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Neoteny



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Synonyms

[Juvenilization](#); [Paedomorphism](#); [Paedomorphosis](#)

Definition

Neoteny is the deceleration of the rate of somatic development, resulting in paedomorphism (or paedomorphosis).

Neoteny is the deceleration of the rate of somatic development, resulting in paedomorphism (or paedomorphosis). Paedomorphism is a form of heterochrony characterized by the retention of ancestral juvenile traits in descendent adults (McNamara, 2012). Paedomorphism can be the result of neoteny or progenesis (acceleration of sexual development) and it is important to distinguish whether apparently juvenile reproduction is better explained by neoteny or progenesis. The term “neoteny” was introduced by German zoologist Julius Kollmann (1885) to describe the retardation of physiological development in species of amphibians that results in the retention of larval traits in sexually mature adults (Gould, 1977). In neotenic animals, growth and

sexual maturation progress but with certain arrests in physiological development.

Neoteny is arguably demonstrated in many modern animals such as species of gobies, termites, mayflies, cicadas, crustaceans, jellyfish, and the Mexican axolotl (*Ambystoma mexicanum*) (Skulachev et al., 2017). An axolotl is an aquatic salamander that retains its gills and remains in water throughout its life. Most salamanders have an aquatic larval stage and emerge from the water as metamorphosed terrestrial adults capable of reproduction and with lungs instead of gills, whereas axolotls reproduce while exhibiting features characteristic of juvenile salamanders (Ridley, 2003). The age at which an axolotl reproduces is not abnormally early for a salamander, suggesting that axolotl age of reproduction remained consistent with non-neotenic salamanders while somatic development slowed down – evidencing neoteny rather than progenesis (Ridley, 2003). Other amphibians display features of neoteny similar to the Mexican axolotl, including the olm (*Proteus anguinus*) and the American mudpuppy (*Necturus maculosus*); however, debate is ongoing as to whether these features are the result of neoteny, progenesis, or both (Wakahara, 1996). Similarly, research has not yet identified the mechanistic basis of neoteny in axolotls, and outstanding questions remain about the functions of variations in salamander life history strategies (Crownier et al., 2019).

Although the etiology and function of neoteny in axolotls remains unclear, research indicates that

neoteny evolved in various nonhuman animals to facilitate coexistence with humans as a result of artificial selection. Neoteny is a feature of the domestication syndrome, and many neotenous mammals are domesticated. Common physical and behavioral traits of domestication in mammals (and animals, more generally) were identified by Darwin (1868) and include reduction of body mass, shortening of the face, smaller tooth size, reduced sexual dimorphism because of feminization, and reduced skull volume (Wrangham, 2019). Humans have selectively bred animals for docility, and Belyaev (1969) demonstrated that selection for lowered propensity for aggression in foxes produced a suite of phenotypic traits characteristic of neoteny and domestication syndrome such as smaller jaws, skulls, and teeth (Wrangham, 2019). Exemplary features of neoteny visible in many domesticated mammals are thus the unintended downstream consequence of artificial selection for docility. Animals such as dogs, cats, fancy rats, hamsters, ferrets, and rabbits exhibit neoteny related to the domestication syndrome produced by selective breeding by humans. Natural selection presumably contributed to the development of the domestication syndrome and neoteny in these species since coexistence with humans affords survival and reproductive benefits, such as access to human food and shelter.

Bonobos also demonstrate neoteny related to the domestication syndrome, likely a result of sexual selection. Bonobos evolved from a shared ancestor with chimpanzees between one million and 1.8 million years ago and, despite many shared features, appear to demonstrate the domestication syndrome whereas chimpanzees do not (Wrangham, 2019). Adult bonobos exhibit physical and behavioral similarities to juvenile chimpanzees, suggesting that bonobo development is delayed or occurs at a slower pace than in chimpanzees. Compared to adult chimpanzees, sexually mature bonobos have thinner limb bones, smaller teeth, and narrower faces (Wrangham, 2019). Bonobo females do not face the feeding competition from gorillas that chimpanzee females face and are therefore able to form alliances with other females to dominate an

aggressive male and prevent sexual coercion. Female chimpanzees are routinely subject to sexual coercion and unprovoked attacks apparently related to male control of food sharing (Wrangham, 2019). Female alliances facilitate female mate choice, which appears to be the mechanism by which bonobos self-domesticated. Throughout bonobo evolutionary history, females apparently chose to mate with males exhibiting lowered aggression, leading to the unintended downstream consequence of neoteny.

There is strong evidence that humans exhibit neoteny. When a human is sexually mature, it has the bulbous cranium, small jaw, and flat face of a developmentally immature ancestor (Bogin, 1999). Compared to other primates, adult humans demonstrate neotenous traits such as a lack of body hair, central position of the foramen magnum (which migrates backward in most other primates), a high relative brain weight, persistence of cranial structures to an advanced age, absence of brow ridges, thin skull bones, small teeth, later eruption of teeth, lactose tolerance into adulthood, and no rotation of the big toe (Skulachev et al., 2017). Other neotenous features in humans include the form of the pelvis, the labia majora in females, prolonged growth, prolonged infant dependency, a long lifespan, and short extremities relative to body size (Skulachev et al., 2017). *Homo sapiens* reaches sexual maturity at a later age than ancestral humans, demonstrating neoteny rather than progenesis (Bogin, 1999). Studies have reported that neotenous features illicit more help, render babies cute, and that neotenized female faces are more attractive (Jones, 1995; McArthur & Berry, 1987; Montagu, 1989). The role of neoteny in human ontogeny and phylogeny is a rich area of research that has produced a wide array of theories and findings.

Cross-References

- ▶ [Adolescence](#)
- ▶ [Artificial Selection](#)
- ▶ [Coevolution](#)
- ▶ [Common Ancestor](#)
- ▶ [Developmental Arrest](#)

- ▶ Domestication
- ▶ Domestication Hypothesis
- ▶ Domestication Syndrome
- ▶ Female Choice
- ▶ Feminization
- ▶ Hominid
- ▶ *Homo Sapiens*
- ▶ Human-Animal Interaction
- ▶ Husbandry
- ▶ Life History
- ▶ Mammalia
- ▶ Natural Selection
- ▶ Parenting
- ▶ Patchy Food Distribution
- ▶ Pets
- ▶ Phenotype
- ▶ Phylogeny
- ▶ Primates
- ▶ Richard Wrangham
- ▶ Self-Domestication Hypothesis
- ▶ Sexual Dimorphism
- ▶ Sexual Selection
- ▶ Species

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