

## **GROUP BINDING AS THE MAIN DRIVER OF LANGUAGE EVOLUTION**

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A novel hypothesis concerning language evolution is advanced. It posits that languages have evolved as a means of binding individuals to a group, as well as for defining these groups. The key evolutionary adaptation is the loss, in adults, of the ability to learn languages with the ease that children possess. The proposed hypothesis helps to explain the diversity of human languages, their complexity, as well as the apparent uniqueness of the language faculty to humans.

### **1. The main hypothesis**

The problem of language evolution has fascinated researchers for centuries (Wang and Minett, 2005), with the question of language diversity being one of the most intriguing ones (Lupyan and Dale, 2016). Why do people speak different languages? Whereas for groups of people that communicate little or not at all some languages differences are expected to appear due to the effects akin to genetic drift, the language divergence between groups that live next to each other is much harder to explain (Labov, 2010). Moreover, unlike in biological reproduction where each new individual inherits genetic material from one or two parents, each new carrier of a language samples from a much larger set (dozens or even hundreds of carriers). Thus, it may be expected that mutations would average out and the new learner would adopt the norm that is most common; according to Nettle (1999), this problem in modelling language evolution has been recognized since at least Sapir (1921).

The importance of language in the individual's social identity is well-established, and is manifest in children from an early age (Kinzler, 2021; Cohen, 2012). We suggest that the need for social identity has been the main driver of the evolution of language. More specifically, language evolved in such a way as to make it difficult to learn as an adult. Consider the fact that children have the ability to learn a language perfectly and the adults do not, in the sense that it is extremely difficult or often impossible for an adult to learn to speak a language as well as someone who learned it as a child. The cornerstone question that we pose is the following:

### *Can the loss of the language-learning ability in adults be adaptive?*

In other words, can the loss of this ability serve some purpose, and if so then is it possible that languages have evolved to fulfill this purpose? Put this way, the question may appear baffling, since it is difficult to imagine what advantage a loss of a cognitive ability may confer to an individual. However, the advantages become clear if this question is considered on the level of groups. The loss of language-learning ability defines, for each language, the group of its native speakers, and effectively binds them to this group.

## **2. Altruism and group-level selection**

Binding individuals to a group allows for the evolution of altruistic behaviour via group-level selection, which means that the evolution of language has to be considered in the context of the evolution of altruism. Let us consider this latter point in more detail.

Group-level (or, more generally, multilevel) selection is used to explain the evolution of altruistic behaviour. Altruistic behaviour is a behaviour that is detrimental to the individual but is beneficial to others which may be only distantly related; non-altruistic behaviour is called selfish. If selection acts on the super-individual level, that is, if groups compete between themselves, then groups which have more altruists get an advantage, even though an altruist is disadvantaged within their group (so long as it has at least one selfish member). It is worth noting that the idea of group-level selection as an explanation for the emergence of altruistic behaviour can be traced back to Darwin (1871).

In sociolinguistics, it is generally acknowledged that language should be considered a property of a group first and individual only second. In the words of Labov (2010), who calls is the central dogma of sociolinguistics, language is seen as an abstract pattern located in the speech community and exterior to the individual. The function of language as a source of social markers is widely recognized and well-studied (Nettle and Dunbar, 1997; Roberts, 2013). Moreover, the diversity of language seems interfere with the its other functions, such as communication (Labov, 2010; Roberts, 2013). Cohen (2012) gives a list of properties of language (more specifically, of accent) that makes it a particularly reliable source of social markers. Of particular importance for the hypothesis proposed is that it is salient and hard to fake. Indeed, one's native accent is hard to impossible to hide in a foreign language (Cohen, 2012; Sigmund and Nowak, 2001; Roberts, 2008), and it is extremely difficult for an adult to learn to speak a foreign language as well as a native speaker (Birdsong, 2009; Roberts, 2013; Kinzler, 2021).

Mathematical and computational models of various complexity have been proposed to explain the evolution of altruism through group-level selection, and, more specifically, tag-based cooperation; see (Rand and Nowak, 2013) for a review. Again, for the purpose of the proposed the hypothesis the most important aspect is the need for a mechanism that binds individuals to groups. Intuitively, it is

clear that between-group migration works against cooperation; specifically, one might think of individuals fleeing a group in the face of danger, e.g. under attack by another group. Mathematical modelling not only confirms this intuition, but shows that already random migration has this effect. One of the simplest models that allows for migration is that by Traulsen and Nowak (2006). In this model, the population is divided into groups and individuals reproduce within the groups. Groups may split upon reaching a certain size, and individuals may migrate at random with a certain probability. The authors show that group-level selection favours altruism if  $b/c > 1 + z + n/m$ , where  $b/c$  is the ratio between the benefit and cost of the altruistic act,  $n$  and  $m$  denote the maximum group size and the number of groups, and, finally,  $z$  is the average number of migrants arising from one group during its lifetime. Thus, at least in this model, migration works directly against altruism: the higher the migration ( $z$ ) the bigger the benefit of altruism should be related to its cost ( $b/c$ ) in order for altruism to survive.

Group-level selection in our own species had almost certainly taken place; in particular, Tattersall (2016) notes that the spread of *Homo sapiens* over the planet between 100kyr and 50kyr ago occurred far too rapidly to be accounted for by the slow workings of natural selection at the individual level (and suggests an explanation based on the invention of language, but does not consider its role as a group-binding tool).

### 3. Other mechanisms of group-binding

If binding individuals to groups is an essential part of group evolution, and in particular of the evolution of altruism, then one should expect there to be more than one means of achieving it. Some examples of the manifestations of this phenomenon can be found in artificial body deformations. These have been found across a wide variety of human cultures, and include cranial deformations, foot-binding, scarification, tattooing and so on, which can often be linked to class, status, religion or other forms of social identity (Mackie, 1996; Hoshower et al., 1995; Ludvico and Kurland, 1995). While it is clear that these phenomena are cultural, their widespread presence in only distantly related populations is an evidence of an underlying common genetic adaptation. It is worth noting that many of the artificial body deformations mentioned are applied to young children, i.e., at the same age that language acquisition starts; others are applied at adolescence, where group membership is being ascertained (e.g., as a right of passage).

The presence of these group-binding practices provides an indirect support to the hypothesis advanced in this note.

One can also ask the question of whether there is anything that makes the language a better group-binding tool than these practices. One possible answer is the universality of language: everyone has it. Indeed, Cohen (2012) lists this property as one of those making the accent an especially good source of social markers. While some of the other social practices mentioned above may be more

flexible, none is based on something that readily exists in all humans.

#### 4. Discussion

We have proposed a hypothesis that language has evolved as a tool to bind individuals to groups; thus, the difficulty with which adults can learn it is a group-level evolutionary adaptation. The need for languages to be complex is a direct consequence of this hypothesis (they need to be complex so as to be difficult for adults to learn). Moreover, for group-level selection to take place, groups need to reproduce, which entails language diversity (languages diverge to accommodate or to define group splits). Thus, the proposed hypothesis fits well the empirically observed phenomena – the complexity and diversity of languages – that have so far remained largely enigmatic from the theory point of view. Moreover, it is supported by theoretical models of group evolution as well as by the evidence of other group-binding practices that permeate human populations around the world.

There are many questions left to be answered. Most importantly, while the proposed hypothesis attempts to explain why the language evolved and what purposes it serves, it remains so far to speculate exactly how this evolutionary process took place. One can envisage two distinct possibilities: either the language evolved on the basis on some pre-existing cognitive abilities that children possess and that they lose growing up; or, the evolutionary process has somehow suppressed some existing cognitive ability; or, which is most likely, it was some combination of the two. If some pre-existing abilities played the main role, we would perhaps be able to find some other cognitive abilities that children have but adults do not. These appear rather difficult to find in humans. However, looking beyond our own species, a related mechanism can be found, namely that of imprinting. It is widespread in the so-called precocial species, i.e. those in which the young are born relatively mature. Specifically, filial imprinting establishes social preference for an object that should typically be the parent, during the first hours or days of life; sexual imprinting works similarly to establish sexual preference (see, e.g., Reznikova (2007) for review). Most importantly, these mechanisms are only active during certain sensitive periods of life. Clearly, humans are not precocial species and do not need to imprint the parental image for the same reasons that geese chicks do. However, similar cognitive mechanisms could be present. Sexual imprinting is also interesting to consider from this point of view, as the choice of sexual partner is largely affected by their group membership and social standing.

Parallels can be drawn with language acquisition and change. Thus, children are sensitive to language variation from an early age, and they start to use it as a strong source of social markers (Johnson and White, 2020; Kinzler, 2021); for example, 5-6 year-old children were demonstrated to prefer native-accented speakers and this preference was stronger than that for race (Kinzler et al., 2009). However, it is during the adolescence that the propensity to make changes to the language is the strongest Eckert (2004); Kinzler (2021). It thus may be interesting

to study the emergence of new language forms from the point of view of reproduction of groups and its relation to the sexual partner choice.

As with any hypothesis, an important question to consider is what evidence would disprove it. Finding other compelling reasons for the loss of the language-learning ability in adults, corroborated by studies on related species would be one way of doing it. Finding other learning abilities that have nothing to do with language (so that it could not be argued that language has developed on their basis) that disappear in adulthood would considerably undermine the hypothesis. It could also be useful to consider under which circumstances a language can actually become simpler. One example, that may appear contradicting the hypothesis proposed, is that languages spoken by larger with many non-native speakers have a tendency to lose some morphological complexity (Lupyan and Dale, 2010). However, it can be argued that precisely the fact that there are many non-native speakers (and that the is spoken by a large group) weakens its role as a source of social identity. In such cases this role is perhaps relegated to dialects, accents and other local language variations.

Another question that acquires a new perspective in light of the hypothesis advanced is the exclusivity of the capacity for language to our species. Language is often considered a uniquely human ability (e.g. Jackendoff, 2011), or at least partially so, in particular, Hauser et al. (2002) suggest that the FLN is uniquely human. From the perspective of the evolution of groups and altruism, our species does appear to be unique, though by no means the most advanced. Humans are perhaps the only species to live in large, highly-structured but at the same time genetically heterogeneous communities. Eusocial species, such as bees, ants and mole rats, are more advanced in the sense that their communities are much more genetically homogeneous. Some of these latter species, in particular bees and a select few species of ants, possess communication systems that allow for transmission of quantitative information, and, at least in the case of ants, are flexible enough to allow for information compression (review in Reznikova and Ryabko, 2011). Since they are eusocial, the groups in these species are families, i.e., are bound genetically, and so do not need to bind their members further using language or other means (this said, in many ant species the colonies are actually groups of families, and thus are genetically heterogeneous). Therefore, if the hypothesis advanced in this note is correct, their languages should be much simpler and less diverse. While their relative (with respect to humans') simplicity is perhaps a foregone conclusion, the diversity aspect appears an interesting subject for a comparative study.

## References

- Birdsong, D. (2009). Age and the end state of second language acquisition. *The new handbook of second language acquisition*, 17(1):401–424.

- Cohen, E. (2012). The evolution of tag-based cooperation in humans: The case for accent. *Current Anthropology*, 53(5):588–616.
- Darwin, C. (1871). *The descent of man: and selection in relation to sex*. John Murray, Albemarle Street.
- Eckert, P. (2004). Adolescent language. *Language in the USA: themes for the twenty-first century*, 6:58–75.
- Hauser, M. D., Chomsky, N., and Fitch, W. T. (2002). The faculty of language: what is it, who has it, and how did it evolve? *Science*, 298(5598):1569–1579.
- Hoshower, L. M., Buikstra, J. E., Goldstein, P. S., and Webster, A. D. (1995). Artificial cranial deformation at the omo m10 site: A Tiwanaku complex from the Moquegua valley, Peru. *Latin American Antiquity*, 6(2):145–164.
- Jackendoff, R. (2011). What is the human language faculty? two views. *Language*, pages 586–624.
- Johnson, E. K. and White, K. S. (2020). Developmental sociolinguistics: Children’s acquisition of language variation. *Wiley Interdisciplinary Reviews: Cognitive Science*, 11(1):e1515.
- Kinzler, K. D. (2021). Language as a social cue. *Annual review of psychology*, 72:241–264.
- Kinzler, K. D., Shutts, K., DeJesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children’s social preferences. *Social cognition*, 27(4):623–634.
- Labov, W. (2010). Principles of linguistic change, cognitive and cultural factors. *Malden, MA: John Wiley & Sons*, 10:9781444327496.
- Ludvico, L. R. and Kurland, J. A. (1995). Symbolic or not-so-symbolic wounds: The behavioral ecology of human scarification. *Ethology and Sociobiology*, 16(2):155–172.
- Lupyan, G. and Dale, R. (2010). Language structure is partly determined by social structure. *PloS one*, 5(1):e8559.
- Lupyan, G. and Dale, R. (2016). Why are there different languages? The role of adaptation in linguistic diversity. *Trends in cognitive sciences*, 20(9):649–660.
- Mackie, G. (1996). Ending footbinding and infibulation: A convention account. *American sociological review*, pages 999–1017.
- Nettle, D. (1999). Using social impact theory to simulate language change. *Lingua*, 108(2-3):95–117.

- Nettle, D. and Dunbar, R. I. (1997). Social markers and the evolution of reciprocal exchange. *Current Anthropology*, 38(1):93–99.
- Rand, D. G. and Nowak, M. A. (2013). Human cooperation. *Trends in cognitive sciences*, 17(8):413–425.
- Reznikova, Z. (2007). *Animal intelligence: From individual to social cognition*. Cambridge University Press.
- Reznikova, Z. and Ryabko, B. (2011). Numerical competence in animals, with an insight from ants. *Behaviour*, 148(4):405–434.
- Roberts, G. (2008). Language and the free-rider problem: An experimental paradigm. *Biological Theory*, 3(2):174–183.
- Roberts, G. (2013). Perspectives on language as a source of social markers. *Language and Linguistics Compass*, 7(12):619–632.
- Sapir, E. (1921). *Language, race and culture*. Harcourt Brace & Company.
- Sigmund, K. and Nowak, M. A. (2001). Tides of tolerance. *Nature*, 414(6862):403–405.
- Tattersall, I. (2016). A tentative framework for the acquisition of language and modern human cognition. *Journal of Anthropological Sciences*, 94:157–166.
- Traulsen, A. and Nowak, M. A. (2006). Evolution of cooperation by multilevel selection. *Proceedings of the National Academy of Sciences*, 103(29):10952–10955.
- Wang, W. S. and Minett, J. W. (2005). The invasion of language: emergence, change and death. *Trends in ecology & evolution*, 20(5):263–269.