# Harnessing teleology for one's own purpose

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**Short Abstract**

This contribution first argues, expanding on the work of Hans Jonas, that a programmed system, cannot be teleological in the true sense, at it relies on an heteronomous semantic domain. Then, I build on Jonas's idea of a primitive teleology in the cell and suggest that a teleological machine could be obtained by harnessing existing teleological agents (such as cells) in a structured organization. This could be done by controlling the environment in which the agents operate and by mediating their interaction. The self-coordination of teleological elements has been the object of ethological and sociological studies, which provide a large body of knowledge that could be of potential relevance.

**Long Abstract**

The notion of purpose has long been inextricably linked to the notion of life and it is thus no wonder that in ancient world views such as animism, when life was the dominant interpretative category, even natural phenomena were ascribed a purpose, either by themselves or through a divine entity. The scientific revolution initiated during the Renaissance was made possible by the rejection of the Artistotelian physics and its final causes, which gradually shun teleology from the scientific discourse. This move was swift in the physical sciences, where following the theories of Galileus and Kepler, Newton's classical mechanics dealt a final blow to any teleological discourse in physics. In the life sciences, however, the teleological discourse persisted but it came under strong attack first by Darwin's theory of evolution and then by the demise of vitalism in the beginning of the 20th century. From purposeful, the world became purposeless and the mechanistic view of life became dominant. This paradigm allowed for tremendous progress in the understanding of biological processes, but also set the ground of a synthetic approach to life and cognition. The endeavor to create living or thinking artifacts started in the early 20th century with the creation of electro-mechanical devices and gained momentum with the cybernetic movement in the mid-century (Cordeschi, 2002). With the discovery of the negative feedback loop and associated attractor dynamics, the notion of teleology resurfaced again (Rosenblueth et al. 1943), only to be substituted by teleonomy, presented as an explanation of teleological behavior. After a few decades of technological development, it became legitimate in the early 21st century to aim for the development of a humanoid robot with the abilities of a two-year old child on the principles of open-ended development and enactive cognition (Tsagarakis et al, 2007). But it is when the old phantasm of creation seemed within our reach, and with it the final demonstration of mechanism, that the teleological discussion was called again. Indeed, roboticists currently stumble on the question of how to let their robot loose of their detailed instructions and acquire some proper agency (Froese and Ziemke, 2009). It was long thought, and many still believe, that agency (and thus teleology) would emerge out of increasingly complex interactions with the environment coupled to increasingly powerful computations. But some believe the opposite is true, meaning that complex, structured and autonomous interaction with the environment can only emerge from a basic and growing sense of agency and teleology. This has spurred a new research program in minimal cognition, which attempts to extract the basic principles of cognition out of the basic principles of life (Van Duijn, 2006).

The present contribution to this discussion first focuses on the notions of purpose and function, based on their analysis by Hans Jonas (1984). In particular, I distinguish, following Weber and Varela (2002), between an intrinsic teleology envisioned by Artistotle and Kant, from an extrinsic teleology more akin to Wiener's teleonomy and criticized by Jonas (1966). The later argues that an heteronomous purpose, as the one set by a roboticist for his robot is very different from a real teleology and cannot explain the teleological aspect of behavior that we observe in organisms and, more crucially, experience as human beings. Indeed, I argue that a machine controlled by a program cannot be teleological, as the categories used for representing and setting goals are ours and foreign to the machine. A true teleology can only be self-referential, even if as observers we interpret it in

our own language.

After those clarifications, I address the actual question, namely the need of teleology for the modeling of life. I first underscore that the modeling of life, like any scientific investigation, is itself a teleological behavior experienced as such, and which cannot be otherwise understood. In this endeavor, the synthetic model is a tool and is thus assigned an external purpose by the researcher. This purpose is to help with the investigation of specific aspects of life. Whether this model, in addition to this external purpose, needs an intrinsic teleology depends on the specific aspect under scrutiny. Indeed many aspects of life can be and have been clarified with non-teleological synthetic models. However, as teleology appears to be in itself an aspect of life as we experience it, it is reasonable to assume that the understanding of some core aspects of life such as motivations would benefit from a teleological synthetic modeling of life. Indeed there is no good reason to exclude subjective experience from scientific investigation.

But, if, as mentioned above, the true teleological nature of a machine cannot be imposed from outside, the question remains of how it can come into being. This question is addressed by looking at natural occurrences of teleology. Still following Jonas, we consider the cell as a very basic teleological system that prefigures our own teleological experience. The direction suggested here is that new teleological forms can be formed by harnessing and canalizing existing forms of teleology. This can be observed in the evolutionary history of organisms, where multi-cellular organism arise by self-organization of cells. In those cases, the environmental conditions drive existing teleological forms to self-organize, yielding a new teleological form animated by a somewhat different purpose. This work examines if the same can be said of other systems such as the outcome of synthetic biology, of colonies of social insects, of animal or human societies, or social agents such as institutions, and to what extent those examples could guide the synthetic and controlled organization of teleological units. The general methodology suggested here is at the theoretical level to formalize the general principles allowing the self-organization of teleological units. At the practical level, it is to attempt to guide the self-organization of cells by controlling and mediating their interaction with the environment and among themselves. Directed evolution is a first step in this direction, albeit with a scope too narrow for our purpose.

Admittedly, this sociology of the proto-teleological leaves unanswered the question of the first origin of teleology. But it explores the possibility of some complementary teleological account of life, as advocated by Niels Bohr (1958) in analogy to his complementarity interpretation of the wave-particle duality.

## References


Bohr, N. (1958). *Atomic Physics & Human Knowledge*, Chapman & Hall

Cordeschi, R. (2002). *The discovery of the artificial: Behavior, mind and machines before and beyond cybernetics* (Vol. 28). Kluwer Academic Pub

Van Duijn, M., Keijzer, F., & Franken, D. (2006). Principles of minimal cognition: Casting cognition as sensorimotor coordination. *Adaptive Behavior*, *14*(2), 157-170.

Froese, T., & Ziemke, T. (2009). Enactive artificial intelligence: Investigating the systemic organization of life and mind. *Artificial Intelligence*, *173*(3), 466-500.

Jonas, H, (1966). *The phenomenon of life: Towards a philosophical biology*, Harper Collins.

Jonas, H. (1984). *The imperative of responsibility: In search of an ethics for the technological age*. Chicago: Chicago University Press.

Weber, A., & Varela, F. J. (2002). Life after Kant: Natural purposes and the autopoietic foundations of biological individuality. *Phenomenology and the cognitive sciences*, *1*(2), 97-125.

Rosenblueth, A., Wiener, N., & Bigelow, J. (1943). Behavior, purpose and teleology. *Philosophy of science*, *10*(1), 18-24.

Tsagarakis, N. G., Metta, G., Sandini, G., Vernon, D., Beira, R., Becchi, F., ... & Caldwell, D. G. (2007). iCub: the design and realization of an open humanoid platform for cognitive and neuroscience research. *Advanced Robotics*, *21*(10), 1151-1175.