HOW DOES NICHE CONSTRUCTION IN LEARNING ENVIRONMENT TRIGGER THE REVERSE BALDWIN EFFECT?

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While the Baldwin effect describes how previously learnt knowledge becomes a part of innate knowledge, according to Deacon, under some circumstances, innate knowledge would be replaced by more plastic, learnt knowledge. As the process seemingly follows the opposite flow of what the Baldwin effect describes, he called this process the "reverse Baldwin effect" (Deacon, 2003). This effect is thought to have a strong explanatory power which has already been applied to explain such phenomena as the mysterious loss of the synthetic ability of Vitamin C (Deacon, 2003) in primate lineage. This paper will present how the niche constructing aspect of language evolution serves as one of the key mechanisms necessary for the purported effect without assuming, as Deacon has, that externally motivated changes (like climate changes) in environmental conditions would take place.

The reverse Baldwin effect is thought to consist of two successive subprocesses called "Masking" and "Unmasking" effects. Masking effect is an effect where an environmental change causes shielding to an extant selective pressure to penetrate phenotypic variations, and subsequently "neutralizes" genetic differences responsible for expressing such phenotypes. This eventually leads to random drifts in the purported region of the genotype. On the other hand, unmasking process is in effect where another environmental change somehow reinstates the original selective pressure so that the function the adaptive phenotype once achieved becomes necessary again. Together, these two processes lead to the necessary function originally established by a single phenotype where a single gene is responsible for being redistributed onto a group of phenotypes.

Given the potential explanatory power of the reverse Baldwin effect, Deacon (Deacon, 2003; Wiles, Watson, Tonkes, & Deacon, 2005) envisages that it could play a significant role in language evolution. However, it is apparent that, for the reverse Baldwin effect to take place, there needs to be some causal agent to induce the masking effect. In the case of vitamin C, it was the warm climate (and abundant fruits). Deacon considers the potential masking agent in language evolution is its niche constructing process. However, it is unclear quite how the process comes into play as regards the masking effect.

In order to examine how niche constructing process in language induces the masking effect, we set an agent-based computer simulation based on (Yamauchi, 2004). In the simulation, agents in the same generation attempt to establish communications with their learnt grammar (i.e., I-language) which constructs a normative social niche (i.e., E-language) which works as a selective environment, determining agents' fitness. The E-language becomes the next generation's learning environment from which learning agents receive linguistic inputs. As such, information in a given I-language is transmitted vertically through learnings. During learning, if a linguistic input cannot be paresed with the agent's current grammar, she changes her grammar so as to be able to parse it. The cost of such modifications is calculated based on what type of genetic information (i.e., UG) she has: if her UG is consistent with the input the cost will be smaller than when it is inconsistent with the input.

The result shows that the Baldwin effect takes place as Yamauchi (Yamauchi, 2004) reported: the agents' genetic information (i.e., UGs) quickly aligns with the niche-constructed learning environment. This is due to evolution attempts to minimize the cost of learning. Initially, different adults provided all sorts of random inputs causing many modifications on a grammar. However through the genetic assimilation, eventually most adults' grammars converge into one single type. This makes learning inputs highly consistent, and reduces the number of modifications. Subsequently, it changes the mode of learning fundamentally. This high consistence of inputs *masks* the importance of the UGs as agents can reliably keep a grammar and do not have to consult with their UGs frequently. This triggers gradual genetic drifts in the gene pool. However, the result of the drift slowly kicks into their grammars where some adults acquire different grammars. Consequently, learners in later generations eventually receive noise-included inputs which increase the cost of learning once again. This provides a strong selective pressure for another genetic assimilation like the early populations did, i.e., an *unmasking* effect.

References

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