

"ENIR" - Foresight study for the development of an European NeuroImage Repository
Accompanying Measure under the 'Research Infrastructures' Programme of FP6, DG Research

The ENIR project aims to carry out a foresight study to investigate the scientific needs in relation to the development of a large and shared European multidimensional repository of high resolution magnetic resonance (MR) images of normal brains and brains with different neurodegenerative disorders (Alzheimer's, amyotrophic lateral sclerosis, Parkinson's disease, etc.) completed by clinical, genetic and neuropsychological data.

Project objectives

Magnetic Resonance Imaging (MRI) is a non-invasive diagnostic technique that uses a magnetic field and radio waves to create high quality images of the head or body, without X-rays or radiation. Images are black and white representations of the brain tissues (grey and white matter and cerebrospinal fluid) of high spatial resolution (around 1 mm). Computerized algorithms can reconstruct the whole brain into realistic 3D models that can be treated mathematically. Such information on brain structure is pivotal for research about early diagnosis of neurodegenerative disorders.

The major problem that the basic and clinical researchers face is the huge variability of brain morphology such that the judgement of what constitutes normality or the comparison among different brain groups are loaded with great uncertainty – indeed, the structural variability of the brain is much higher than that of all other organs. In order to model and manage this variability, a wide amount of brain images and information on the sources of variability (age, gender, education, disease state, cognitive performance, genetic asset, etc.) are needed. To reach meaningful numbers, such a repository cannot be collected in a single centre, but requires that brain images taken from many centres be pooled. Moreover, consistent sociodemographic, clinical, neuropsychological, and genetic information are mandatory for a meaningful interpretation of the images and pathology would be desirable (the definitive diagnosis of most neurodegenerative disorders can be obtained only on pathology). A European repository of this kind does not exist at the present time due to the lack of a structured communication network among centres and of the huge heterogeneity of acquisition protocols and clinical information collected from the patients.

The needs to approach and solve to develop the ENIR repository are related to the following topics:

- different centres have different MR machines and different scanners have different image data acquisition protocols;
- sharing large groups of MR images among many centres through the internet carries problems of bandwidth and sharing through CD or other storage device carries problems of versatility and immediacy: a common manageable solution has to be identified;
- brain images alone are useless. Clinical data must necessarily be collected, but pooling images requires that the same type of clinical data be collected in all centres.

The proposed project aims to carry out a foresight study focused on investigating the scientific needs in relation to the development of a large and shared European multidimensional repository collecting and sharing high resolution magnetic resonance (MR) images of normal brains and brains with different neurodegenerative disorders (i.e. Alzheimer's, amyotrophic lateral sclerosis,

Parkinson's disease, etc.) completed by related meaningful clinical, genetic and neuropsychological data.

The ENIR project will investigate the needed standardization topics and practical implications in acquisition, processing and storing of neuroimages by means of a co-ordinated approach to the setting up of a devoted research infrastructure, making the best use of those already existing.

The project will provide a deep insight into the facilities to be supported by the future developed infrastructure to guarantee a wide fruition and exploitation of the envisaged European collection and sharing system of brain MRI. Consensus will be achieved on a number of currently discordant theoretical and practical issues that have so far hindered the setting up of a large European brain image repository. The proposed study will also identify standardized procedures in order to make the best use of existing repositories, in view of their increased integration towards the development of the future European infrastructure.

In the long term the project results may pave the way for a future development of a pilot prototype of the repository on a restricted number of centers. Once operational, the system could be extended to clinical and research centers and expanded with different types of images (for example PET, fMRI, etc.), attracting users from various countries, thus facilitating their integration and supporting the construction of the European Research Area.

Potential beneficiaries are members of academic and industrial community having an interest in the study of normal and diseased brain. The project will also result in a benefit, in the long-term, of translational research and clinical practice related to neurodegenerative disorders.

Once operational, the repository will:

- allow clinical researchers to compare the brain of a given patient to a "true" normative group, i.e. to a group of normal brains of comparable age, gender, education, and genetic asset. This will allow to detect departures from normality with a precision much higher than can be done to date where "normal" groups are a blend of brains with markedly heterogeneous features due to different age, gender, education, and genetic assets;
- provide basic researchers with large groups of subjects so that even diseases and features with low prevalence but high disease risk (for example amyotrophic lateral sclerosis or homozygosity for the e4 allele of apoE) will be amenable to accurate study;
- provide both with individual or groups of normal or diseased brains for teaching and training. The knowledge base will allow to pool the small groups of patients with rare neurodegenerative conditions scattered throughout Europe and reach a critical threshold for clinical meaningfulness.

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