Editorial

Coping with Brain Disorders using Neurotechnology

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Abstract

Brain disorders account for more than 34% of the global burden of disease, crippling nations by decreasing their "mental capital"—with greater effect in developing countries. Early detection is the key to their management, but establishing such programmes seems nearly impossible due to the high prevalence of the dysfunctions as compared with the high cost of neuroimaging devices. Thus, at first sight, the research of the Decade of the Brain and the international Human Brain Mapping Project might seem to be condemned to benefit only a small elite. Cuba has shown that is not so by using neurotechnology for the last 3 decades to implement stratified active screening programmes for brain disorders at the population level. This experience has shown that, by the transformation of health indicators, an appropriate use of technology can be integrated with attention to the population at the primary levels of both health care and education. An essential component of neurotechnology is neuroinformatics, which—like its counterpart bioinformatics—combines databases, analysis tools, and theoretical models to craft tools for early disease diagnosis and management. Much work remains to be done and will depend critically on south–south cooperation to solve problems for countries with similar situations.

Keywords: *brain disorders, international cooperation, medical informatics, neuroimaging, neurosciences, technology*

Brain Disorders and the Mental Capital

There are many expectations with regard to the outcome of the Decade of the Brain (1). This is justly so, for not only is there the promise of solving the essential enigma of human consciousness, there is also hope of finding ways of dealing with the brain disorders, a grouping of dysfunctions that account for more than 34% of the global burden of disease measured in disability-adjusted life years (2). Consider the numbers in Figure 1 (3). These disorders cripple the development of nations, subtracting substantially from their mental capital (4)—a situation dramatically more critical in developing countries.

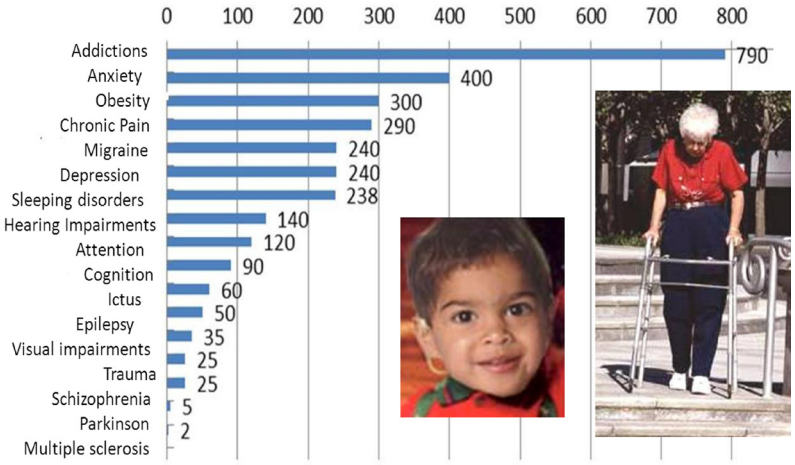

Figure 1: Brain disorders affect millions of people in the world, affecting the mental wealth of nations.

Many look for solutions to these problems from research in the neurosciences, an effort that has reached an unprecedented level. Of note is the Human Brain Mapping Project—a gigantic exercise in systems neuroscience—that is assembling what is known of brain structure and function along the full span of levels from molecular genetics to behaviour. A critical feature is that all levels are linked by different types of neuroimages. Central to these endeavours is neuroinformatics: the use of shared databases, tools for image analysis, and theoretical modelling to develop, validate, and deploy instruments for early detection and optimal management of brain disease, as well as the support of clinical trials (Figure 2). An overview of this field can be found at the International Neuroinformatics Coordinating Facility website (5).

Current neuroscience research (including neuroinformatics) has even spawned a new industry, neurotechnology, that now rivals in growth and importance that of biotechnology. In spite of these encouraging developments, many express concern that this gigantic effort may fall short and not justify the expenditure involved. Similar misgivings have been voiced about the Human Genome Project (6). What is needed to deal with brain disorders, according to this view, is not more technology but rather more public health measures. These critics point to the high cost of neuroimaging devices and the impossibility of deploying them where most needed.

Cuba has had to deal with its own problems under tight economic constraints. This has led not to less but rather more neurotechnology—with a twist (7). This has been to insert the use of neurotechnology in a public health framework of stratified active screening of brain disorders. This approach uses the appropriate technology at each health level. A prime example of this has been the programme of early screening for hearing loss (Figure 3), initiated in 1983, which has already pushed the children detected with the problem 5 years of language development ahead of what was expected without screening (8). This is an increase of mental capital indeed! These programmes are now actively being extended to other Latin American countries.

Cuba considers that this model can be extended to other brain disorders (Figure 4) and is now embarked on projects for the early detection and appropriate management of neurodevelopmental disorders, learning disabilities, stroke, as well as several types of cognitive disorders. Conscious that combining research efforts and data is essential, our country has been active in promoting initiatives that group nations with similar problems, recent examples being the Latin American Brain Mapping Network (9) and the Chinese/Cuban Brainnettome Project.

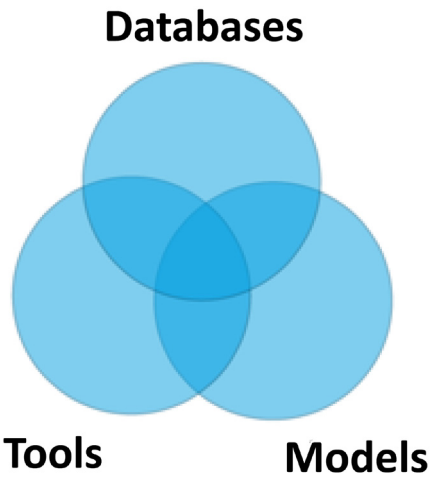

Figure 2: Neuroinformatics is the intersection of neuroimaging databases, tools for managing them, and theoretical modelling to interpret normal and pathological brain functions.

Figure 3: Cuba has used its own national neurotechnology industry to carry out stratified active screening, an example of which is the detection of hearing loss.

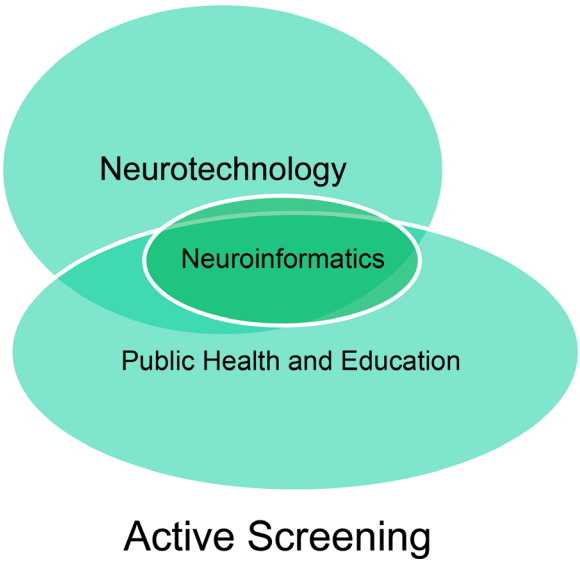

Figure 4: The active screening for brain disorders is based on the appropriate use of neurotechnology and neuroinformatics.

Malaysia is poised to play a major role in the translation of neuroscience research into health and education. It seeks to complement its recent establishment of a neuroimaging infrastructure with the development of neuroinformatics to allow the structured organisation of the imaging data gathered and its integration with other types of information from the country as well as the world. I was lucky to be able to give a recent course in neuroinformatics that was organised by Universiti Sains Malaysia. As a result, Malaysian and Cuban neuroscience groups have recently decided on a roadmap to join efforts in research, technology development, and medical evaluation geared towards collaboratively solving mental health problems of our countries and to establish links to other groups. We have a major role to play in transforming the mental health landscape of developing countries. This is an exciting time in which we who are engaged in neuroscience have the possibility and the responsibility of guaranteeing that the goal is reached.

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