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Mechanism-based extrapolation reconsidered

Applying experimentally established causal knowledge to natural systems faces the problem of extrapolation – how to know that the causal claim established in the experimental system is true of the target system, given that the systems are dissimilar in causal detail. One way to justify extrapolation is to establish similarity of the mechanisms that support the causal relation of interest in the source and the target. Recently, Daniel Steel has developed this idea into a comprehensive account of extrapolation.

I argue that this account provides no general solution to the problem of extrapolation. The account relies on an assumption that mechanisms exhibit modularity: it must be possible to change features of individual components without changing the causal structure of the rest of the mechanism. However, it is unlikely that this assumption can be justified by any general argument, for two related reasons. Firstly, the modularity-assumptions required for particular extrapolation tasks will vary depending on the specification of the causal claim of interest. For example, extrapolating quantitative aspects of a causal relation requires more demanding modularity-assumptions than extrapolating a qualitative causal claim. Secondly, when studying a causal relation in an experimental context, variation in the mediating mechanism's components and its causal context is deliberately controlled for. As a consequence, the specific modularity-properties of the relevant mechanisms are often unknown.

I conclude that mechanistic reasoning can ameliorate the problem of extrapolation, but provides no general warrant for it. However, once we acknowledge the assumptions that go into mechanistic reasoning, the warrant that mechanistic knowledge gives to extrapolation can be evaluated case-by-case.