LEARNING THE BASICS

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Abstract

The mind's basic task is to organize adaptive behaviour. It is argued that necessary conditions to achieve this are acquiring a 'body-self', a differentiated perception, motor intuition, and motor control. The latter three can be learned implicitly by crosswise comparing the perceived actual situation, the desired situation, the perceived result and the anticipated result.

1 Introduction

What is the functional role of a functioning mind? It is first and foremost designed to control behaviour in the most adequate way. This consideration implies that there cannot be a functioning mind without a body. So the starting point to design a functioning mind is to design a body with adequate action and perception. Speaking of "mind" instead of "brain" purports a certain potency of the behaviour control system. It should not be a hard-wired forward control system, like (more or less) an insect's brain, but an adaptable learning system. A functioning body-mind system needs to learn behaving flexibly in an ever-changing environment. Probability to "survive" increases if it predicts environmental changes correctly. This can only be done if it discriminates between what happens caused by the physics of the environment and what it causes to happen through its own action.

2 Learning tasks

Let us assume that designing a functioning mind depends only on adaptation starting at a *tabula rasa* state of mind. The only control mechanism available must be emotion, i.e. an evaluation system that provides the direction of learning. So the body-mind system's starting point is perceiving a stream of not interpretable noise and a feeling of discomfort.

2.1 Perception and the 'body-self'

One thing the body-mind system has to learn is to detect invariances in the stream of noise. The rating scale for the discrimination of invariances is the significance for its well-being. One significant invariance is for example the mother's face, her voice, the warmth of her skin, and the good feeling of being fed. One other significant invariance is that some entities in that noise persistently feed back a feeling when touched. They feed back pain when touched roughly, and warmth when touched tenderly.

Thus, perception (which is always directed) is being learned. And one of the first things being perceived is that some entities in the stream of noise belong physically to the body-mind system itself. It leads to a concept of a 'body-self'.

2.2 Motor intuition

The next thing the body-mind system has to learn is a mapping between the muscle commands, perceived environment and distal effects (e.g. Jordan and Rumelhart 1992), i.e. a forward model (for the engineer) or a motor intuition (for the psychologist). This is done by 'motor babbling'. Motor commands are produced in a random-like fashion. The invariant effects of the produced action (under environmental circumstances) are learned. This enables the body-mind system to anticipate its action's distal results, which enhances behavioural security (Hoffmann 1993) and provides a feeling of comfort or joy.

2.3 Motor control

Once it is able to anticipate the results, the body-mind system might "want" to produce them. I will not discuss the problem of the emergence of a "free will" here, that cause the desire. But admittedly it will be necessary to implement desires in some way for designing a functioning mind.

So the system has to learn the mapping between desired situation, perceived environment and motor behaviour, i.e. an inverse model (for the engineer) or motor control (for the psychologist). Jordan and Rumelhart (1992) developed a connectionist model for a small scale task in a static environment, where they integrated a forward and an inverse model for learning an controlling the movement of a two joint arm in a planar space.

3 Learning principles

In general, to enable learning, a body-mind system must have four concepts (implicitly) available in its mind: The perceived actual situation, the desired situation, the perceived true result available at the moment of the occurrence of the distal effect, and the anticipated result available at the moment of action. This implies the existence of an (implicit) memory, because the four concepts are not available in one time slot. For learning, the last three concepts are compared crosswise. We can distinguish four cases:

1. The true result equals the anticipated result, but both do not equal the desired situation. E.g. the system shoots a basketball to the basket, it fails, but in the moment of ball release it anticipates the failure. This is a usual case. Motor control, i.e. the inverse model has to be learned

2. The desired situation equals the anticipated result, but both do not equal the objective result. This is the case in novel situations. E.g. the system plays table tennis with always the same partner, which cannot play sliced balls. When a new partner now plays a slice, the system desires to return with a cross and in the moment of ball release it anticipates that the desired result will be achieved. But it does not; the perceived true result is that the ball leaves the bat in an unpredicted angle. In this case, perception must be differentiated. The environment's variance is mainly detected because the anticipated effect of a well-known action in an only seemingly well-known situation does not come true (see Hoffmann 1993 for further details).

3. If the desired situation equals the true result, but not the anticipated result, motor intuition must be learned. This is the case in trial and error learning, when suddenly, and not anticipated, action leads to the desired situation.

4. If all three concepts equal each other, everything is (presumably) fine and nothing must (can) be learned. This is the limit for implicit learning; improvement is only possible through presentation of explicit, consciously mediated knowledge of result.

4 Explicit vs. implicit learning

For implicit learning, the actual situation and the action's effect must be experienced. It is necessary to act. It is the privilege of self-conscious subjects to act cognitively instead of physically, to 'act as if you were acting'. A more or less correct motor intuition (or its conscious equivalent, motor imagery) and a concept of the 'body-self' presumed, distal results can be predicted mentally without acting. This protects consciously planning subjects from experiencing undesired or even lethal consequences, which enhances clearly the probability of survival of subjects and species.

To sum up, it is suggested here that for designing a functioning mind it is necessary to implement a functioning body-mind system, which is able to adapt to environmental changes without hardwired intelligence.

Acknowledgements

I thank the Cognition and Motor Behaviour Research Group (http://www.uni-giessen.de/~g51027/comoweb) for their helpful advices.

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