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Naïve Physics

Naïve physics is that branch of artificial intelligence research which seeks to fix our everyday, commonsensical knowledge of the external world in a form that is capable of being conveyed to and utilized by a computer. Research in naïve physics originated in reflection of the computational difficulties associated with the use of standard physics as a basis for programming in robotics. The theories of standard physics seem not to address cuts through reality of the right sorts and dimensions to assist in the negotiation of obstacles of the sort we encounter in our (and the robot's) everyday experience.

Different variant forms of the discipline have been advanced. Thus for example there is the work of J. R. Hobbs *et al.* (1987) on the use of common-sense knowledge in the understanding of texts about mechanical devices and their failures, work that is centred on the development of what is explicitly referred to as a 'common-sense metaphysics', amounting to a theory of those core concepts (such as granularity, scales, time, space, causality, etc.) which figure in virtually every domain of enquiry.

There is the 'qualitative physics' of J. D. de Kleer and J. S. Brown (1984). This seeks to provide qualitative algorithms for predicting the behaviour of complex devices from the generic behaviours of their respective components. The latter prove capable of being reduced to a relatively small number of basic types enjoying different realizations in highly disparate fields. Conduits, for example, may be used to convey air, water, electric current, information, and so on. The algorithms themselves rest on the use of a qualitative differential calculus which in some respects recalls the morphological ideas of René Thom.

The term 'naïve physics' itself, however, is associated above all with the work of Patrick Hayes (1985). Hayes envisages a programme of massively large-scale formalization of common-sense knowledge to be expressed in terms of a first-order axiomatic theory embracing of the order of 10^4 to 10^5 predicates. Such predicates may be divided into various sub-clusters, representing tentatively and provisionally distinguishable branches of the discipline of naïve physics taken as a whole. Thus in particular Hayes distinguishes sub-clusters of predicates relating to:

- places and positions
- spaces and objects
- qualities and quantities
- change and time
- energy, effect and motion
- composites and pieces of stuff.

Consider, for example, that sub-cluster which relates to places and positions. This might involve predicates coding notions such as: on, in, at, path, inside, outside, wall, boundary, container, obstacle, barrier, and so on. No one of these notions as realized in naïve physics will be capable of being reduced to any of the others. An adequate treatment of the predicate coding 'on', for example, would need to tie this predicate axiomatically to predicates coding notions such as friction, support, gravity, solidity, tension, load, pressure, and so on, in addition to the purely geometrical component of the notion. Moreover, each of these predicates, too, could be treated adequately only by means of axioms in which they are tied in non-trivial ways to some or all of the others. The theory of naïve physics must therefore be highly non-hierarchical, as contrasted with a system like, say, Rudolf Carnap's *Aufbau*, where a very small number of primitive notions suffices for the construction of the entire edifice of the theory.

Pre-history of Naïve Physics. It is not, at this stage, clear whether naïve physicists are indeed able to provide with their methods a computationally efficient and predictively powerful alternative to standard physics. Their work is interesting, however, already from a *descriptive* point of view. In this respect it echoes back to an earlier sort of physics such as we find, for example, in Aristotle and his followers, and modern-day practitioners in the field have indeed recognized that valuable insights are to be gained from those medieval thinkers, such as John

Buridan and Nicole Oresme, still operating within a broadly Aristotelian framework. (See e.g. Holland *et al.* 1986, p. 208.)

In the works of the medievals, however, the issue is for obvious reasons not addressed as to the proper relation between this (qualitative) physics and (quantitative) physics of the more standard modern sort. Early exponents of what might be called a *sophisticated naïve physics*, which is to say: a theory of the commonsensical domain whose relations to physics proper are made the subject of explicit theoretical concern, were Ernst Mach and Richard Avenarius, who sought a view of the world as this is directly given in the fabric of 'pure perceptions', the latter conceived as having been stripped of those metaphysical ingredients (for example, ideas about absolute space and time) that are customarily imported into experience.

It is in the work of the Gestalt psychologist Wolfgang Köhler (1887–1967), however, that there appears what is perhaps the first occurrence of the term 'naïve physics'. In his *The Mentality of the Apes*, a work whose original German text dates back to 1917, Köhler points out that "psychology has not yet even begun to investigate the physics of ordinary men (*Physik des naiven Menschen*), which from a *purely biological standpoint*, is much more important than the science itself". As Köhler shows:

> not only statics and the function of the lever, but also a great deal more of physics exist in two forms, and the non-scientific form constantly determines our whole behaviour. (With experts, of course, this is saturated in all stages by physical science in the *strict* sense.)

Köhler's ideas, along with those of his fellow Gestalt theorist Max Wertheimer (1880–1943), were then worked out in detail by two Berlin psychologists Otto Lipmann and Hellmuth Bogen in a work entitled *Naive Physik*, published in Leipzig in 1923.

The phenomenologists, too, and above all Edmund Husserl in his *Crisis of European Sciences*, addressed in explicit philosophical fashion the problem of the relation between pre- and post-Galilean physics and the ontology of the common-sense world – called by Husserl the "theory of the structures of the life-world" (cf. Petitot and Smith 1990). A history of naïve physics from Aristotle and the commentators to Hayes and his associates has still, however, to be written.

FURTHER READING

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Names. See: Singular Terms

Naturalism

Apart from certain uses of this term in ethics, naturalism signifies all those systems for which nature is the whole of reality. By nature is understood, especially in American naturalism, that which is amenable to scientific explanation. This use of 'scientific' to mean *natural* science, common in English-speaking countries, yields, if the qualification is made explicit, a circular definition of nature. Hence there must be added the claim that natural science can explain all there is, at least in principle.

The key idea, however, is that of reality as a monistic system and hence as subject to a uniform method of study. Thus nature, besides signifying all that can exist, has also to be seen as a single process in which all events are connected in a strict determinism – for freedom, it is thought, evades explanation and prediction. Thus nature must form a kind of Spinozistic total event which is given or