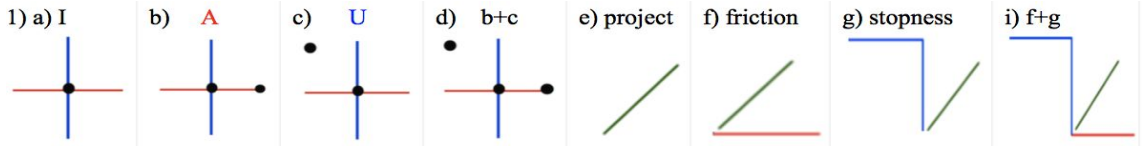
spatial cognition, evolution, correlated primitives, phonology, elements

Evolution and complexity: Grammar is made up of ones and zeroes

Phonological theories have primitives, e.g.: elements in Government Phonology (Kaye et. al. 1985). Though phonetically-grounded, primitives say nothing about their physical incompatibility (friction and nasality, Sole 2007) or correlations (labiality-voicing, Ohala 2005); labiality-stopness (the robustness of [m], illustrated in (2)). I will argue in favour of Spatial Phonology (SP) (Author, in press), where 'primitives' are mathematical objects whose dimensional complexity predicts such phenomena. Further, primitives of simpler structure are utilisable for extra-grammatical purposes (emotion, imitation) (3). Crucially, SP indicates an evolutionary leap from navigating physical space to creating a cognitive one. This view is in accord with findings in biolinguistics: Arsenijevic (2008) argues that Language evolved from spatial cognition.

SP adopts the position that language is an algorithm to asymmetrically (Di Sciullo 2005, for instance) build a three-dimensional cognitive space. Elements are coordinates in this space (0/1). By asymmetry, no non-zero coordinates are identical on a plane (1a-d). In (1), I deduce all and only the possible place and manner properties as degrees of dimensional complexity: The elements I (palatality), A (coronality) (Broadbent 1991), U (labiality) (1a-c); no constriction (only projection), friction, stopness (1e-g). The exact mapping of (1) to elements is motivated on phonological and phonetic grounds in Author (in press).



The system has two *levels* and *kinds* of complexity. **Levels:** Objects with depth (1e-i) vs without (1a-d). **Kinds:** Point (1a/1e), line (1b/1f), plane shape (1c/1g). Objects without depth give place: The elements I, A, U respectively (1a-c). Objects with depth give manner: no constriction, only projection (1e), friction (1f), stopness (1g). Plosives contain stopness+friction (1i), a stop without oral release is (1g) (differing from Pöchtrager 2006, cf. Schwartz 2016).

Crucially, place and manner properties contain the same shapes: Stopness and U have a plane shape, A and friction have a line, predicting place-manner correlations. For instance, [m] is the most robust stop, resisting assimilation and deletion in Turkish, and clustering with liquids (2).

The element H (aspiration, high pitch) is replaced by a bonding operation between the points on a line (1b, 1f) (cf. Pöchtrager 2006); the element L (true voicing/nasality/low pitch) between the points on a plane shape (1c, 1g). This is why nasality is incompatible with friction, and aspiration with stops (not plosives!). (These combinations may only exist at the higher 'syllabic' level, which makes them marked.) Also, since L is an operation on U and stopness, labiality and voicing in plosives are correlated (Ohala 2005), e.g.: Japanese and Arabic lack [p].

Since L, H are bonding operations, not configurations, they are peripheral to the system: Pitch and phonation are used extra-linguistically: singing, intonation to express emotion, whispering for dramatic effect. Also, since place is simpler than manner (no depth), it can be utilised extra-linguistically, e.g.: Turkish levels vowel place in sentences for pejorative imitation (3). I focused on the correlation of U-stopness-L and extra-linguistic utilisability. That a mathematical model accurately predicts physical facts better than physics-based ones indicates coevolution of the physical and cognitive systems.

2) Robuts behaviour of [m] in Turkish		
a) [m] resisting assimilation: *zamk* 'glue', *semt* 'district but not *np, nk, ŋp, ŋt#	**b)** [m] following liquids: *olm* 'mate!', *sperm* 'semen' but not *ln, rn#	**c)** [m] resisting deletion: *sonra/sõra* 'later', *tanrı/tãrı* 'god' but *kumru* 'dove', not **kũru*

3) Turkish vowel levelling for pejorative imitation (From ongoing corpus study of eksisozluk.com, forum)	
a) levelling to [o]: *Ostonboldon kodoloro gondorolom.* **original**: *Istanbul'dan kedileri gönderelim.* **gloss:** Istanbul+ABL. cat+PL.+ACC. send+OPT.+1st.PL. 'Let's empty Istanbul of cats'. **Abbreviations:** abl(ative), pl(ural), acc(usative), opt(ative)	**b) levelling to [i]:** *Viginlik bir yişim tirzidir* **original:** *Veganlık bir yaşam tarzıdır.* **gloss:** vegan+NOM. a life style+HAB. 'Being a vegan is a lifestyle.' **Abbreviations:** nom(inaliser), hab(itual)

500 words

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