

Can a Robot Hear Music? Can a Robot Dance? Can a Robot Tell What it Knows or Intends to Do? Can it Feel Pride or Shame in Company? -- Questions of the Nature of Human Vitality

Colwyn Trevarthen,

Department of Psychology

The University of Edinburgh

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Robot: Czeck, from *robotiti*, to work, drudge. Related to German *arbeit*.

a) A living being that acts automatically (without volition).

b) A machine devised to function in place of a living agent; one which acts automatically or with a minimum of external impulse.

Robots ... persons all of whose activities were imposed upon them and who were not allowed 'even the luxury of original sin'. -- G. B. Shaw.

Robotize: To mechanicalize.

"The doctrine which I am maintaining is that the whole concept of materialism only applies to very abstract entities, the products of logical discernment. The concrete enduring entities are organisms, so that the plan of the whole influences the very characters of the various subordinate organisms which enter into it. In the case of an animal, the mental states enter into the plan of the total organism and thus modify the plans of successive subordinate organisms until the ultimate smallest organism, such as electrons, are reached.

There are thus two sides to the machinery involved in the development of nature. On the one side there is a given environment with organisms adapting themselves to it ... The other side of the evolutionary machinery, the neglected side, is expressed by the word creativeness. The organisms can create their own environment. For this purpose the single organism is almost helpless. The adequate forces require societies of cooperating organisms. But with such cooperation and in proportion to the effort put forward, the environment has a plasticity which alters the whole ethical aspect of evolution."

(A. N. Whitehead, *Science and the Modern World*, 1925)

Introduction and Summary

I give the OED definition of a robot to emphasise that it is the lack of volition that distinguishes and robotic 'worker', which by this criterion is a mere tool. I reproduce a favourite quotation from Whitehead for the clever and illuminating way it distinguished between abstractions, 'products of logical discernment', and organisms that have a special coherence and 'organisation', out of which properties 'emerge' that are both adaptable and creative. I do not accept that *simulation* of the appearances or the motions and effects of life, however intricate and ingenious, is a making of life. Organisms are complex dynamic systems (CDSs) of a strange kind, always active within envelopes that limit and constrain what emerges, and that separate and aggregate sub-CDSs in intricate hierarchies, in such a way that what 'emerges' is fated to adaptive ends. It is the 'finality' that is the secret of the creativity of a living being, not its 'plasticity'.

Every living thing has a system or programme of development, the course of which is both genetically and epigenetically determined from each zygotic beginning. There is never less than one bounded, complex and organised, actively self-sustaining cell, with an intricate 'import-export, customs control' of a multi-layered molecular cell wall, a cytoplasm full of energy-storing and metabolism and gene expression controlling organellae, and a nucleus with genetic material, also bounded by an 'editorial' wall. And what happens when this cell changes, divides, differentiates and re-integrates by a determined auto-poesis depends on the whole structure of that initial organism-cell. The genes it inherits are just part of the play, with constrained roles and responses, obedient to the messages from the cell surface and its systems of cytoplasmic organellae.

Plants *grow* their life in species-specific form, making substance by draining nutriment and moisture from the earth and capturing energy from the sun, with chloroplasts that react to light by assuming the green

colour that will capture light energy effectively. Plants socialise by hiding in one another's shade, by climbing or perching on one another, by joining in canopy layers to meet light and withstand storms, by poisoning one another's growth if the competition is intense. Some branches become leaves that grow across the life-giving light and against gravitation, channelling off excessive water to the roots; others aggregate into flowers that seduce insects or birds and make sugary fruits, coloured to signal ripeness, that birds or mammals eat to carry off seeds, or dry seeds that are lifted away by wind or water. The 'purposefulness' of their growth forms is obvious, and well-defended to exploit the vagaries of the physical 'context', relying on the sufficient consistencies of the matter and energy around them.

Animals *move* to live. Their bodies are formed to allow intricately timed pulses of muscular energy in harmonious complexes of plastic transformation that push against the environment, to drive displacements of the whole body in the gravitational field -- through water or on air, by stepping over solid surfaces or by climbing in 3-D mazes. Every animal embryo has genetic symmetry and polarity that defines a locomotive self, and in the process the 'prefunctional morphogenesis', anatomy elaborated before any muscle moves, specifies a mobile future and maps out the principle of a geographical territory for action. Time and space made in the body become the condition and context for the individual animal's activity, as well as for the social life and ecological specialisation of the family and social group.

Animal bodies have muscles that can attack things in the environment (including other animals or plants) to assimilate nourishment, as well as muscles that distribute vital fluids, gases and chemical products around the organs inside their bodies. Brains give the muscle masses and skeletal mechanisms unified purpose and calculate the future economy of effort. The socially sophisticated forms grow extra muscles and neural motor nuclei that elaborate states of inner self-regulation into signals of motivation -- of interest, intended effort, investigative strategy and state of well-being. Eventually, in response to socially aware others, these self-revealing expressions become social-devices regulating companionship with selected others. Signals of the visible surface of mobile bodies, or thrown from the interior of the body by vocal or chemical means, condition and guide affective relationships, giving rise to the 'ethical' implications Whiting referred to -- of affiliation, enmity, loyalty and betrayal.

I will outline what we know of the early life of a human individual to demonstrate how far from robotic we are already, when innocent of language or 'logical discernment', why we cannot possibly, ever, live as robots, and why I am sure robots will never live as we do. I believe that the idea of simulating psychology with computational machines is thinkable for our culture only because of a tautology. We have created a mechanistic cognitive psychology that forgets, or misrepresents, the natural intentionality and emotionality that makes cognition useful. In consequence of this reduction of our particular cultural view of mentality, our psychology hasn't a clue about the nature of our emotional concerns, either in our relations of collaborative companionship together, or as we may find ourselves when alone with our conscience. Just as the ancients were inspired and befuddled by beliefs in wild, seductive, vicious,

pleasure-loving spirits and gods, we are confused by notions of ourselves as mechanisms.

First the nature of animal *motives* needs clarifying, because muscular action, with its prospective guidance by intelligent perception and learning, has peculiar features of rhythm and grace that machines may never reproduce, except by slavish copying of effects without cause. Mathematical analysis of the dynamics of movement in animals, all animals, appears to reveal conservation of principles of prospective control in time and space that are unique in the universe. The same principles have been found in the activity of large populations of neurons in the motor cortex, and elsewhere in the brain, some moments *before* a given movement is exercised. This kind of collective nerve activity is also indicative of a capacity to imitate or 'mirror' agency, enabling one animal to take up the motives of another, and execute a matching act. The society of animals is possible because the minds that motivate animal bodies have evolved ways of detecting and engaging with the purposes and concerns of other embodied and animated minds. The 'motor images' that make vital action coherent, efficient and purposeful in relation to the world can be exchanged between individuals and elaborated cooperatively.

Then, we have to think about how an infant comes about as a trapped and parasitic embryo and foetus, how it is prepared for free living before entering the uniquely emotional epigenetic world of human society. In the earliest stages of a form that will have an elongated locomotile body, the body is mapped with polarity, dorso-ventral asymmetry, and bilateral symmetry, and this same map is impregnated in a prototype CNS while it is still a sheet of undifferentiated cells interconnected by tight junctions. There is a somatic rind to the body, destined to be muscular and furnished with sense organs, and internal viscera adapted to internal metabolic and reproductive concerns, and the embryo CNS maps these regions, too. In the late embryo (the second month of human gestation) the first cell aggregates and axons of a neural net appear in the core of the brain and spinal chord as the head is elaborated with potentialities for forward looking special exteroceptors, but at this stage there is no movement and no sensation. When the first motor axons grow to the muscles, and even when the first movements occur, there is no sensory input to the brain to advise on how circuits should form. The first elaborated systems are the core motivating ones, and those later to be identified with the neurohumoral systems of emotion. The emotional mechanisms serve as morphogenesis regulators of the neocortex, which is in a rudimentary condition, just sheets of neuroblasts, well into the foetal stage. Indeed the emotional and communicative mechanisms serve as controllers of the cognitive machinery of the cortex at all subsequent stages of development. Those attempting robotic modelling should remember this. Emotions, generated and regulated in the brain stem first, are *causal* in both mind development and mind functioning, not just self-regulatory responses or outputs. The whole process has an astonishing plannedness or what Sherrington,

speaking of the integrative action of the nervous system and consciousness, called 'projiscience'.

Finally we will see how an infant, with its already complex and yet rapidly developing brain, moves to find companions, and to engage with and learn about the resources and risks of the physical but mentally transformed world that may be shared -- how he or she gains an individuality in the family and an active understanding of society, learning a culturally extended consciousness of the narrative of being in the history of a community, its acquired beliefs, knowledge, skills and language. We know a great deal now about how an infant becomes interested in the meanings by which other persons live their life, in the culture that patterns the collective consciousness of the society into which the baby has been born. Through the first year an infant first seeks care and comfort, and also engages in rhythmic 'protoconversational' transactions with familiar and trusted others. In early weeks they play together, learning routines of joking and teasing, consolidating trust with affection.

It is this stage that exhibits the most wonderful 'musicality' of human moving -- the intricate rhythms and phrasing, the subtle variations of expression in tone and melody, and the development of narrative forms that guide excitement and promise repetition of climactic moments and calming resolution. From birth, infants are sensitive to the moods and time patterns of music. Why? Because the human body is inherently polyrhythmic and melaodic in its expression. The human body is built for the kind of grace and power one finds in cultivated music and in dance or sport. No other mammal, though all have intentional grace, has such versatility of motor expression. This is the secret of our story-making consciousness and our capacity to invent powerful the ever changing tangible and intangible works of culture.

The infant senses effects of moving in his or her body, and engages with objects that passively receive actions of exploration and manipulative investigation. And then, just before the end of the first year, actively searches the sights and sounds of a partner's actions to share their purposes. The one-year-old is intentionally cooperative, willing and eager to take up the interests and actions of others as meaningful. This is the unique motivation of the human that inevitably leads to mastery of the symbols of language and every other kind of cultural invention. The infant's personal identity becomes a reflection of what others seek in him or her for company, and for sharing meaning.

I will illustrate steps in the argument with evidence that I am not inventing an abstract theory of mind and human conscious thinking, but attempting to describe the natural, but miraculous, vitality of human minds from their beginnings.

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