

## Chapter 5

# Songs to Syntax: Cognition, Combinatorial Computation, and the Origin of Language

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### ABSTRACT

*Language comprises a central component of a complex that is sometimes called “the human capacity.” This complex seems to have crystallized fairly recently among a small group in East Africa of whom people are all descendants. Common descent has been important in the evolution of the brain, such that avian and mammalian brains may be largely homologous, particularly in the case of brain regions involved in auditory perception, vocalization and auditory memory. There has been convergent evolution of the capacity for auditory-vocal learning, and possibly for structuring of external vocalizations, such that apes lack the abilities that are shared between songbirds and humans. Language’s recent evolutionary origin suggests that the computational machinery underlying syntax arose via the introduction of a single, simple, combinatorial operation. Further, the relation of a simple combinatorial syntax to the sensory-motor and thought systems reveals language to be asymmetric in design: while it precisely matches the representations required for inner mental thought, acting as the “glue” that binds together other internal cognitive and sensory modalities, at the same time it poses computational difficulties for externalization, that is, parsing and speech or signed production. Despite this mismatch, language syntax leads directly to the rich cognitive array that marks us as a symbolic species.*

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## INTRODUCTION

It seems appropriate to address the full sweep of cognitive informatics and computing with an analysis of the origin and nature of that part of cognition that seems to be uniquely human, namely, language. There can be no doubt that language comprises a central component of what the co-founder of modern evolutionary theory, Alfred Russell Wallace, called “man’s intellectual and moral nature,” the human cognitive capacities for creative imagination, language and symbolism generally. In short, language makes us smart. In what follows, this article sketches how this remarkable ability might have arisen during the course of evolution and exactly how language boosts our cognitive capacity beyond that of all other animal species. To do this, it first outlines what we know about the evolution of modern humans. This will give us some important clues as to what marks out language as something uniquely human, leading naturally to a brief review of what it is that we humans have that other animals don’t – what paleo-anthropologist Tattersall (1998) calls “flexibility instead of specificity in our behavior.” After all, ants or bees can easily beat us at navigation, and it seems from recent studies that songbirds can do better than us at auditory production and perception. Yet we have surpassed them all in general intelligence.

Remarkably, as we shall see, it turns out that human language seems to arise from just a *single*, small evolutionary innovation, built on two already-available cognitive substrates, present separately in other animals, but brought together for the first time in modern humans. So human language is not just “more of the same,” to use Tattersall’s terms, but involves something entirely new, “how we integrate” cognitive competences that we share with other animals (Tattersall, 2010). In fact then, contrary to what is sometimes thought, human language is *not* complex – on the contrary, it is far simpler than anyone may have thought,

certainly simpler than what one reads about in standard linguistic textbooks. But it *is* novel. On reflection, this is not at all surprising, given the relatively short time scale involved in evolutionary terms – not millions of years but just 100-50 thousand years, according to current accounts. Complicated evolutionary change typically occurs over the time span of many thousands or millions of generations. Given this, we might anticipate that any evolutionary change leading to language would be relatively small, since it seems to have occurred within the time of a few hundred generations, and a hundred generations already takes us back to the founding of the Roman Republic. There simply was not enough time to evolve something as radically new and complex as, say, the wings of birds. As always, evolution by natural selection had to make do largely with what is at hand. Once unleashed, language served as a kind of *lingua franca*, a kind of “cognitive glue” that lets all our other cognitive faculties talk to each other, in a way that is not available to other animals. And applied to other human, digital cognitive domains, it leads to the number system, mathematics, and music. All this appears to be the result of a single evolutionary innovation. So how did this all happen?

Before beginning it is worthwhile to clear away two common misconceptions. First, this view does not entail that ‘thought’ is co-extensive with ‘language.’ Obviously they are not. Why? We all know that there can be language without thought, as is demonstrated to us every day by our rote conversations that take place seemingly without any reflection whatsoever – or failing that, the discourse of politicians. Conversely, there can be thought without language, as evidenced by the visual computation inherent in, for example, Feynman diagrams. Nonetheless, it is clear that language plays a large role in our mental lives. Second, I would also like to emphasize that the emergence of language cannot simply have been due to purely an expansion in brain size. While

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