Preventing Accidents through Dialog with the World of the "Unconscious"

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Profile

Born in 1946
1969 : Received B.S. in Aeronautical Engineering from the University of Tokyo
1971 : Received M.S. Aeronautics from the University of Tokyo
1971 : Joined Japan Airlines Co., Ltd.
1973 : Member of the Flight Dynamics Committee, the Japan Society for Aeronautical and Space Sciences
1990 : Advisor to ICAO Human Factors Study Group
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In evolutionary terms, what has separated humans from other primates has been the development of the frontal lobe of their brain that has given them the capacity to imagine what does not yet exist and the creative power to challenge what is still unknown. The application of these qualities to man's quest for control of his environment has resulted in many important changes in the systems we adopt. The invention of the steam engine in the latter half of the 18th century triggered the Industrial Revolution and helped to emancipate humanity from the burden of heavy labor. The socio-technical systems typified by fields such as aviation, maritime transportation, nuclear power generation, space development, chemicals and others can now be seen as expressions of the same spirit, contributing to both the material and intellectual development of humankind. However, risks are, and have always been an integral part of such strides toward prosperity. Steam engines in their early stages often went out of control, causing injury and damage. It was not until James Watt invented the "governor" or power regulator that the steam engine came to be accepted as a reliable machine. Incidentally, the invention of the governor is said to have pioneered the science of industrial safety engineering. Accidents occurring within our own socio-technical systems in recent years have again raised questions regarding the merits and demerits of the apparently endless human striving for the development of science and technology. It can be said that the sound development of science and technology cannot be achieved without the concurrent establishment of techniques for preventing accidents.

Stated briefly, we can say that human error is the major cause of accidents in all systems. As a result, we have been making efforts to prevent accidents by trying to eliminate human errors. The specific means to eliminate errors are typically to educate and train the individuals involved, and to standardize and regulate their work procedures. In addition, efforts have been made toward systems automation to reduce the amount of human involvement in their operation, and making systems more redundant to improve reliability. Despite these efforts, however, there has been no marked reduction in the rate of accidents. It has been pointed out that measures adopted to preclude errors have, on the contrary, made the systems more complicated and have caused human inaction, thereby bringing about errors that are more difficult to predict and correct. This suggests that there may be a fundamental flaw in our current accident prevention strategies. We are being forced to make substantial changes, both in our behavior and in our way of thinking

The word "error" in English is derived from the Latin "errare" that signifies "to wander, stray, rove". This can be seen as alluding to the fact that errors are prone to exist where brain activity "wanders" between the "conscious" and "unconscious" parts of the mind. Sigmund Freud, the Austrian psychoanalyst postulated that much of human thought and behavior occurred at the boundary between these areas of the mind and named it "the

subconscious". Carl Jung discussed in his theory of the "collective unconscious" and the "individual unconscious" the concept that individual differences exist in how this process works. The "conscious mind" can be defined as being in an activated state, with the brain capable of accurately processing externally derived information. An error may exist when there is an area of the unconscious involved that is incapable of processing that information. Erroneous acts are inseparably related to the unconscious and to the limitations imposed by our physiological and mental make-up and they can be classified into a great variety of categories according to the element of the unconscious involved.

The fact that errors exist at the boundary between the conscious and the unconscious provides a definite reply to the question of whether errors can be eliminated or not. Each of us has a boundary between the conscious and unconscious parts of the mind. Errors in thinking in behavior would not occur if we were always able to process information in the world of the conscious, without coming near the boundary between the conscious and the unconscious. This, however, is a practical impossibility; we humans have been destined to confront and overcome challenges, and to stretch the limits of our capabilities ever since our brains first developed their frontal lobe. We modern humans are constantly creating new challenges to our capacities and capabilities in a great variety of activities, the need to work at night, the development of faster and faster means of transport, expeditions into space and the depths of the oceans, the control and use of nuclear power and oil/mineral resources, and systems automation through the use of computers, all of which are aimed at achieving higher efficiency in our activities. Without our knowledge, these factors are actually expanding the scope of the unconscious within the human brain. Errors are not unrelated to the spirit of challenge that is inherently present in the human mind. So long as humans continue to take on challenges in order to realize their dreams, errors will never cease to exist. Errors are an inevitable consequence of the normal functioning of the human brain. To try to eliminate errors completely implies a denial of something essential in the make-up of humanity.

To think that accidents cannot be avoided because of the impossibility of completely eliminating errors may be too pessimistic a view of the situation. Not all errors lead to accidents. It is possible to pick out those errors that may lead to accidents, and through wise intervention, cut the link between the error and the potential accident. This type of thinking is part of the concept called "error tolerance", a relatively new accident prevention strategy. There are three requirements for the successful implementation of the concept of error tolerance. One is the capability to clearly identify the characteristics of an error. The second requirement is the capability of predicting how an error develops in a given situation and determining if it is hazardous or not. The third requirement is the capability to prepare effective measures to prevent a hazardous error from developing into an accident.

To acquire these capabilities, it is necessary to develop a deep insight into the activities of the unconscious part of the brain. Conventionally, it was considered that errors, and hence accidents, could be avoided if conscious awareness could be maintained to an adequate level. However, the activity of the brain that controls most human thought and behavior actually occurs at the boundary between the conscious and the unconscious, so it is not reasonable to consider that the problem can be solved by avoiding the unconscious. Then how should we deal with the unconscious area of the brain and its impact on thought and behavior? Unexpectedly perhaps, we can find the answer within ourselves. The human large intestine contains a great variety of bacteria, but we cannot eliminate them simply because they sometimes cause disease. For countless generations, there has been a "friendly" relationship between the human body and non-toxic bacteria such as Lactobacillus bifidus. Also, if we try to use an antibiotic drug to kill off a toxic bacterium such as O-157 in one fell swoop, this attempt may result in the death of the host through the release of toxic material. In other words, there is no alternative but to recognize the existence and inevitability of bacteria and encourage a symbiotic relationship, thereby improving the tolerance and the strength of the immunity of the body to ward off illness.

Thinking along these lines, it appears that for humans, the area of the unconscious in the brain is similar in some respects to bacteria. The unconscious occupies a firm position in the brain and cannot be removed. If we try to kill bacteria using an antibiotic drug, new and more powerful bacteria appear. In a similar manner, if we try to eliminate errors through the use of hardware and software, a new area of the unconscious will be formed, and a new type of error will be produced. This phenomenon has already become a reality, taking the form of human inaction in automated systems, and in the ill effects of the "by-the-book" approach. Similarly to the case of bacteria, there is no alternative but to improve tolerance and immunity by means of continued dialog with the unconscious. For this purpose, it is necessary to analyze the characteristics both of errors and of the unconscious using the knowledge and insights gained through the study of cognitive psychology, cerebrophysiology, and information technology. Human factors is defined as "an effort to harmonize and optimize the relationship between humans and their living and working environments with the knowledge and skills related to human performance and limitations". This is now the subject of intense interest all over the globe.

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