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A Clear and Understood Case of Strong Emergence

J. H. van Hateren¹

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The recent *Biosemiotics*' article by Rodríguez Higuera (2016) provides an interesting and thoughtful philosophical perspective on how the origin of semiosis (i.e., the making of meaning) may be explained. There are two broad possibilities if one assumes that semiosis has emerged from non-semiotic phenomena: weak emergence and strong emergence (Bedau 1997). In weak emergence, semiosis is regarded as an epistemic phenomenon, i.e., related to knowledge and its limitations. Its properties follow directly from its constituents, but in a way that is intractable and unpredictable because of its complexity. Thus, such properties appear novel and surprising. In strong emergence, semiosis is regarded as an ontological phenomenon, i.e., existing autonomously, in an underived way. Its properties do not follow directly from its constituents. In particular, it has new causal powers that did not exist before.

Rodríguez Higuera points out (p. 163) that strong emergence is generally regarded as problematic in the philosophical literature, because it is ontologically anomalous (p. 165). He further notes that several of the existing approaches to semiosis can be interpreted as examples of weak emergence. He states (footnote 19) that my recent article in *Biosemiotics* (van Hateren 2015a) gives an argument that only seems to require weak emergence, even if the Abstract mentions strong emergence. However, I disagree on this point. I do think that my theory produces semiosis as a strongly emergent phenomenon. Semiosis has new causal powers according to the theory, and although the ontology of semiosis may be anomalous, it is not a problematic one. The ontology is understood and the anomaly is thereby demystified. However, I did not discuss the issue of weak versus strong emergence in my article, and some of the formulations may seem to suggest weak emergence. Therefore, I will present an explicit argument for strong emergence here, in general terms.

The basic idea of the theory is that all living organisms contain an internal process X (called f_{est} in van Hateren 2015a). X is assumed to approximate, in real-time, the evolutionary fitness of an organism (i.e., its capacity to survive and procreate). X is

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realized as an intracellular physiological process in unicellular organisms, as a mostly intercellular physiological process in multicellular organisms such as plants, and as a mostly neural process in organisms with brains. *X* is distributed like a neural network, and it includes sensors and affects actors. It monitors and evaluates an organism's internal and external state (i.e., its interaction with the environment). It is thereby closely associated with the *Umwelt* concept of von Uexküll (1982), taken to include internal factors (the *Innenwelt*). *X* subsequently changes the organism's behaviour and behavioural dispositions, in a non-deterministic way. The level of fitness, as indicated by *X*, is used to modulate the rate of behavioural change in a highly specific way, whereas individual changes are still made randomly. This non-deterministic mode of operation is one of two crucial factors needed for letting meaning emerge from non-meaning. The other crucial factor is the presence of (conventional) evolutionary pressure. The mechanism can be shown to increase fitness and to be evolvable (originally shown through computational analysis, but more recently through mathematical analysis as well, van Hateren 2015b).

X is associated with semiosis (because it is an internal process evaluating an organism's prospects), but also with agency (because it breaks determinism and produces some behavioural freedom), and with aboutness (because parts of *X* are about parts of the external world). These phenomena are strongly emergent, and they are in fact just different aspects of the same core phenomenon. In order to make strong emergence understandable in general terms, I will focus here on aboutness, which is probably the easiest to understand.

Aboutness follows from the fact that *X* is about fitness. The relationship between *X* and fitness is in fact an anomalous form of correlation. *X* approximates fitness and it is correlated with fitness. But normally, two factors become correlated only when they are causally connected by a deterministic process. The connection may be simple and direct, but also complex and indirect, via other, shared factors. A normal correlation is not ontological, because it is completely defined by the underlying factors that produce it. These underlying factors are the real causes, whereas the correlation as such has no new, independent causal powers.

However, this is different for the approximating correlation (abbreviated to 'correlation' below) between *X* and fitness. This correlation did not arise from pre-existing causal connections between *X* and fitness. There are no such connections. Rather, the correlation is produced by descent with random modification of *X*. In other words, *X* is formed by the conventional evolutionary process of differential reproduction. *X* can evolve to become a good approximation of fitness, because the better *X* approximates fitness, the higher the fitness becomes. This evolutionary benefit follows purely from the specific, non-deterministic way in which *X* modulates behaviour and behavioural dispositions. A random variation of *X* that happens to let *X* approximate fitness better is then likely to be retained, because it leads to more offspring, on average. By this process, *X* and fitness become correlated, gradually.

The correlation between *X* and fitness exists, but it has emerged through evolution, not through pre-existing causal connections. Moreover, the correlation has causal efficacy (i.e., causal power). If it is changed, and *X* approximates fitness with more accuracy or with less accuracy, the organism's fitness is affected. Thus, its chances of surviving and procreating are changed, which is likely to result in significant effects, on average. These effects only depend on how well *X* approximates fitness, not on specific underlying factors.

The aboutness relationship between X and fitness, as well as agency and semiosis, are non-material causal factors. Although they cannot exist without matter-energy, they are not material themselves. Yet, they have causal efficacy. The causal path from non-material factor to material consequences (e.g., more offspring) requires a non-deterministic mechanism. Essentially, the efficacy of these non-material causal factors depends on the fact that X has two different causal aspects. First, it has a non-material causal aspect, namely its correlation with fitness. Second, it has a material causal aspect, namely the fact that it is also a regular physiological or neural process within an organism. The latter process modulates the rate of random change, so it is a direct material cause, but the eventual effects on fitness depend on the non-material causal aspect of X. Both causal aspects are needed in conjunction, as neither of them can do the job alone. Thus, the problems of epiphenomenalism and causal overdetermination do not apply.

The above explanation should make it clear that the proposed mechanism indeed produces semiosis, agency, and aboutness as strongly emergent phenomena. But this emergence is explained and understood. Therefore, it represents at most a non-mysterious ontological anomaly.

It cannot be ruled out that there are other ways to produce a strongly emergent semiosis, but I suspect that the mechanism explained here is the only fundamental one. The reason why I suspect this is twofold. First, fitness, the capacity to survive and reproduce, is truly fundamental to life. Second, internalizing fitness as X seems rather fundamental as well, including the necessity to let it utilize a non-deterministic mechanism. Nevertheless, even if all primordial forms of semiosis must arise in this particular way, there are many ways to build more elaborate semiotic and biosemiotic theories on top of this. But there should be no doubt that all such theories have a firm ontological foundation.

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