Design for Living

By J. A. Scott Kelso, Ph. D.

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As a university-based researcher funded by the federal government to help train the next generation of brain scientists, I am sometimes asked whether there is anything about our current understanding of how the brain works that might provide deeper insights, if not into the mind of the terrorist, into ourselves as human beings and our place in the world. Given our ignorance of the enormous complexity of the human brain, both in terms of the detailed workings of its trillions of cells and intricate communication systems as well as its rich repertoire of behaviors, the question seems premature, if not naïve. I do not think one can ignore it, however. After all, it is our brains that produce deeds, whether seen as magnificent and heroic or dastardly and abhorrent.

Over the last few centuries, two conflicting theories of brain function have emerged. One sees the brain as a vast collection of distinct regions, each localizable in the cerebral cortex and each capable of performing a unique function. The other school of thought looks upon the brain not as a collection of specialized centers, but as a highly integrated organ. In this view, no single function can be the sole domain of any unique part of the cortex. Obeying the old dictum, the holistic brain is greater than the sum of its parts. Like debates on nature versus nurture, these conflicting views have generated more heat than light.

Within the last 20 years, a new theory of brain organization has emerged that may provide deeper insight into the human mind, both individual and collective. This theory is based on a good deal of empirical evidence and is grounded in a biologically realistic model of how brains are coordinated. Neurons in different parts of the brain oscillate at different frequencies. These oscillations are bound together in a coherent network when people attend to a stimulus, perceive, think and act. This is a dynamic, self-assembling process, parts of the brain engaging and disengaging in time, as in a good old country square dance. In the simplest case, oscillations in different brain regions can rise and fall together, locking in “in-phase” brain activities, or the pattern can be “anti-phase,” in which one oscillatory brain activity reaches its peak as another hits its trough. In-phase and anti phase are just two of many possible timing relations that can exist between specialized brain areas. This coordination mechanism allows a person to perceive different features of an object, different aspects of a moving scene, separate remembered parts of an experience or different ideas that arise in a conversation, binding them all

together into a coherent whole.

Additionally, the brain can shift gears from one phase relation to another, causing abrupt changes in perception, attention, memory and action. These switchings are literally “phase transitions” in the brain, precipitous shifts in brain states caused by external and internal influences.

This newer view says that the brain has the capacity to lock into one of many available stable coordinative states or phase relations. The brain can also become unstable and switch to some completely different coordinative state. Instability, in this view, is a selection mechanism that is able to pick out the most suitable brain state for the circumstances at hand. It is apparent that locking in and switching capabilities can be adaptive and useful, or maladaptive and harmful. They could apply as easily to the schizophrenic or obsessive-compulsive, as they could to the surgeon honing her skills.

A third kind of brain behavior has recently been discovered, and it may provide the best key yet for understanding ourselves. It is called metastability. In this dynamic regime there are no longer any stable, phase and frequency synchronized brain states; the individual regions of the brain are no longer fully “locked in,” or interdependent. Nor, are they fully independent. Rather, in the metastable brain, the individual parts of the brain exhibit tendencies to function autonomously at the same time as they exhibit tendencies for coordinated activity. Metastability is an entirely new conception of brain organization, and not merely a reworking of old theories. Individualist tendencies of various regions of the brain coexist with coordinative tendencies. In this new view of the brain, apartness and togetherness coexist in a complementary way, and not as conflicting forces.

That metastable dynamic behavior has been discovered in the brain should be intriguing to policy makers, and, indeed, to all social agencies and organizations. By reducing the strong hierarchical coupling between the parts of a complex system while allowing them to retain their individuality, metastability leads to a looser, more secure, more flexible kind of functioning in which no dictator tells the various parts what to do. Too much autonomy of the component parts means no chance of coordinated activity; too much interdependence, and the system gets stuck, with a loss of global flexibility.

What message can we take away from this brief excursion into the dynamics of the brain? The metastable mind favors no extremes, nor is it a balance of opposing alternatives. The metastable mind expresses the full complexity of the

brain. It reconciles the well-known individualistic tendencies of specialized brain regions with the tendencies of those regions to work together. The metastable mind is a mind of tolerance and peaceful coexistence that accommodates apartness as well as togetherness, stability as well as flexibility. Raised to a social principle, metastability provides a framework for the harmonious interaction of diverse individuals and groups, all working in a common interest. The nation-states of our ever-shrinking world have much to learn from the ingenious design of the human brain.

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