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# Skewness enables stabilising effect of hierarchy in complex competition networks

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## Abstract

In observed ecological networks of interference-competition, hierarchy has been shown to generate asymmetric patterns of interaction strengths which enhance system stability. However, it remains unknown whether this stabilising effect of competitive hierarchies depends on the distribution of link strengths. Here, we analysed the relationship between interaction strength distributions, patterning, and system stability. We found that the interaction strengths within 30 observed encrusting, marine bryozoan networks were characterised by a high level of skewness, with many weak and few strong links. We showed that this distribution of link strengths is necessary for the stabilising effect of hierarchy, as skewness enables a patterning that strongly reduces the weight of short and long feedback loops. The stabilising effect of hierarchy did not appear in systems with uniform or normal distributions of interaction strengths. This has important ecological implications, since theoretical studies using random matrices often assume normal or uniform distributions. Since skewed interaction strengths are a common feature of ecological networks, including trophic and mutualistic systems, such theoretical approaches might overlook stabilising mechanisms present in living systems.

**Keywords:** ecological networks, competition, stability, hierarchy, interaction strengths

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