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Niche

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The *niche* refers to the ecological role of an organism in, and its relationship to, its ecosystem. Organism can exploit a variety of niches that in turn exert selection pressure on the population and hence explain adaptive genetic variation between members of the population. Recent discussions within evolutionary theory have invoked two quite distinct concepts of the niche. Niche Construction (NCT) theory and Developmental Niche Construction (DNC) are both theories designed to put the active organism back at the center of evolutionary theory, albeit with different conception of the niche at their center.

NCT refers to the process by which an organism alters its own environment and hence influences its own and its species selection pressure. It suggests that rather than populations of organisms passively adapting to a changing environment, they actively construct their environment – their *selective niche* – and thereby change the dynamics of evolution. Niche construction shapes the selection pressure of the population, and can result in the ecological inheritance of its selective niche; both of these processes affect the fitness of future generations (Odling-Smee, Laland, and Feldman 2003).

Some recent work on human evolution has emphasised the role of ecological niche construction in human evolution: the evolution of the unique characteristics of

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human psychology and social structure has been substantially driven by the selection pressures created by earlier psychological and social structures (Laland, Odling-Smee and Feldman 2000; Sterelny 2003). Niche construction theory deals with the *selective* niche, defined by the parameters that determine the relative fitness of competing types in a population. The ecological niche of humans overlaps mostly with its cultural niche that features in models of gene-culture coevolution, with genetic and cultural inheritance involved in a complex feedback loop via natural selection.

A quite different aspect of niche construction refers to the dependency of development on a rich *developmental niche*, which is actively constructed by the parents in interaction with the offspring, and other conspecifics. It may involve the physical and biological environment, and cognitive artifacts from tools to languages. Just like the construction of the selective niche, the developmental niche plays an important role in (human) evolution: The environment not just *selects for*, it also *constructs* new heritable variation. The developmental niche is defined by the parameters needed to ensure the reconstruction of the evolved life cycle.

The developmental niche figures dominantly in developmental system theory (DST), another account of evolution that focuses on the active role of the organism. At the center of DST lies the life cycle of a developmental system, which is comprised of the organism and its relationship to its developmental environment, the developmental niche. While most accounts of human nature focus mainly on the genetic heritage, a DS account of human nature pays attention to the role of the legacy of our developmental environment in constituting human nature (Stotz and Griffiths 2017). There is an old saying within anthropology that culture is not only part of human nature, but that our nature is culture. The concept of the developmental niche is designed to integrate and formalize the non-genetic yet heritable factors influencing an organism's development. It is therefore the *evolved* developmental niche that provides channels of sustenance for the developing organism, such as nutrients, warmth, insulation, and behavioral and social stimuli. It 'nurtures' the

offspring in the form of resources, stimulation, and affordances for development, i.e. it gates what is available to be learned. Hence the evolved developmental niche defines several pathways by which effects of experience on the parental generation can be transmitted to later generations. (Stotz 2014, 2017; Narvaez, Gleason et al. 2013).

The concept goes back to the "ontogenetic niche" coined by developmental psychobiologists West and King (1987). In the current formulation of the concept (Stotz 2014, 2017; Griffiths and Stotz 2017), the developmental system consists of genetic and epigenetic resources and an exogenetic developmental niche, which contains reliably inherited physical, social, ecological and epistemic resources needed to reconstruct, or in the case of phenotypic plasticity to modify, that developmental system. These resources can be actively constructed by the parents (producing the 'parental effects' of quantitative genetics) or by the larger group, co-constructed by parent and offspring, or sourced passively from a stable environment. Wherever they come from, if there exists an evolutionary explanation for the interaction of the evolved developmental system with the resource then that resource is part of the system. What evolves by natural selection is a relationship between system and each resource.

How does the developmental niche influence human development? Human babies are needy. They are born early in comparison to other primates, meaning that for several months postnatally, relative to other primates, human babies share characteristics of fetuses rather than of infants in those other primates (Trevathan 2011). Comparing brain size at birth among primates, humans should be born at 18 months of age. A large part of brain development takes place outside the uterus, influencing human offspring epi- and exo-genetically much more postnatally than their ape cousins, which makes the early niche fundamental for human development. Over the course of human evolution, as brains became bigger and human infants more immature at birth, human childrearing practices evolved in tandem with these changes to ensure the survival of the helpless infant. As

bipedalism, hemochorial placenta, large brains and the need for a great amount of learning after birth emerged, human evolution intensified parental care. The latter were important preconditions for selection to favor the evolution of a large brain in a bipedal animal (Trevathan, 2011, 33). The evolution of a more complex and resource-demanding developmental niche has been a key feature of human evolution.

For this reason, it seems to us entirely natural to say that that human nature resides partly in the human developmental environment. We are a species that is particularly strongly influenced by niche construction, both selective niche construction over evolutionary timescales and developmental niche construction over ontogenetic timescales. A concept of nature according to which what is natural must come from the inside is particularly unsuitable for such a species. Imagine trying to determine the real nature of an ant, another powerful niche constructor, by removing the influence of the nest on the developing egg and embryo. The result would be either dead or biologically meaningless, and so it is for humans. The concern is that when the developmental niche is not provided, the offspring will not develop in a species-typical manner.

As social mammals, humans have an intensive developmental niche for their young --soothing perinatal experience; warm responsive care; nearly constant physical touch (carrying, cosleeping); years of breastfeeding, free play in the natural world (Konner, 2005). The human developmental niche became more intensive because of the immaturity of the neonate, adding to the social mammalian practices a positive climate of mother-dyad support and multiple adult caregivers (Hrdy, 2009). All these practices have known epigenetic and plasticity effects on neurobiological systems and longterm wellbeing of the child (for reviews see: Narvaez, Panksepp, Schore & Gleason, 2013). The developmental niche has powerful effects on the type of human nature one develops, as notable among societies who routinely provide it—small-band hunter-gatherers (e.g., Ingold, 2005), the type of society in which the human genus spent 99% of its genus history. Recent empirical studies also show the

developmental niche's relation to adult mental health, sociality and morality (Narvaez, Gleason et al 2013).

The developmental niche has two fundamental functions. One function is to ensure the stable, reliable development of species-typical traits. So what explains *Typicality* is the developmental systems dynamics within what we may call 'normal' parameters, some of which are provided by pre-existing physical and developmental constraints. The rest are ensured by reliably and stably inherited resources, which are not just the genome and but essential environmental resources that assist, among other functions, in the species-typical expression of the genetic factors. These stable resources are also what partially explain fixity. In addition there are buffering internal mechanisms of the organism that buffer against internal (genetic, epigenetic, metabolic) and external perturbations. These are invoked when we talk about canalization.

But human nature needs to embrace and explain human diversity: Here the second function of the developmental niche comes in. Beyond ensuring reliable, species-typical development, the developmental niche also provides input to developmental plasticity. Plasticity is often defined in terms of a genotype's ability to produce different phenotypes in response to the environment. It would be more accurate, however, to say that the shape of the norm of reaction is a property of the whole developmental system. So what explains human diversity are differing developmental systems dynamics supported by modifications in the developmental niche. In other words, human diversity results primarily from the interaction between the evolved developmental system and a wide range of environments, including novel environments. We should find order by identifying underlying patterns of similarity and difference rather than universal elements (Griffiths 2011). Developmental niche construction therefore provides dependability, but also adaptive flexibility, in the provision of necessary developmental resources.

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