HOW THE BRAIN GOT GRAMMATICALIZED: GLOBULARIZATION AND (SELF-)DOMESTICATION

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1. Introduction

This paper seeks to explore a potential connection between two evolutionary hypotheses recently put forward linking the language phenotype and genotype. Both are aimed to cast light on the pre-requisites for more complex communication systems; in the case of our species, grammatical systems. One (Boeckx and Benitez-Burraco 2014 et seq., Theofanopoulou 2015) is the idea that the globularization of the braincase that characterizes our species is the reflex of a genetically-regulated specific brain growth pattern that provided the neural scaffolding for "cognitive modernity", most distinctively our 'language-readiness'. This distinctive growth process is well established (Hublin et al. 2015), and clinical evidence suggests that deviations from this growth trajectory entail cognitive/language deficits (see, e.g., Knight et al. 2014). The other idea concerns (self-)domestication. As Thomas 2014 discussed extensively, self-domestication in our species can prove extremely valuable in understanding the central role played by cultural learning, giving rise to the grammaticalization of our mind. It is now clear that cultural learning appears to be key in capturing all the grammatical paraphernalia that was usually (and misleadingly) assigned to the "Universal Grammar". But as Thomas 2014 points out, a major problem

facing any attempt to account for language structure through a cultural mechanism is that the required processes are only possible if we assume the existence of a range of preconditions, which we may call the "cultural niche" (the 'cooperative' niche, as Tomasello would call it). Thomas 2014 thinks that this niche may have been formed by the behavioral, cognitive and temperamental outcomes of self-domestication. Interestingly, Wilkins et al. (2014) have recently put forth the hypothesis that the hypofunction of the neural crest cells (NCCs) during embryonic development in response to external stimuli may result in a constellation of distinctive traits (the "domestication syndrome").

2. Our hypothesis

Our hypothesis is that the genetic changes that have been claimed to bring about globularization affected the NCC too, thereby fueling the emergence of the (self-)domestication syndrome in our species. To test this hypothesis, we did an exhaustive literature search to determine whether (some of) the "domestication syndrome" genes highlighted by Wilkins et al. are also important for globularization and/or have changed in our lineage compared to Neanderthals and Denisovans (see, e.g., Pääbo 2014). We have also proceeded the other way around: we made extensive search of the literature to learn how many of (and to what extent) the candidates for globularization are involved in the development and function of the neural crest and could be also regarded as "neural crest genes". The intersection of the two set of genes (encompassing *SOX10*, *SOX9*, *SOX2*, *MTIF*, *MAGOH*, *FGF8*, *EDNRB*, *RET*, *TCOF1*, *BMP7*, *BMP2*, *CDC42*, *CTNNB1*, *DLX5*, *DLX6*, *FGFR1*, *PAX6*, *SHH*, *VCAN* among others) strikes us as particularly promising, given that most of these genes have been implicated in aspects of language and cognition.

3. Conclusions

The data we have gathered suggest to us that a globularized brain and brain case may be intimately connected to the developmental/genetic context for a domestic phenotype, which could then have been selected for the reasons Thomas 2014 discussed. Put another way, the language-ready brain which a globularized brain(case) gave rise to led to full-fledged modern linguistic behavior, the grammaticalization and (self-)domestication of mind.

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