The Dual Inheritance Model

Chris Marriott[1] and Jobran Chebib[2]

[1]University of Washington, Tacoma, WA, USA 98402
[2]University of Zürich, Zürich, Switzerland 8057
dr.chris.marriott@gmail.com

Dawkins (1976) applied the principles of evolution to the domain of human culture introducing the field of memetics (see also Dennett (1995)). He suggests that the realm of genetics and the realm of memetics both follow the same evolutionary principles. Theories of genetic and cultural co-evolution recognize that these two domains are parts of the same evolving system. The dual inheritance model incorporates the evolutionary interactions between genes *and* memes.

In developing our model of genetic and cultural evolution (Marriott and Chebib, 2014) we have considered the characteristics of an acceptable model. In our opinion any acceptable model will incorporate three modes of adaptation: phylogeneitc (biological), ontogenentic (individual), and sociogenetic (social).

These three modes of adaptation will impact one another (Hinton and Nowlan, 1987). We think that an acceptable model of genetic and cultural evolution must support divergence in the genetic and cultural evolutionary trajectories. Divergence can occur when genetic and cultural selection pressures are cooperative or competitive.

Alternative models to Dawkins' model are expansions of his basic model to include things like horizontal transfer mechanisms, evolutionary development, and cultural information. The dual inheritance model is a model that attempts to incorporate all of these different features into one model.

In the dual inheritance model genetic and cultural information are stored separately and perform separate roles. At birth a new agent inherits its genome from its parents (Fig. 1). Through a process of development the genome produces the newborn's memome. The genome remains inert over the lifetime of the agent while the memome is active in behavior selection and adaptive through learning. The memome interacting with the environment creates the phenotypic information which is active in selection. The memome is modified through interaction with the environment (learning) and through interaction with other agents (social learning).

We have implemented this model once before as a proof of concept (Marriott and Chebib, 2014) and have expanded the system to demonstrate divergence of the cultural and genetic evolutionary trajectories (Marriott and Chebib, 2016b,a). We find that divergence is strongest surrounding behaviors related to sexual reproduction, in some cases culture completely suppressing reproductive behavior.

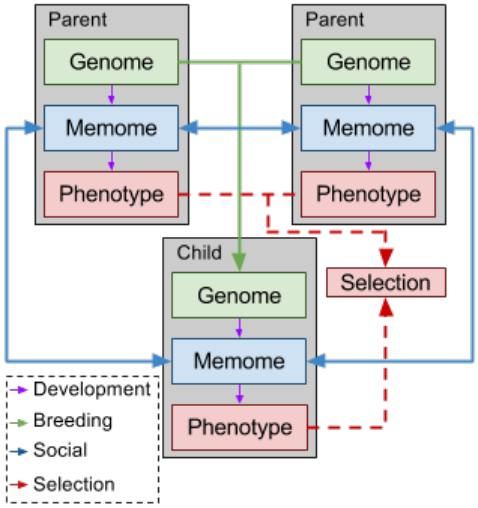

Figure 1: Dual Inheritance Model

References

Dawkins, R. (1976). *The selfish gene*. Oxford University Press.

Dennett, D. C. (1995). Darwin's dangerous idea. *The Sciences*, 35(3):34–40.

Hinton, G. E. and Nowlan, S. J. (1987). How learning can guide evolution. *Complex Systems*, 1:495–502.

Marriott, C. and Chebib, J. (2014). The effect of social learning on individual learning and evolution. In *ALIFE 14: The Fourteenth Conference on the Synthesis and Simulation of Living Systems*, pages 736–743. MIT Press.

Marriott, C. and Chebib, J. (2016a). Divergent cumulative cultural evolution. In *Proceedings of the 2016 Conference on the Synthesis and Simulation of Living Systems*. MIT Press.

Marriott, C. and Chebib, J. (2016b). Finding a mate with eusocial skills. In *Proceedings of the 2016 Conference on the Synthesis and Simulation of Living Systems*. MIT Press.