Challenges and opportunities for brain imaging with large population datasets

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A fundamental challenge for neuroscience has been to understand cognition and behavior in terms of its underpinning neurobiological substrates. Important advances have been made in discovery brain specialisations for particular functions and mechanisms common across people.   More recently, attention has focused increasingly on understanding the basis for individual differences. This has been triggered by anatomical data characterizing individual variations in cytoarchecture and advanced imaging method for more sensitively establishing brain functional- behavioural correspondences. It is motivated by the need for more refined, objective measures of brain functional pathologies. Large population studies promise to accelerate this discovery by providing access to datasets from large numbers of people who have contributed detailed information concerning their heritage, development, occupations and exposures, nutrition, lifestyles and clinical histories. Informative analytics need to address data reduction multiple dimensions in ways that preserve key information; a framework for parameterizing and comparing alternative strategies is needed. Part of the challenge lies in determining performance criteria ("success") appropriate for discovery. However, this work opens new opportunities for understanding brain mechanisms, characterizing disease risks and, ultimately, making diagnostic or treatment decisions. In my discussion I will describe current challenges and some approaches being taken, while illustrating the opportunities with a few examples of novel insights already emerging from these large datasets.

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