

# Linguistic Co-Evolution and the Poverty of the Stimulus Argument

## Introduction

This paper investigates Chomsky's Poverty of the Stimulus Argument (1980) from a Darwinian co-evolutionary perspective, and argues that while language learning without some form of innate grammar seems almost impossibly difficult, both the brain, and languages, have evolved to make it possible. The arguments presented in this paper substantially weaken the intuitive appeal of the poverty of the stimulus argument but are not intended as a refutation of it. They are intended to contribute to a Darwinian perspective on *Plato's Problem*, and provide relevant conceptual tools to allow co-evolutionary reasoning about language.

## Background

Following Pinker and Bloom's landmark 1990 paper on the evolution of the language faculty (conceived in its broad sense (Hauser et al. 2002)), the Language Faculty has been widely analyzed as an evolutionary adaptation. Such analyses unsurprisingly make use of evolutionary ideas of the usual kind, familiar from biology. But these are not the only kind of evolutionary analyses that have been invoked in the study of language in recent years. Cultural evolutionary theories have also started to be applied in various areas of linguistics, particularly in relation to language change (Croft 2002, Ritt 2004). These cultural theories concern not the selection of genetic information, but the selection of information being passed from individual to individual via cultural transmission (Dawkins 1976, Blackmore 1999, Dennett 1995). Language is not the product of just a single evolutionary process, but of the combined product of two separate processes.

These two processes, biological evolution and cultural evolution, do not operate in isolation from one another. Each process affects the selective environment in which the other operates, and so changes to either, can have effects on the evolutionary outcomes of the other. Therefore, together, the biological evolution of the language faculty, and the cultural evolution of languages, can be seen as a combined co-evolutionary process. Unfortunately cultural-biological co-evolutionary systems are not well understood at present, and so it is still common practice to analyze the processes one at a time. This is not always desirable however, as there exists situations in which their interaction leads to outcomes not predictable from analyzing either in isolation (McCrohon to appear).

## Co-Evolutionary Adaptation

Evolutionary adaptation at both the biological (Pinker and Bloom 2002) and cultural levels (Christiansen and Chater 2008) has previously been proposed as contributing to making language learning more tractable. But there is no reason why adaptation at either of these two levels would need to exclude it at the other. Biological evolution to make the brain better equipped to learn the types of languages present in its environment, would not have stopped the cultural evolution of languages to be easier for L1 speakers to acquire. The combined effect of these two evolutionary processes therefore results in the easier acquisition of languages than would be expected if only one of them were operating.

In this paper, it is further argued that the effects of linguistic co-evolution are not limited to a linear combination of the effects of the two evolutionary processes in isolation. Instead when combined, they are likely to lead to simplifications to the learning problem that could not have been

reached by either of the evolutionary processes separately. The potential existence of such simplifications and justification as to why they could not be reached by the evolutionary processes operating independently is demonstrated via a pair of hypothetical fitness landscapes describing the possible states of the linguistically relevant biological and cultural systems.

These two fitness landscapes cannot however be simply combined to determine what would happen in the co-evolutionary system as a whole. Due to potentially divergent fitness evaluations it is shown that no direct equivalent of fitness landscapes can exist for a co-evolutionary system. A close equivalent is however possible if we disregard several of the standard properties of a “landscape”. The co-evolutionary “landscapes” thus derived are used to show that the previously identified unreachable simplifications are potentially reachable via co-evolutionary adaptation. This shows learning of languages can be simplified even more than a linear combination of biological and cultural adaptation effects would suggest.

## Summary

Both biological and cultural adaptation can potentially make Plato’s Problem more tractable. When these two processes take effect, it is no longer the task of learning an arbitrary linguistic system on a general purpose learning device, but rather a task of learning a linguistic system specially designed to be learnable on a learning device tailored to exactly that type of system. Given this simpler task, perhaps the stimulus is not as impoverished as we would otherwise believe. How much of a simplification occurs depends on the ability of the linguistic system and the learning mechanism to adapt to each other. The key contribution of this paper is to show that a co-evolutionary analysis of their evolution suggests they are better able to adapt than an analysis of either in isolation would suggest. In arguing this, the *co-evolutionary fitness “landscape”* was introduced which is likely to be useful elsewhere.

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