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Genes as causal powers

Recent work on Metaphysics of Science has increased attention to dispositions and powers in order to account for causation. In particular, Mumford and Anjum (2011) have developed a dispositional theory of causation in which effects are brought about by powers manifesting themselves. In their account, causation is conceived as a process, and causes and effects are conceived as the items in the process that are productive and produced, respectively. This causal dispositionalism is strong in a twofold sense: it is committed to the reality of powers and the identity conditions of powers depend on their manifestations. An important feature of the approach is that it distinguishes causal production from causal necessitation, allowing for causes not being sufficient conditions for their effects. This particular feature makes the approach suitable to account for biological processes, which are strongly context-sensitive and causally complex. In fact, Mumford and Anjum choose biological processes and biological causality as a nice example of their model (Mumford and Anjum 2011, ch. 10). In particular, they argue for a dispositional concept of genes, one in which genes seem to be conceived as powers or bundles of powers “coded” into the structural complexity of DNA strands, and they show how empirical data and contemporary research in Molecular Biology and Genetics square well with their dispositionalist account. Postgenomic scientific advances are then presented by them as motivations for their metaphysical theory.

In this paper, I intend to deploy a dialogue between such metaphysical conception and the traditional approaches to the problem of the ontology and definition of the gene in contemporary Philosophy of Biology. In particular, I will reassess whether a strong causal dispositionalist account of genes can handle traditional and well accepted difficulties raised in the postgenomic era (from now on, “postgenomic difficulties”) which have led to eliminativist, processual or strongly contingent positions (Dupré 2007, Dupré and Barnes 2008, Griffiths and Neumann-Held 1999, Oyama 2000). In order to explore these difficulties I will pay attention to two particular biological phenomena which are behind some of those difficulties, namely, RNA alternative splicing and the role of morphogenetic fields in gene expression (Matlin et al. 2005, Gilbert et al.1996).

In Section 1, I will start by presenting the central features of causal dispositionalism that make it a plausible theory to account for gene characterisation, in particular, complexity of causation, context-sensitivity, dependence of causation on thresholds, simultaneity, defeasibility of prediction and involvement of an irreducible *sui generis* modality in causation.

In Section 2, I will present several postgenomic difficulties and address the question whether the dispositionalist can account for them. This Section has a twofold aim. On the one hand, some of the ideas of the causal dispositionalist will be developed further, such as for example the advantages of the causal dispositionalism to handle the tension between genetic determinism and the strong contingency view of the developmental systems theory. This tension will be dealt with by means of features such as complexity of causation, context sensitivity and involvement of irreducible modality in the specific way in which Mumford and Anjum conceive of them. On the other hand, I will raise some doubts on the potential of the causal dispositionalist account to completely characterise the genes, when focus is on individuation and temporality/simultaneity features. In particular, I will pay attention to a tension in the dispositionalist account between a view in which a gene is identified with a power that combines with other powers in different contexts resulting in a variety of effects and a view in which a gene is identified with a bundle of powers.

In Section 3, I will explore several strategies that a dispositionalist might follow to complete his story. The first strategy is to conceive of a gene as a disjunction of powers (different, therefore, from a power or a bundle of powers). The second strategy is to combine the causal dispositionalist account with the gene-asprocess view. The third strategy is to look not at DNA sequences, but at sequences in the transcriptome (mRNA sequences) as power bearers. Finally, I will explore the idea of indeterminate power, where this indeterminacy should not be understood as a disjunction of particular, determinate powers, but rather as an intrinsic feature that results in incomplete or open powers, in which the manifestation of the power is just one part of an effect. The consequences that these different strategies have for the causal dispositionalist account will be evaluated.

References:

Dupré, J. 2007. *The Constituents of Life*, Van Gorcum, Assen.

Dupré, J. y Barnes, B. 2008. Genomes and what to make of them, Chicago, University of Chicago Press.

Gilbert, S.F, Opitz, J.M and Raff, R.A. 1996. Resynthesizing Evolutionary and Developmental Biology, *Developmental Biology* 173, 357-372.

Griffiths, P. E. and Neumann-Held. 1999. E.M, The many faces of the gene, *BioScience* 49, 656-662.

Matlin, A.J., Clark, F. and Smith, CWJ. 2005. Understanding alternative splicing: towards a cellular code. *Nat Rev Mol Cell Biol* 6, 386–398.

Mumford, S. and Anjum, R.L. *Getting Causes from Powers*, Oxford University Press, 2011.

Oyama, S. 2000. *The Ontogeny of Information: Developmental Systems and Evolution*, Durham, N.C., Duke University Press