LANGUAGE EVOLUTION IN ONTOGENY AND PHYLOGENY

OLGA VASILEVA

Psychology Department, Simon Fraser University,
Vancouver, Canada
ovasilev@sfu.ca

Research in language evolution frequently turns to studies of language development for generating hypotheses about possible evolutionary trajectory of communicative development in humans. One of the problems faced by such hypothetical models is the necessity to explain both universal aspects and individual variation in language development, which is essential for determining the core characteristics of language capacity shared by all humans and estimating the time of their emergence in evolution.

The current submission introduces a potentially fruitful tool, the Theory of Functional Systems (TFS). It was developed by P. Anokhin, and is supported by existing research (e.g., Toomela, 2010; Sudakov, 1997). This theory can contribute to our understanding of language development by examining variation in human communicative and linguistic abilities and its relation to the evolution of our species.

The TFS explains the development of complex behaviors both in evolution and in individuals by treating them and their supporting cognitive substrates as complex systems, and postulating three levels of systemogenesis. In primary systemogenesis, core abilities forming the basis of behavior are created; in accompanying secondary systemogenesis, these abilities are modified through the individual's interaction with its environment and preserved through brain plasticity in ontogenesis. If the environment creates stable selective pressure, certain behavioral systems formed during individual development may prove advantageous, and their maturation in the next generation's ontogenetic development may take place earlier. This third process is referred to as evolutionary systemogenesis.

Evolutionary systemogenesis relies, among other things, on specific mechanisms of gene expression in the nervous system. Growing evidence suggests that genes expressed in an individual's brain at the time of early Central Nervous Systems (CNS) development are often expressed again in the adult brain during various learning experiences. Moreover, the same genes can be involved in different aspects of behavioral development and learning (e.g. Tokarev et al., 2011). TFS has a potential for explaining (i) such genetic - behavioral interconnection, (ii) the process of transition from individual adult learned behavior over multiple generations into pre-adult species-specific behavior, iii) the links between phylogeny and ontogeny at the behavioral level, as well as (iv) the time sequence of emergence of certain abilities during development.

Application of TFS to the problem of language evolution requires examining genes associated with language development. For example, research in rodents demonstrated that one of the most prominent language associated genes - FoxP2 - is apparently involved not only in vocal development, but in certain aspects of learning in adult brains (Enard et al., 2009).

In ontogenetic language development, the core systems which have experienced strong evolutionary pressure will mature earlier and build the foundation for the organism's tuning to the specific environment through plasticity and learning, allowing further development of linguistic capacity. Thus, those aspects of language that develop early in ontogeny are most likely to have experienced strong selective pressure during evolution. Aspects of language development that are variable might help us identify specific environmental cues that are essential for an infant's growing linguistic system in secondary systemogenesis, and their developmental timing may unravel the evolutionary history of language. A TFS-based model can explain why human infants are capable of acoustic differentiation of speech sounds well before reaching motor independency and learning other aspects of language. Candidate abilities for primary and secondary systemogenesis are sound discrimination, word-object recognition, gestural communication and language acquisition styles. The ontogeny and phylogeny of language development has been a struggle to elucidate; TFS may greatly advance our understanding of human linguistics.

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