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The Impact of Brain Technology on Mankind¹⁾

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INTISARI

Soedjono Aswin — *Dampak teknologi otak terhadap umat manusia*

Pemahaman dan penguasaan manusia atas proses-proses dan hukum-hukum fisis dan kimiawi, serta dasar-dasar biokimiawi dan biosisis proses-proses kehidupan, memberinya kemampuan yang seolah-olah tidak terbatas untuk memodifikasi gena, pikiran, emosi dan perilaku manusia. Perkembangan dan kecenderungan teknologi otak pada saat ini telah membangkitkan perhatian dan sekaligus kecemasan. Kemungkinan penerapan praktis teknologi otak dalam menanggulangi berbagai masalah klinis dan sosial senantiasa dilekati oleh dampak medis, hukum, etis dan sosial, baik positif maupun negatif.

Teknologi otak memberi manusia kemampuan dan potensi untuk mengubah perilaku manusia dan keberadaannya di muka bumi ini, potensi merekayasa spesiesnya sendiri, karena teknologi otak dapat dirancang untuk memodifikasi sifat-sifat dasar manusia. Dengan teknologi otak ini, di tangan manusia terletak kemampuan menembus, menyelidiki dan bahkan mengendalikan berbagai mekanisme pengendalian yang terdapat di dalam otaknya sendiri. Walaupun demikian, apa yang dapat dilakukan manusia tidak berarti boleh dilakukan. Masih banyak aspek kehidupan lain yang harus dijunjung tinggi dan dipertimbangkan sebelum melangkah, yaitu aspek-aspek moralitas, etis dan religius, jika integritas manusia dan keberadaan spesiesnya di planet bumi ini ingin dipertahankan.

Key Words: brain technology – behavior – genetic engineering – psychotechnology – morality

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INTRODUCTION

Man is not just a "super-animal", man is unique. Besides his limitations and shortcomings, man was created by Allah the Almighty and provided with advantages, *i. e.* the ultimate manipulative ability of his hands and his ability to communicate using languages. Moreover, man's special characteristic is thinking by using his brain (Jacob, 1975). It is the brain that makes man human (Livingstone in Quarton, 1967), therefore, he names himself *Homo sapiens*. According to Eccles (1973) man is characterized by what he called the World 3, which is of course, created by man, *i. e.* the world with intellectual, rational, ethical, and esthetical activities. There is something very special about the human brain: it has the performance in relationship to culture, to consciousness, to language, to memory, that uniquely distinguishes it from even the most highly developed brains of other mammals.

The most mysterious known area of man's universe does not lie in the farthest reaches of outer space, it is located inside the human skull, which is physically pinkish-gray matter, weighing about 1.5 kg; it is of course the human brain. The brain is without any qualification the most highly organized and most complex organized matter in the universe.

Everything that man has ever been, and everything he will ever be, is the product of his brain. It is the brain that enabled the first hominoid to use tools and inherited to his genetic successors the ability to build spacecraft, explore the universe, and analyze their discoveries.

How far is the possibility that a man can understand his own brain by using his brain? It is no easy question to answer. It is obvious that we are now at the starting point, because the ultimate goal to achieve, that is to understand man, is too far in the future. The brain is the newest and perhaps the last frontier in man's exploration of himself (Schmitt in Quarton, 1967).

It took man centuries to comprehend that there was a miraculous mechanism inside his head and began to investigate its working. Thanked to the development of neurosciences, including electronic and chemical techniques and cybernetics, brain technology has fastly developed. Brain technology is considered to be a technology that fits within the human engineering category, although it is neither reproductive nor genetic, because it is capable to directly control man's neural system by physical and chemical stimulation of specific parts of the brain. Since brain technology creates an immense impact on mankind, society must immediately face implications of this awesome power for good and evil before it is too late.

The advances of science and technology have profoundly altered various aspects of human life, his institutions, life styles, paradigms, and aspirations (Jacob, 1988). Any practical application of technology, including brain technology, certainly creates sociomedical, legal, and ethical impacts, either positive or negative.

It is interesting to observe and study the human efforts to control his own brain. It is not supprisingly, therefore, that the practical applications of brain technology, controlling his behavior, motivation, and emotion, and by manipulating brain function, will raise attention, interest, and also concern and anxiety in the scientific and lay societies.

THE ISSUES

Brain technology is considered to be one of the basic aspects of human engineering, a term used to describe experiments which are designed to modify the basic human nature. Knowledge of the brain has been ground and has been compounded since the nineteenth century, until today the whole technology exists for physically penetrating, probing and controlling the brain's own mechanisms of control. The issues are:

1. How far are the impacts of using brain technology on the basic human nature?
2. How far are the consequences of the development and trends of the brain technology concerning its potential capacity to engineer human beings?

The present paper is an attempt to discuss the abovementioned issues by considering the medical, ethical and social aspects in an effort to proportionally balance the dilemma faced by societies nowadays on the impacts of brain technology on mankind.

BRAIN TECHNOLOGY

Development and trends

In essence, the fast development of new vision and understanding on the brain originated from (Valenstein, 1973):

1. the latest development of electronic and chemical techniques. With these techniques man can explore the brain up to molecular and electronmicroscopic details, move to the sources of emotion and thinking processes, and eventually man can control it, either by stimulating or suppressing it artificially;
2. the emergence of the relatively new discipline, cybernetics, a discipline that studies animal, man and machine comparatively on learning processes, on information received, stored and retrieved, and the method of various problems solved based on the previous experience. It shows that the brain can be simulated by creating machines which "think", "learn" and "respond" like a human being.

It was the study of Hess in the 1930s that did much to usher in the present era. Hess is the first person who inserted electrode in the brain. In a series of illuminating experiments for which he received the Nobel prize in physiology and medicine in 1949, Hess found that by gentle electrical stimulation of certain areas in the hypothalamus of cats he could evoke emotional and motivational states, such as fear, anger and reactions related to digestion and other body functions. With this artificial stimulation the functions of many areas of the brain were revealed.

Those discoveries started a train of highly fruitful experiments in electrical and chemical stimulations by many investigators, culminating in the discovery of nerve circuits that appear to control pleasure and punishment (Fisher, 1967; Delgado, 1969) and self-stimulation centers (Olds, 1958; 1965) in various animals. Hess's studies and conclusions have been directly applied to human behavior problems (Valenstein, 1973).

The findings of the physiologists and biologists attracted the interest of psychologists. They tended to concentrate on more holistic behavior pattern such as eating, drinking, aggression and the mental states that accompanied these responses when they were elicited by brain stimulation. They wanted to know if the animals experienced hunger, thirst, pain, and fear when stimulated.

The demonstration that brain stimulation would produce an aversive emotional states capable of motivating an animal to avoid a repetition of experience opened up many research possibilities for studying the brain mechanisms involved in learning and motivation. In addition to any implication for learning theories, the fact that emotional experiences could be evoked by brain stimulation laid the foundation for studying the brain correlates of states and later attempts to alter human moods.

A number of reports of dramatic changes in animal behavior following experimental destruction of parts of the nervous system provided a very significant force in encouraging neurosurgeons to undertake various brain manipulations as a means of treating human emotional and behavioral problems. Some of the changes actually seemed to radically transform the temperament or personality of the operated animals. These changes were most often seen following destruction of regions either in the limbic system and hypothalamus or in the prefrontal cortical area, which is believed to be part of the same functional circuit. These results provided support for the highly speculative theory proposed by Papez (1937). Papez assembled arguments and clinical data in support of a theory that the limbic system (in conjunction with the hypothalamus) constituted an anatomical circuit regulating emotionality.

Papez's theory was further developed by McLean (1949) who stated that parts of the limbic system (including amygdala) which are found in all mammals are "visceral brain" connected with emotional responses essential for the preservation of the self or of the species.

Aggression, and even the killing behavior could be elicited by stimulating certain area in the depth of the brain of the cat (Flynn, 1967) and monkey (Hofstatter & Girgis, 1972) by radiostimulation at the lateral part of the hypothalamus. Delgado (1969), on the other hand, succeeded in ceasing the bull aggressive behavior by controlling through electrode implanted in the brain with radiofrequency stimulation. One region of the brain that has been consistently implicated in aggression and sexual behavior is the temporal lobe. Structures lying beneath the cerebral cortex in the temporal lobe, particularly the amygdala and hippocampus, seem to be critically involved in the regulation of emotionality. The amygdala and hippocampus are important structures in the limbic system, which, in conjunction with the hypothalamus, form a circuit modulating biologically significant behaviors involved in what one whimsical neurophysiologist referred to as the four F's - feeding, fighting, fleeing and sexual behavior.

Aggressive and sexual behavior can be elicited by destroying the temporal lobe in monkeys (Klüver & Bucy, 1937), and cats (Schreiner & Kling, 1953), with the involvement of amygdala and hippocampus.

Jacobsen's experiment in 1935 is one of the most dramatic examples of the direct and immediate influence that animal experiments may have on the treatment of human problems. The development of psychosurgical procedures

are profoundly influenced by the description of the modification behavior following surgical destruction of the brain of monkeys and chimpanzees (Jacobson, 1935). Moniz (1936) was the first neurosurgeon who applied psychosurgery to depression and schizophrenic patients.

Clinical, social and ethical implication

With his ever increasing capacity to tinker with the brains of animals and men and to manipulate their thoughts and behavior, Rensberger (1971, *cit. Valenstein, 1973*) is concerned that some time in the future man is able to create frightening and sophisticated techniques for making human beings act according to the will of the psychotechnologist. In his book, *Profile of the Future*, Clarke (1964) also stated his concern that the discoveries of pleasure reward and punishment centers in the brain may be fraught with more social consequences than the early work of the nuclear physicists.

Previously, the appreciation of brain technology in human experimentations in the laboratory was only limited to the very serious cases. Further development, however, showed that its application seemed to penetrate those limitations, because the emotion and the sensation of healthy men could also be aroused artificially. The liberation of technology penetrating the laboratory walls, according to Jacob (1988), might escape the scientist's control and dehumanize human beings. Valenstein (1973) described that direct manipulation of the brain technology as potentially diabolic techniques for controlling human behavior.

Two social phenomena which cause serious concern in the society are:

1. the trends of rapidly increasing number of violence, aggressiveness (including war), and crimes; and
2. the inability to develop means or methods to effectively combat those trends.

It is, therefore, not surprising that solutions involving biological approach have been proposed (Teich, 1972). It is also hoped that brain technology, including psychotechnological and biochemical interventions, would assure the leaders positive use of power and reduce or block the possibility of using power destructively (Clark, 1971, *cit. Valenstein, 1973*).

In case of human engineering, some people are concerned that new development of brain technology will revive the psychosurgery era. The procedures are not only applied to alleviate curable psychotic patients, but are also used as means to control someone's behavior in order to manage and control him by destroying his personality and creativity. On the other hand, people still nurture their hope that social conflicts, according to them, originated from "inherited aggressive instincts", may be eliminated by applying brain technology.

Emotions engendered by psychosurgery have come to run high enough to frustrate meaningful discussions between those who disagree on the use of this practice. On the one hand, some view psychosurgery at best as useless, and at worst as a destructive assault on the human spirit, eventually to be used on a large scale to prevent social unrest. On the other hand, some consider it defensible in certain cases of otherwise intractable mental disorder and pain.

It is believed that biological factors contribute towards the expression of violence behavior. However, the violence wave in the society in general occurs as the result of "the sick society" not as the product of "the sick brain".

In the beginning, brain manipulation by invading it with electrodes so that emotional responses may be excited or suppressed, shaking the society and caused serious concern. Attitude and thought which opposed these techniques gradually fade away after appropriate conditions were established, as shown by the medical history.

Most people today are capable enough to accept strange medical traditions and practices which were formerly regarded as unnatural, immoral, disgusting and even repugnant. Now people have learned to accept such diverse medical procedures as psychoanalysis, tranquilizers, electroconvulsive therapy, radiation treatment, organ transplants, and cardiac pacemakers. It seems that people now are much more open to novelty and change.

DISCUSSION

According to Rabinowitch (1975) it is commonly said that, in the last hundred years, first chemistry, then physics, have had the greatest impact on human existence on earth; and that now this role is being taken over by biology. It seems unlikely, at present, that the era of biological weapons will succeed that of nuclear weapons, as the latter had succeeded the age of chemical explosives; but biochemical and biophysical understanding of life processes clearly is approaching the stage when man will be able to understand and significantly effect the genetic makeup and behavioral patterns of living organisms – including his own species. Man's control of chemical and physical processes has given him immense capacity for constructive achievements as well as for destruction, the latter culminating in almost unlimited destructive power of nuclear explosives.

Breakthroughs in biology promise to put in human hands revolutionary tools for changing human behavior and for reshaping man's existence on earth for better or worse. Even more crucial – and totally unprecedented – will be certain problems raised by powers the biological sciences are likely to put into the hands of individuals and societies.

It should be conceived the possibility of the difficult dilemma faced by man, whether it concerns with medical, social, legal, ethical or political aspects, as the consequences of the development and the trends of brain technology concerning its potential capacity to engineer human beings. To cope with this dilemma, it is necessary to develop and maintain dynamic balance between the necessity to conduct experiments with animal and humans for the sake of science and technology on the one hand, and the rights of the individual, the need of the society, and moral responsibility on the other. Although brain technology creates power to engineer human beings, it does not mean that we may do it.

The important implications of the animal experimental results are that the dramatic behavioral changes demonstrated in animal experiments suggested to some psychiatrists and neurosurgeons that the deteriorating psychotic patients in their charge might be helped by appropriate manipulation of what was commonly referred to as the "emotional brain".

Technology, like a coin, has two faces. Its creation, development and application are always facing with dilemmas, positive and negative. There is no doubt

the value and significance of technology as a tool of basic research which gives man a means to study further, more widely and deeply about how the brain is organized and works. On the other hand, some concluded that with brain technology at hand man will immediately be capable of engineering his own species; he is in the position to manipulate the brain so that he can modify thought, emotion, and behavior with methods which results can be predicted, has practical significance and in accordance with his will, so that it can directly solve medical and social problems. The result has been to consistently convey the impression that a wide range of applications to medical and social problems will be possible in the near future.

In an attempt to foresee the possible development and application of brain technology we look at a glance to Gordon & Ament's (1972) reports on the study of the Institute for the Future. By employing the Delphi method to develop a series of forecasting of possible future events in science and technology, it was forecasted that in 1980s the behavior of some people in society will be controlled by radiostimulation of the brain, and reach its culmination in the year 2000. During that period brain technology will give results which are categorized as "possible" with "favorable" effect, *e. g.* the creation of an instrument that controls abnormal behavior, including crimes. In the first part of the 20th century, research into the means of directly stimulating the cortex may have led to demonstration of man-machine symbiosis in which certain men (perhaps with implanted electrodes or other, less repugnant devices) will extend their intelligence by being connected to a computer. This development might have the effect of multiplying human intelligence manyfold.

If the society accepts the placing of needles in the body (acupuncture), why not accept acupuncture of the brain? Diagnostic procedures such as heart catheterization, some of which involve even greater physical risks than electrode implantation in the brain, have been accepted for a long time. If the application of brain technology could be demonstrated to be safe and beneficial, it is conceivable that it would come to be regarded as a routine procedure.

The above-mentioned optimistic opinion is based on the idea that technology provides a "self-correcting system", and also based on the emergence of a new type of society which is referred to as technological society, *i. e.*, the society which is able to control its development, and dominates technology instead of being dominated by technology (Ferkiss in Teich, 1972).

CONCLUDING REMARKS

The characteristics of technology is that it creates new possibilities to select and conduct, but it leaves the trends uncertain. Technology creates new opportunities and also generates new problems for men and societies. Technology is the product of human ingenuity, and without human purposes behind it, it is not the cause of anything. Therefore, technology is just promising the possible alternatives in the future.

Some people believe that by developing a new technology man can change the limits of society and thereby the conditions creating the problems (Weinberg in Teich, 1972). On the other hand, the rest of the people believe that the

development and understanding of the powers and laws of the physical world do not guarantee the creation of better conditions, it might even tend to lead to disaster. One prime cause, according to Morison (in Teich, 1972), is the fact that science and technology are central to man's ability to manipulate the world around and inside him, and it is increasingly apparent that this manipulation has not always been for the good of mankind.

Social and ethical problems will always emerge on the surface as the results of brain manipulation and intervention, because it might affect basic aspects of human existence. With brain technology man is able to engineer human beings, changing his personality, managing and influencing his thought and behavior. Human integrity will be degraded and fragmented (Aswin, 1986). Without the basis of higher morality, such as honesty, personal integrity, love, responsibility, and the identification of good and bad, good science and technology will never be developed at all (Boulding in Teich, 1972).

In such situations the most important aspect to be kept in mind is control. Control is not enough by developing new techniques, sociomedical and legal settings, but it should be led as such that brain technology can serve the advance of the society without eliminating human integrity. In addition, its control needs the highest power that man has, *i. e.*, ethics and religion. Above all, man himself – as the motor that moves science and technology – needs an ethical and religious control as the source of morality, which guides him in any aspect of human life.

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