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The remarkable simplicity of complex signalling networks

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Robustness, and the ability to function and thrive amid changing and unfavourable environments, is a fundamental requirement for all living systems. Moreover, it has been a long-standing mystery how the extraordinarily complex communication networks inside living cells, comprising thousands of different interacting molecules, are able to exhibit such remarkable robustness since complexity is generally associated with fragility. In this talk I will give an overview of our recent research on robustness in cellular signalling networks, with an emphasis on the robust functionality known as Robust Perfect Adaptation (RPA). Our work has now suggested a resolution to the complexity-robustness paradox through the discovery that robust adaptive signalling networks must be decomposable into topological basis modules of just two possible types. This newly-discovered modularisation of complex bionetworks has important implications for evolutionary biology, embryology and development, cancer research and drug development.

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