Object recognition is not predication - Commentary on James R. Hurford: 'The neural basis of predicate-argument structure'

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Dessalles, J-L. & Ghadakpour, L. (2003). Object recognition is not predication - Commentary on James R. Hurford: 'The neural basis of predicate-argument structure'. *Behavioral and Brain Sciences*, *26* (3), 290-291.
Available at: http://www.ling.ed.ac.uk/~jim/BBSNEURO/dessalles.html
and: http://www.dessalles.fr/papiers/pap.cogni/Dessalles_03031001.pdf

Object recognition is not predication

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Abstract

Predicates involved in language and reasoning are claimed to radically differ from categories applied to objects. Human predicates are the cognitive result of a *contrast* between perceived objects. Object recognition alone cannot generate such operations as modification and explicit negation. The mechanism studied by Hurford constitutes at best an evolutionary prerequisite of human predication ability.

Jim Hurford's claim is an impressive attempt to ground human distinctive cognitive abilities like logical reasoning and language in mammalian brain anatomy. His claim is conceptually important to help us understand how a dual where-and-what processing, leading to object recognition, may be a likely prerequisite of human predication. The claim that object recognition and predication are similar by nature, differing only in degree, is however too difficult to accept, for two groups of reasons.

The first objection is a general critique that can be addressed at any gradualist account of phylogenetic descent. Modern evolutionary theory emphasizes that species are most of the time in equilibrium, and qualitatively differ by clear-cut characteristics (Gould & Eldredge 1977). This view is widely confirmed by computer simulations based on genetic algorithms, which show that evolutionary processes are rapid and produce local optima (Holland 1992; Dessalles 1996). One characteristic that our species has in proper is the cognitive ability to manipulate predicates through logical reasoning and to express them through language. The object recognition behaviour shown by mammals is not expected to be either equivalent to, or even to be a draft of, this human ability. One further argument along this line is provided by successful attempts to evolve syntactic language in populations of artificial individuals, as soon as they are granted with some predicate-argument semantics (Kirby 2000; Batali 2002). The fact that other primates seem unable to master syntactic symbolic expressions casts doubt on predicates being available to them.

The second objection against equating object recognition abilities with (even simple) predication comes from the fact that the underlying cognitive processes are qualitatively different. Jim Hurford restrains the cognitive role of predication to the process of categorisation, "*[…] the mental events involved when a human attends to an object in the world and classifies it perceptually as satisfying the predicate in question*". When a perceived object is categorised as an apple, many perceptual features are involved in the recognition: aspects of the shape, colours, textures, presence of two characteristic extremities, etc. This ends up, according to Hurford's account, with a predicate like *APPLE(x)*. Let us call this process, based on mere object recognition, *R-predication*. Contrary to Hurford's account, we claim that R-predication is qualitatively different from those cognitive processes involved in language that logic represents with predicates. Let us call the latter *C-predication*.

Available models of categorisation, and thus of R-predication, are holistic. Neural networks or standard statistical devices rely on the maximum number of common features that can be found between the object to be recognised and known classes, exemplars or prototypes. The difficulty, addressed for instance in conceptual clustering techniques (Michalski & Stepp 1983), is precisely to extract short explicit descriptions for classes and objects. C-predication radically differs by showing non-holistic features: it isolates one *explicit* property from the context. In (Ghadakpour 2003), this process is described as resulting from a *contrast operator* (hence *C* meaning contrast in C-predication). We are able, without any training, to contrast any object with another resembling object or with its known prototype. This allows us to characterise a perceived object as a *blue apple* or as a *big apple*. Even if the remarkable ability to form prototypes and to see global resemblance between two objects is

well within the reach of any mammalian brain, there is little reason to believe that we share with other animals the general ability to *isolate* relevant distinctive properties. Let us mention two reasons.

First, our ability to modify names, like in *a big flea*, has little to do with the co-occurrence of a general property and a location. As Hurford rightfully remarks, the adjective *big* has to be understood here in the flea context (Kamp & Partee 1995). A writing like *BIG(x) & FLEA(X)* cannot represent this contextual effect, and hides the proper cognitive processing. In our own account, both the adjective *big* and the scale on which it is interpreted are provided by the contrast operator. The perceived object contrasts with the prototype of flea by its size; the scale (millimetres *vs.* metres or light-years) comes from the standard deviation of the prototype; the position of the perceived object on the scale is given by the magnitude of the contrast on this scale. Holistic object recognition (R-predication) does not offer means to pick a relevant axis and an appropriate scale, so adjective-name modification is strictly beyond its reach.

The second reason why C-predication radically differs from R-predication is that the former can systematically lead to explicit negation. When performing explicit negation, one has to contrast the perceived object with some prototype and to exclude the former from the latter. You may say *this is not a flea, because it is too big*, or *this is not a star, because it is too big*. R-predication alone, because it is holistic, cannot offer such explicit negation. It can only refuse class membership by measuring a holistic distance and comparing it to some threshold. Yet, every human being has the ability to perform explicit negation on any domain without any specific training. This endowment, which underlies the argumentative use of language, is a consequence of our ability to contrast perceptions and form C-predicates. We suggested elsewhere why this ability can be considered as one of the main cognitive differences that distinguishes *homo sapiens* (Dessalles 2000). It offered a new adaptation, namely the possibility to detect lies. By contrasting one's own perception with the liar's report, one may not only disbelieve the report, but also offer an explicit reason why the report should be rejected. Similarly, because they can be systematically negated, the predicates used in logical accounts of human thinking are C-predicates, not R-predicates. The fact that C-predicates can be used to make membership explicit (*this is a galaxy, because it is big*) may explain why they are mistakenly supposed to be necessary for any categorisation, and hence imprudently granted to animals.

The scope of Hurford's argument is thus more limited than anticipated, since it cannot be extended to "genuine" predication, what we called C-predication. The author's insight and the comprehensive line of argument that he draws from it could yet be extended in some way to C-predication. Our ability to "locate" an object on the axis provided by the contrast operator may be an evolutionary derivative of the fundamental ability to handle location and property separately. In order to say that this apple is big or that it is bigger than that apple, we must assign positions to objects, not in physical space, but on the contrast axis, which may be, in some cases, quite abstract.

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