) from **pu** in isolation, or **pu-ka**.

- Now it is *several* sounds that correspond to one meaning.

- This establishes a *many-to-one relationship between sound and meaning*, a development found in all languages.

- The juxtaposition of one sound to another thus opens the floodgates of second-order symbolism.

- As these sound complexes are repeated and repeated in their appropriate real-world contexts, *new* sounds inevitably arise.

- The medial closure in our pu-ti example may eventually undergo a process of voicing, becoming pu-di .

- Both ti- and -di now correspond to a single meaning: every time ti (with a voiceless closure) is immediately preceded by another sound, it is replaced by di (with a voiced closure).

- -di may now be assigned an additional meaning, and thus becomes free to appear as the first element of a complex, for example, di-bu (as opposed to a different complex, ti-bu).

86 Two different meanings are now cued by the same sounds in comparable
87 or even identical contexts. We may have bu-di in which -di means one
88 thing, but also bu-di in which -di means something else.

89

90 • This establishes a *one-to-many relationship between sound and meaning*, a
91 development also found in all languages.

92

93 • The mere juxtaposition of two simple sounds triggers remarkable growth
94 and complexity of both the phonetic and the semantic inventories.

95

96 • Both one-to-many and many-to-one correspondences between sound and
97 meaning naturally evolve and, as we'll see, have good reason to flourish.

98

99 • This is **second-order symbolism**.

100

3.2 More examples, more complexity

bu- di- ga- → pu- ti- ka-
(drag to initial stop devoicing)

pu- ti- ka- → pʰu - tʰi- kʰa-
(push to initial stop aspiration)

103

104   bu- di- ga- → mbu - ndi- ŋga-   bu- di- ga- → pù- tì- kà-

(push to prenasalization)   (shift to tone)

104 • Modern-day pressures on sound patterning are not merely characteristic
105   of the modern-day grammatical system. Rather, they were in place long before
106   the grammatical system came into existence, acting as a driving and inertial
107   pressure on the very development of grammar itself.

108

109 • Systematic phonetic changes are not only a *result* of grammatical complexity.
110   Also, they are a very *cause* of this complexity.

111

112 **Summary**

113 • The juxtaposition of two simple speech gestures may have evolved to
114 convey increasingly complex meanings.

115 • Such juxtapositions necessarily change the phonetic character of both
116 gestures in systematic ways.

117 • The consequent sound complexes now achieve second-order symbolic
118 status: both many-to-one and one-to-many sound-meaning
119 correspondences come to be present in the speech code.

120 • These sound complexes may also be harnessed to encode new meanings,
121 thus precipitating an explosive growth in the complexity of both the
122 phonetic and the semantic inventories.

123

124 • *We are moving closer to grammar*.

3.3 Entrenching the juxtaposition of two symbols, and the rise of post-compositionality (lexicalization)

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128 • Lexicalization: pu-ti → puti? pudi? pʰuzi? pútì?

129 • Earlier, the juxtaposition of one sound to another involved only two
130 mouth-opening gestures.

131 • Now such juxtapositions may involve three or four opening gestures, for
132 example, puti-ka , puti-kati , etc.

4. ***Third-order symbolism*** **in the speech code: the ambiguous affiliation of string-medial content, and the triggering of hierarchical constituent structure and recursion**

- Semantic ambiguity of structural origin feeds a hierarchical constituent structural analysis, which in turn feeds recursion.

4.1 The tug-of-war between first-order and second-order symbolism

- There are now pressures *towards*, and pressures *against* the development of third-order symbolism. We first consider a passive *resistance to* the triggering of third-order symbolism.

putika   pu-tika puti-ka

- Sound-internal intervocalic voicing disambiguates the structure:

putiga

pu-tiga

155

pudika   pudi-ka

- Oral closure voicing now acts to cue the compositionality of the forms: "boundary signals". Here, voicelessness cues a boundary.

Stress may serve a comparable function:

Ambiguous:

162

i putika

pu-tika puti-ka

Unambiguous:

163

i

'pu'tika

'pu-'tika

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166   'puti'ka   'puti-'ka

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168   **Summary**

169   • The juxtaposition of a very small inventory of simple meaning-imbued

170   sounds inevitably leads to an explosion of phonetic and semantic

171   complexity, rife with cues to structure and meaning, of the sort possessed

172   by all languages.

173

174   • This complexity now sets the stage for full-blown grammar to emerge, as

175   second-order symbolism gives way to symbolism of the third order.

176

4.2 The ambiguous affiliation of string-medial content, and the rise of hierarchical constituent structure

putika

pu-tika *OR* puti-ka

- Listeners' conditioned expectation of binarity, coupled with the string's semantic ambiguity, triggers its deeper, higher-order analysis.

- Structural ambiguity opens the gateway to third-order symbolism, by requiring listeners to perform a deeper analysis of the sounds than had been heretofore required.

187 • The ambiguous affiliation of the middle term thus opens the gates to
188 hierarchical structure.

189

190 • (1) sound-sequencing cues

191 • (2) meaning-sequencing cues

192 • (3) pragmatic cues to the intended meaning and structure of the string.

193

194 • It is exactly those rarely-encountered ambiguous forms that are most
195 important for the development of the system toward third-order symbolic
196 status.

197

198 **4.3 Hierarchical constituent structure, and the rise of recursion**

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200   putikakatipu   putika-katipu *OR*
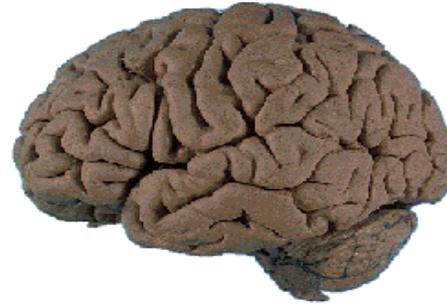
201   putika [ka-tipu] *OR*

202   [[pu-ti]-kaka]-tipu *OR*

203   puti-[kaka-[ti-pu]] *OR*

204   [[puti]-ka]-[[kati]-pu], etc.

205 •   It is the listener's expectation of binarity, coupled with the semantic

206   ambiguity of the string, that triggers deeper structural analyses, analyses

207   that quickly culminate in both hierarchical and now recursive structures,

208   when embedding involves elements of the same type.

208 • *Semantic ambiguity drives grammatical complexity*.

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- 208 The phonetic product of two juxtaposed sounds of increased length may
  209 lack semantic clarity, due to an ambiguous affiliation of its middle span.
  210 The resulting string is thus ambiguous between (at least) two different
  211 structures, each involving these sounds' hierarchical structuring, and thus
  212 opening the floodgates to recursion.

- 214 All the major structural components of grammar are now in place: a
  215 lexicon, a phonology, a morphology, a syntax, a semantics.

- 217 *We have now arrived at grammar*.

5. Conclusion: the grammatical Big Bang

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220 • The humble origins of the speech code likely consisted of extremely short,
221 meaning-imbued sounds uttered in isolation that first accompanied, and
222 then replaced our manual iconic communication system.

223 • These sounds' yielding to their juxtaposition in pairs may indeed have
224 triggered a sort of grammatical "Big Bang".

225 • Phonetic and semantic pressures came to interact in a way that inexorably,
226 and perhaps rather suddenly, led to genuine grammatical complexity.

227 • Listeners' conditioned expectation of binarity, coupled with the sporadic
228 semantic ambiguity of these increasingly long structures, required deeper
229 cognitive analyses in order to extract their meaning, which in turn
230 triggered the emergence of hierarchical and recursive grammatical
231 structures.

232 • Semantic ambiguity drives grammatical complexity.

233 • These primordial pressures and their yielded structures, in remarkably

234 similar function and form, continue to constrain, shape, and change the

235 speech code, even unto to this very day.

237 **Thank you.**

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