



THE BENEFICIAL EFFECTS OF DNA CRUNCHING THE HUMAN GENOME PROJECT

BY TERRY NG

An examination of the complexities of the Human Genome Project.

All humans have genomes – the complete library of genetic material comprised of deoxyribonucleic acid (DNA) molecules. These storages of hereditary information consist of one pair of one sex chromosome and 22 pairs of autosomes – non-sex chromosomes – within each normal human cell. The DNA molecules that carry these genetic instructions are made up of four simple nitrogenous bases – adenine (A), cytosine (C), guanine (G) and thymine (T) – where G pairs up with C, and A with T, using hydrogen bonds, to form the double-helical molecule of DNA. About 99.9 percent of the human genome sequence is homologous in all human individuals (Patrinis and Drell, 1997). Scientists think that there is approximately one base-pair difference of one thousand cases among each individual. See Figure 1 (U.S Department of Energy, 2002).

New technologies for understanding and working with DNA were developed in the 1980s. The realization soon dawned upon scientists that, by decoding human DNA, the blueprint of our heredity, they would be able to fully understand the underlying processes and causes of the various “effects” in the human body. Hence, the idea to sequence the entire human genome arose, and with this idea came the birth of the Human Genome Project (HGP).

THE HUMAN GENOME PROJECT – AN OVERVIEW

In simple terms, the HGP is an attempt to map the complete set of coded instructions – DNA – that is responsible for creating and conserving the life of all human beings. See figure 2 (Human Genome Sequencing, 2002).

The Human Genome Project was formally initiated and sponsored by the U.S. Department of Energy (DOE) in 1990, and is now managed in joint effort with the National Institute of Health (NIH). It is also a 13-year effort that was originally planned to last 15 years, but rapid technological advances have accelerated the expected completion date to 2003 (Casey, 1999). A historic initial draft of the human genome was completed, and published in the journals *Science* and *Nature* in February of 2001.

Despite multiple revisions of the project goals – such as a 5-year plan for 1990-1995, a revision for 1993-1998, and a revision for 1998-2003 – the ultimate goals of the project have remained more or less the same. They are:

- To identify all of the approximate 30,000-35,000 genes (Patrinis and Drell, 1997) in humans

- To determine the sequences of the 3 billion chemical base pairs that make up human DNA
- To improve current tools and develop new technology for data analysis to increase effectiveness and reduce cost
- To identify useful model organisms for comparison with the human genome
- To improve content and utility of genomic information in databases to make the data more accessible to the public
- To address the ethical, legal, and social issues (ELSI) that may arise from the project
- To nurture the training of genomic scientists [Human Genome Management Information System (HGMIS), 2001].

The complete DNA sequence of a typical human cell will serve as a comprehensive public reference source that others will be able to build upon without having to repeat the same research. It will also provide information and resources to understand some of the critical differences that make us individuals, as well as factors that often contribute to diseases.

THE FUTURE OF THE HGP IN MEDICINE...POSSIBILITIES AND LIMITATIONS

All diseases have a genetic component, whether inherited or resulting from the body's response to environmental stresses, such as viruses or toxins (HGMIS, 2001). By understanding the biological function(s) of each gene and the molecular events that arise from them,

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May I Have Your Attention Please...

BY: REBECCA McEVILLY

Attention. To focus, divert, and maintain it are all tasks that involve the brain, which researchers are examining in order to better understand Attention Deficit Hyperactivity Disorder (ADHD). Externally, the symptoms of ADHD appear rather simplistic, involving such criteria as lack of attention and inability to sustain it, as well as fidgeting, interrupting and other such hyperactive, impulsive behaviours (Long, 2000). In order to examine the causes of these symptoms and develop a more specific treatment, ADHD is now classified into three subsets. Based on various evaluations of the behaviours, the patient is diagnosed as a predominately *hyperactive type*, predominately *inattentive type*, or a *combined type* (Long, 2000). Even with this breakdown, however, the mechanisms for brain action remain complex behind such a multifaceted diagnosis.

A major factor that affects attention in ADHD is a developmental failure in the brain circuitry, which underlies inhibition and self-control. Researchers have found that children with ADHD are less capable of preparing motor responses in anticipation of events, and are less sensitive to feedback about errors (Barkley, 1998). Many brain regions also appear to be involved in the integration of these tasks. Researchers at the National Institute of Mental Health found areas of the right prefrontal cortex, the two basal ganglia (caudate nucleus and globus pallidus) as well as the vermis region of the cerebellum to be significantly smaller in children with ADHD. The prefrontal cortex may be involved in “editing” behaviour, while the basal ganglia is more involved in switching off responses to allow for deliberation. The vermis region may have a role in motivation (Barkley 1998). None of these regions act in isolation, and it appears that, when looking for an anatomical

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A Heartening Alternative

*Western focus on chemical therapy versus
the Eastern principle of holistic medicine*

BY KAMYA RAMASWAMY

The veritably translucent line that separates science and spirituality has been repeatedly disputed, distorted, erased and redefined, with little chance of ever becoming distinct. When the focus is shifted toward health issues, however, the debate becomes a matter of medical priority, pitting the advocates for orthodox science against those who support methods of alternative healing.

One of the most contested methods of alternative medicine is the practice of Qigong (pronounced "Chi-Kung"), a Chinese system of channeling internal energy for the purpose of self-healing. Qigong is built upon the principle of *qi* ("chi"), the body's vital energy, which flows through pathways that connect to one's internal organs and functions (Barrett, 2001). Illness is caused when one's *qi* is disturbed, projecting the body into a state of imbalance (Journal of Traditional Eastern Health, 2001).

Although the custom is only recently acquiring popularity in North America, it has formed an extensive foundation in China. Qigong stresses the importance of healing through the cultivation of inner energy, via two major branches of practise: the Taoist School and the Buddha's School. Practitioners of either school defend the medical significance of the art through the logic that cultivation energy is akin to actual energy, which, in turn, can be justified as matter (Jauhal, 1998).

Breathing initially triggers the healing process of Qigong, and it has proven effective for thousands of years in treating mainly chronic disorders. Some such ailments include: neurosis, arthritis, anxiety attacks, muscle aches, and high stress levels (Wharton, 2001). As a significantly meditative practice, Qigong encourages recuperation by merely acting as an aid to the body's visceral functions. Anne Wharton, a patient and advocate of this physiological therapy, explains the process of healing in a basic experience:

The deeply relaxing state achieved by the practice of Qigong suppresses the excitation perimeters of the cerebral cortex (in the brain). This internal inhibition or suppression of over excitation and fatigue of the cerebral cortex allows a quiet calm state for extended periods, and this provides a receptive medium for the restoration of the brain to its normal calm and alert condition. Hyperactivity is quietened by internal control, which means conditions in the central nervous system become more conducive to the regeneration of vitality, and recovery of health from disease (Wharton, 2001).

Often described as a holistic approach to healing, Qigong may thus be seen as a sort of "grass-roots" method of disease treatment in its potent ability to focus on the initial cause of illness.

Arguably the most infamous form of Qigong, however, is Falun Dafa, or more commonly, Falun Gong (pronounced fah-luhn gong), which has proven controversial for both its effects on a political level, as well as its claims of validity as a method of healing. Falun Gong is an arrangement of five exercises that involve yoga-type postures and a wide range of limb movements (Religious Tolerance, 2001). Typically performed to calming music, this rapidly spreading movement began in China in 1992, when its founder, Li Hongzhi (a.k.a. Master Li), finished the development of its principles. In disseminating the message of "truthfulness, benevolence and forbearance," the practise places more emphasis on spirituality and healing the body's ailments on a mainly

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ADHD

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breakdown of attention, the result is more intricate than a mere sum of the brain parts.

These brain regions communicate primarily through the neurotransmitter, dopamine, involved particularly in regulating movement and emotion. A decrease in the effectiveness of this neurotransmitter is believed to play a key role in ADHD. When examining a possible explanation for this phenomenon, researchers at the University of California at Irvine have linked the malfunction to a specific dopamine receptor gene, D4 (Moyzis, 2001). The understood action of dopamine provides the main basis for handling ADHD, and methylphenidate, more commonly known as ritalin, is the most commonly prescribed drug treatment. Acting as a stimulant, ritalin inhibits the transporter for both dopamine and norepinephrine (also known as, noradrenaline), thereby blocking their reuptake. Although the amount of dopamine is not altered, its postsynaptic effect becomes amplified (Sanagare, 2000). This method of drug action has proved effective in increasing attentiveness, and studies involving children indicated that their behavior had improved as a result of using this drug (AORN Journal, 1999).

Putting children on drugs always comes with some controversy, and ritalin is no exception. Its side effects include nervousness, weight loss, appetite loss, sleep disturbances, and even impeded growth. Additionally, it may interfere with drug metabolism and have interactions with other medications. Reportedly 80% of children with ADHD, however, show improvement while receiving this drug (Dugas, 2000). While addiction has also been stated as a concern, research has shown that people with ADHD will not become addicted if the medication is taken in the prescribed form and dosage (Volkow, 1998). It has been found that, 60 minutes after ingestion, the drug reaches its peak concentration in the brain. As a result of this slower course of action, users do not experience a chemical high (AORN Journal, 1999). A recommended solution by the Canadian Pediatric Society is an annual trial without the medication. This course of action would provide an important assessment of whether the drug is necessary. Drugs are by no means the only forms of treatment; psychotherapy, cognitive behavioural therapy, as well as support groups, all prove beneficial in addressing the social, psychological and behavioural aspects of the disorder.

As research continues to delve into ADHD, scientists will be able to identify further causes, and thus will be better able to treat it. The known genetic link, supported by twin studies, is just one factor of the disease; researchers are also aware of the impact of cigarette, alcohol and drug abuse during pregnancy, and environmental toxins such as lead. Knowing further links that may act as triggers for the disorder could potentially have positive implications for preventative measures. It is clear that new questions will continue to be generated by the many implications of ADHD, but by studying the biology of the disorder, much will be illuminated about the intricate processes involved in learning, attention and activity.