# Design Issues of Biological and Robotic 'Minds'

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**Abstract**

This abstract discusses the social dimension of biological and robotic 'minds'. Firstly, the evolutionary perspective is addressed. The *Narrative Intelligence Hypothesis* suggests that the evolutionary origin of communicating in stories was correlated with increasing social dynamics among our human ancestors. Secondly, it is suggested that a variety of different 'minds' exist and have evolved, e.g. the autistic mind. These issues are related to current projects on social robots which the author is involved in. Implications for designing a functioning mind are discussed.

## 1 What Are Minds For? The Evolutionary Perspective

Designing a functioning mind can benefit from analysing the conditions and constraints which have shaped the evolution of animal minds. Minds are certainly attributed to members of *Homo sapiens* (and as some evidence suggests several other hominid species might have existed with 'minds'), but other candidates exist among mammals (e.g. non-human apes, dolphins, elephants) and birds (e.g. parrots and members of the crow family). Interestingly, species which we describe as possessing a 'mind' are usually highly social. Even the 'solitary' life style of *Pongo pygmaeus* (orangutan) (who nevertheless seem to be highly social in their ability to recognise and interact with each other) is rather a secondary adaptation to a particular environment which demands a spatially distributed social organisation. The *Social Intelligence Hypothesis* suggests that primate intelligence primarily evolved in adaptation to social complexity, i.e. in order to interpret, predict and manipulate conspecifics (Byrne and Whiten, 1988). However, as Richard Byrne recently pointed out (Byrne, 1997), this hypothesis might account for the evolution of *primate* intelligence, but *not* for the specific *human* kind of intelligence. This suggests that other factors (e.g. language as suggested by Byrne (1997) and others) played a significant role in the evolution of human intelligence. If language was a major milestone in human evolution, what attributes of language made it superior to other forms of communication?

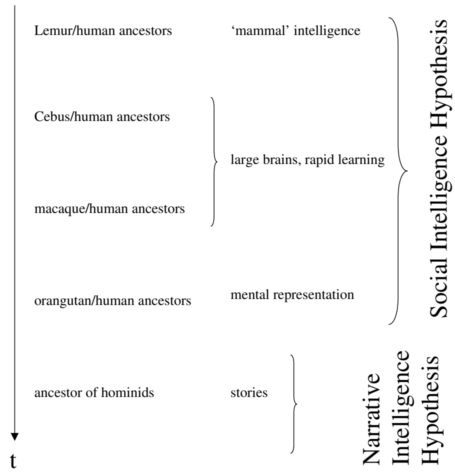


Figure 1: Evolution of the Social Mind, modified from Byrne (1997).

In (Dautenhahn, 1999) I discuss how narrative psychology and studies on the development of autobiographic memory and a 'self' give evidence which suggests that 'stories' are the most efficient and natural human way to communicate, in particular to communicate about others (Bruner, 1991). The *Narrative Intelligence Hypothesis* (Dautenhahn, 1999) proposes that the evolutionary origin of communicating in stories was correlated with increasing social dynamics among our human ancestors, in particular the necessity to communicate about third-party relationships (which in humans reaches the highest degree of sophistication among all apes, e.g. gossip), see Fig. 1. The lessons for designing a functioning mind are: a) minds need to be designed as social minds, b) a human-style social mind need to be able to communicate in 'stories'.

# 2 The Case of Autism: Diversity and Adaptive Radiation of 'Minds'

Autism is a specific disorder which results in significant deficits in the social domain: people with autism generally have great difficulty relating to other people, interacting socially in an appropriate way (Baron-Cohen, 1995). Rather than considering people with autism as having 'defective' minds, they can be viewed as possessing minds which are functioning but *different* from other people. Similarly, other non-human animals might possess minds equally 'powerful' as ours, (see Herman (2000) for a comprehensive assessment of dolphin intelligence), but different, and often difficult to study due to our limited understanding of the species and their environments. Natural evolution supported diversity and adaptive radiation so that different minds might have evolved in adaptation to particular environmental constraints (biotic and abiotic) and thus creating a particular niche. A 'general purpose animal mind' does not exist. Lessons and speculations for designing functioning minds: 1) A single architecture as a 'solution' to designing a functioning mind is unlikely. The design spaces of natural and artificial minds are still to be discovered, but we can expect a high degree of diversification. 2) For artificial minds, a number of constraints (e.g. body shape of robots) are under our (the designer's) control and this synthetic approach could further our understanding of minds complementary to investigating animal minds. 3) In the same way as the notion of 'fitness landscape' helps biologists in understanding evolution and speciation, a similar concept might be developed in order to describe and evaluate the 'fitness' of artificial systems.

# 3 Robotic Friends

The project AURORA investigates how an autonomous robotic platform can be developed as a remedial tool for children with autism (Dautenhahn 1999, Dautenhahn & Werry 1999). A deliberately non-humanoid robot with a simple behaviour repertoire is used as a toy, providing an 'entertaining' and playful context for the autistic child in which it can practise interactions (specific issues addressed are e.g. attention span and eye contact). The project poses several challenges for developing an artificial mind: 1) how can the robot's mind 'grow'?, 2) how can narrativity develop, what are its precursors?, 3) the role of physical interaction and embodiment: what can the physical robot provide that cannot be studied in using software systems?, 4) can the robot ultimately serve as a 'mediator' between the child and the teacher and/or other children? 5) what is the relationship between the internal control architecture (the 'artificial mind') and the way the robot behaves believably and 'mindfully'?

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