How to Make a Long Theory Short: Lessons from Confirmation

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Scientists tend to opt for simpler and more unified theories. In this talk, I put forth a novel conception of unification as well as an associated formal measure. I begin the discussion with a brief survey of some failed attempts to conceptualise unification. I then proceed to offer an analysis of the notions of confirmational connectedness and disconnectedness. These are essential to the proposed conception of unification. Roughly speaking, the notions attempt to capture the way support flows or fails to flow between the content parts of a theory. The more the content of a theory is confirmationally connected, the more that content is unified. Theories that make more strides toward unification, and, hence, are more economical in the way they capture the same phenomena, are thus to be preferred to those that make less strides for purely confirmational reasons.

Attempts to devise a satisfactory conception of unification abound. One of the earliest is Friedman (1974) where it is argued that understanding is generated when we reduce the number of independently acceptable law-like assumptions that feature as explanantia in the derivation of an explanandum. The lower that number the more unified an explanation. Friedman's account was in great part motivated by a desire to avoid trivial explanations. It had already been observed that deriving an explanandum from a set of premises is not sufficient to turn those premises into a genuine explanation. Friedman sought to avoid this problem by limiting the derivations that yield genuine explanations to those that unify phenomena. Though highly influential, his account soon faced a number of insurmountable difficulties. As Kitcher (1976) and others pointed out, Friedman's account rules out trivial explanations only at the expense of also ruling out some genuine ones. Several other attempts at conceptualising unification have been made with similar problems. They include Forster (1988), Kitcher (1989), Schurz and Lambert (1994) and Thagard (1993).

While it ultimately fails, Friedman's account does at least get one fundamental thing right. By emphasising the role of the acceptability of law-like assumptions his account places a premium on the link between unification and confirmation. The proposal in this talk agrees with this appraisal and indeed elevates the link with confirmation to the single most important ingredient in our quest to understand unification. According to this account, unification is to be understood as a measure of confirmational connectedness. But what is confirmational connectedness and its opposite confirmational disconnectedness?

Roughly speaking, the notions attempt to capture the way support flows or fails to flow between the content parts of a theory. The more the content of a theory is confirmationally connected, i.e. support flows between its content parts, the more that content is unified. Let us use '$x \vdash_r y$' to denote that y is a relevant deductive consequence of x. In formal terms, confirmational connectedness can be articulated thus:

Any two content parts of a non-self-contradictory proposition Γ expressed as propositions *A*, *B* are confirmationally connected if, and only if, for some pair of internally and externally nonsuperfluous propositions α, β where $A \vdash_r \alpha$ and $B \vdash_r \beta$: either (1) where $0 < P(\alpha)$, $P(\beta) < 1$, $P(\alpha/\beta) \neq P(\alpha)$ or (2) there is at least one true or partly true atomic proposition δ such that $\alpha \wedge \beta \vdash_r \delta$, $\alpha \nvdash_r \delta$ and $\beta \nvdash_r \delta$.

An explication of the notions in the analysandum cannot be pursued in the abstract due to obvious limitations of space. Suffice it to say that the probabilities are meant to be objective. That is, probability statements indicate true relative frequencies and/or true propensities of things happening like events, states-of-affairs or property instantiations. An objective interpretation of the probabilities captures the intuition that the confirmational (dis-/)connectedness of the content of a theory is determined by facts about the world, i.e. it is not a subjective matter.

We are now ready to express the unification u of a proposition Δ with the following function:

$$u(\Delta) = 1 - \sum_{i=1}^{n} d_i^{\alpha,\beta} \Big/ \sum_{i=1}^{n} t_i^{\alpha,\beta}$$

where $d_i^{\alpha,\beta}$ denotes the number of disconnected pairs α, β in a given content distribution i, $t_i^{\alpha,\beta}$ denotes the total number of connected plus disconnected pairs α, β in a given distribution i and n denotes the total number of content distributions. To determine the number of disconnected pairs in a given content distribution we count how many times a *different* pair of relevant deductive consequences α, β turns out to satisfy either clause (1) or (2). Any pair that is not disconnected is counted as connected. The higher the value of $u(\Delta)$ the more unified its content. That's how you (justifiably) turn a long theory short, i.e. by insisting that it's content is confirmationally connected.

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