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Neuroimaging: what can we learn from qualitative and quantitative functional brain imaging

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Abstract. There are two important steps that transform imaging of PET tracers into biologically relevant information: data quantification and kinetic modeling of the tracer time course. Data quantification requires accurate corrections for physical and instrumentation performance aspects, while kinetic modeling requires good understanding of tracer binding properties and their characteristics over time. Given the naturally coarse nature of the PET data (i.e. limited time and spatial resolution), the biologically relevant outcomes (such as binding potentials and uptake rate constants) are often only proportional to the processes under observation and their validity must be confirmed for each tracer. In spite of these intrinsic limitations PET data have provided invaluable insights into brain behavior in health and disease. Of particular relevance are instances where brain disease can be studied before the manifestation of clinical symptoms, thus providing a unique window on early changes, where disease origin might be discover or treatment might be most effective. Disease progression can be determined with quantitative brain images as is the interplay between different brain systems affected by disease. Likewise the effect of treatments can be measured in an objective fashion and correlated between brain function and personality traits can be teased out. Finally, pre-clinical brain imaging can also serve as a translational tool bridging invasive post-mortem observations done in rodent models of disease with imaging data obtained in humans.

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