Freeness in cognitive science

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Free random calculus and free random variables (FRV) are viewed as probability calculus of the XXI century, with diverse applications to many-body physics, network analysis and cognitive sciences. In the latter, the techniques like dense array encephalography (dEEG), functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG) or optogenetics, provide enormous amount of data at wide spectrum of temporal and / or spatial resolutions. The multivariate character of time series brings immediately connotations to random matrix theory (RMT), which for the rotationally invariant matrices in the large size limit can be described by free probability. We provide three examples:(i) inference of noisy signals from multivariate correlation data from the brain; (ii) distinguished role of non-normality in real neuronal models; (iii) applications to the field of deep learning in artificial neural networks.
In the talk I will mostly concentrate and explain the system (ii).

References

[1] E. Gudowska-Nowak, M.A. Nowak, D.R. Chialvo, J.K. Ochab, W. Tarnowski, Neural Comput. 32, 395-423 (2020)