Following is an excerpt from Krakauer JW, Ghazanfar AA, Gomez-Marin A, MacIver MA, Poeppel D (2017) Neuroscience Needs Behavior: Correcting a Reductionist Bias. Neuron. 93(3):480-490.

Why Higher-Level Concepts Are Needed to Understand Neuronal Results: The Nature of "Mechanism"

Why is it the case that explanations of experiments at the neural level are dependent on higher-level vocabulary and concepts? The answer is that this dependency is intrinsic to the very concept of "mechanism." A mechanism can be defined as "a structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena" (Bechtel, 2008, p. 13). Crucially, the components of a mechanism do different things than the mechanism organized as a whole (i.e., emergence) (Bechtel, 2008). A reductionist treatment of the components must be combined with investigation of how the total mechanism is organized and how it behaves when embedded in an environment; an approach that unavoidably spans two levels (Bechtel, 2008) (Box 1). Even the reductionist idea of causality needs to be qualified. An idea related to emergence is that of "downward causation." Take, for example, the cardiac rhythm—a behavior that is the net consequence of the interplay between a cell's membrane and the ion channels in it (Noble, 2012). The conceptual point is that the ion channels do not cause the cardiac rhythm—instead the rhythm just is the combination of the higher level of the cell membrane and the lower level of ion channels. So even when causality claims are sought they often only make sense when all levels are considered together simultaneously rather than seeing the higher level as subordinate or collapsible to the lower level. Ion channels do not beat, heart cells do. Neural circuits do not feel pain, whole organisms do. A potential objection to this might be to say, "Who cares what

philosophers say about the differences between psychology and neuroscience, or reductionism in general? We are scientists, not philosophers!" The answer to this is simple: there is no escape from philosophy. Every scientist takes a philosophical position, either tacitly or explicitly, whenever they state that a result is "important," "fundamental," or "interesting." This is because such assertions are always a judgment from outside of science. There is no "interesting" variable inherent to the data that can be objectively plotted on a graph—abstract reasoning and normative claims cannot be substituted by, or obtained from, data.

…….understanding in neuroscience was made by the cognitive scientist Longuet-Higgins, "In so far as the neurophysiologist is concerned to understand how the brain works, he must equip himself with a non-physiological account of the tasks which the brain and its peripheral organs are able to perform; only then can he form mature hypotheses as to how these tasks are carried out by the available 'hardware'—to borrow a phrase from computing science" (Longuet-Higgins, 1972, p. 256).

References

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