Universal Grammar

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Outline

Rules

English yes-no questions

Move the verb to the front of the sentence.

Reflections

1. When you think about the communicative function of language the fact that there are regularities is not surprising.
2. The fact of regularities at multiple levels (phonological, syntactic) is a little more surprising, but maybe understandable when you learn more about the difficulties of syntactic and acoustic processing.
3. But why should there contentful universals? (Xbar theory, +/- Q in C, Wh-movement, a universal Tense feature, universally defined structural positions in clauses [T,C])

Stanislaus Dehaene on reading (video)

1. **Visual word form area:** There is a very specific area of the visual cortex which is activated during the early stages of reading (Dehaene's slides)
2. Key points:
   1. Consistency across ideographic, syllabic, and alphabetic writing systems
   2. (Early) Visual area responses to **words**, as opposed to letter sequences, distinguishable (Szwed et al. 2011)
   3. Aphasias specific to **reading** impairment

The puzzle

1. How can there be an area of the brain specialized for **reading**?
2. Analogous region in monkeys: What is the prior function of the visual word form area in the monkey brain?
3. Obviously writing systems evolved much too recently for the brain to have **evolved** a specialized “device”
4. So there can be no **reading organ**

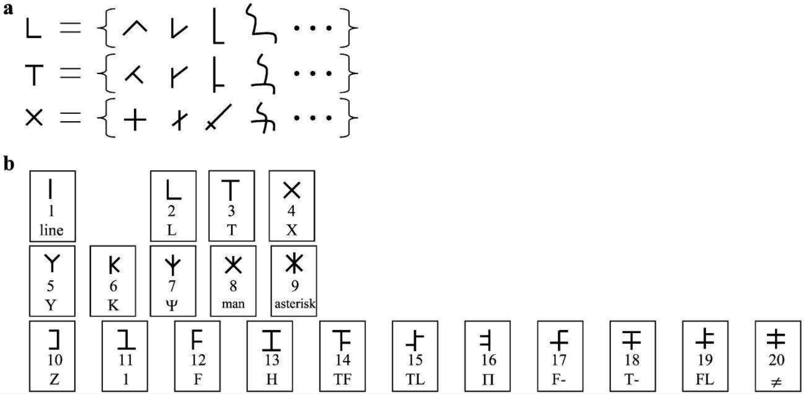
The statistics of strokes

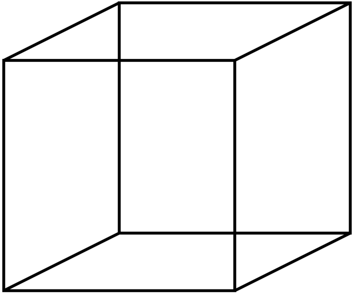
Changizi and Shimojo (2005): Letters/Ideograms is writing systems can be decomposed into simpler 3-stroke components. (certain junctions are very frequent, others not).

2-stroke version: L is much frequent than X. Count junctions in natural images, these regularities are maintained. More often than not the more frequent junctions occur in our writing systems.

Changizi's stroke table: Changizi et al. (2006)

Changizi and Shimojo (2005), Changizi et al. (2006) found that the typology of strokes obeys a universal statistical distribution. (Deshaene's slide 38)





Line junctions are very important in vsisual recognition (24:51 video) Biedermann effect (Biederman and Kim 2008)

Line junction area of visual cortex overlaps with visual word form area (26:51 video).

Face recognition analogies: invariance, line detectors, conjunction detector

Junctions in line drawings

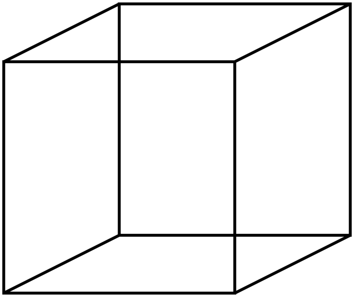
Particularly informative are those parts of an image where contours touch or intersect (Clowes, 1971; Huffman, 1971; Albert and Hoffman, 1995) and many authors have shown how these various junctions form a set of constraints that are often sufficient to specify the original object (c.f., Barrow and Tenenbaum, 1981; Malik, 1987).
For example, a T-junction is formed when one object interrupts the contours of another object behind it (the contours meet in a junction as in the letter T); a Y-junction is seen at the front corner of a cube; an X-junction is formed when the contours of a transparent material cross those of a background surface. ...
These local junction cues are clearly used by the visual system to make sense of line drawings ...

Sayim and Cavanagh (2011), p. 118

Word specificity: Neuroplasticity

Neuroplasticity refers to the ability of the brain to reorganize the function and structure of its connections in response to changes in the environment.

Neural recycling



No organ for reading, this region never evolved for reading. It is a fairly early part of the visual processing system specialized for junction recognition. (Slides 29-31)

Deshaenes: Consequences of the neuronal recycling model

Architecture: The **fringe**

The architecture of our primate brain is tightly limited. It is laid down under genetic control, though with **a fringe of variability and plasticity** (itself evolved and under genetic control).

New cultural acquisitions are only possible inasmuch as they fit within this fringe. Each cultural object must find its neuronal niche. Far from being a blank slate, our brain adapts to a given cultural environment by minimally reconverting or recycling its existing cerebral predispositions to a different use.

From cultural “invariants” to toolbox

X L | T

1. Numerous cultural invariants should be identified and ultimately related to neuronal constraints (Deshaenes)
2. The strengths and weaknesses of our brain architecture should determine the speed and ease of cultural learning. (Deshaenes)
3. Soft universals: Since we’re talking about “ease” of learning here, not learnability writ black & white, we should see many features that are just tendencies or trends, rather than strict universals

Universals in the Carnie book

A descriptive vacbulary: head, modifier, tense, clause, nominal/verbal, questions (yes-no,wh)

Xbar theory	Based on word order variation across languages, the property of encoding modification relations by adjacency may be just one strategy
+/- Q in C	Encoding yes-no questions by some clause periphery marking probably has good motivation, as does encoding subordinateness of a clause
Wh-movement	Wh-movement not universal, found in diverse languages.
Tense feature	Tense not found in all languages (Vietnamese), a tendency
T,C	Aux/subordinateness info often morphologically marked (on verbs), again Aux and Comp found in typologically diverse languages, a tendency

Biederman, Irving, and Jiye G Kim. 2008.
17000 years of depicting the junction of two smooth shapes.
Perception 37(1):161.

Changizi, Mark A, and Shinsuke Shimojo. 2005.
Character complexity and redundancy in writing systems over human history.
Proceedings of the Royal Society of London B: Biological Sciences 272(1560):267–275.

Changizi, Mark A, Qiong Zhang, Hao Ye, and Shinsuke Shimojo. 2006.
The structures of letters and symbols throughout human history are selected to match those found in objects in natural scenes.
The American Naturalist 167(5):E117–E139.

Sayim, B., and P. Cavanagh. 2011.
What line drawings reveal about the visual brain.
Frontiers in Human Neuroscience 5:118.

Szwed, Marcin, Stanislas Dehaene, Andreas Kleinschmidt, Evelyn Eger, Romain Valabrègue, Alexis Amadon, and Laurent Cohen. 2011. Specialization for written words over objects in the visual cortex. *Neuroimage* 56(1):330–344.