

# FUNCTIONAL SALUTOGENIC MECHANISMS OF THE BRAIN

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**ABSTRACT** Neuroscientists are typically interested in the brain in relation to disease, but much could also be learned by studying the brain in relation to health. The brain has processes, functional salutogenic mechanisms, that contribute to health by enabling one's outlook on life to benefit one's health. For example, the belief that things will work out as well as can reasonably be expected is a key aspect of the outlook of people who tend to stay well even when in potentially stressful situations. Believing in God, feeling happy, being mutually in love, and expecting things to change for the better are also outlooks that can be salutogenic. Beliefs need not even be rational or realistic in order for them to be salutogenic, as shown by phenomena such as faith healing and the placebo effect. Thus, the brain responds to stimuli and interprets them, mainly without one's awareness, in ways that can enhance one's well-being. Although little is presently known concerning neuropathways of functional salutogenic mechanisms, further research on relations between salutogenesis and brain function can be expected to provide new strategies for improving health worldwide.

TODAY, THE MIND AND BRAIN ARE VIEWED as one (Bishop 2000), and modern neuroscience rests on the premise that a complete knowledge of the workings of the brain can provide a complete knowledge of human behaviors, thoughts, and feelings, both in sickness and in health (Damasio et al. 2000;

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Haines 1997). Neuroscientists usually study the brain in relation to disease, but perhaps they should begin paying more attention to the brain in relation to health.

### WHO STAYS WELL?

Life is notoriously dangerous. Germs and pollution cause disease (Curtis and Biran 2001). Accidents and disasters happen. There are wars. Genocide occurs. People become poor and homeless. Clearly, life is uncertain (Pidgeon and Beattie 1998). People must manage as best they can, dealing with ever-changing events that often have unpredictable consequences. Yet some people do fairly well. Somehow they stay healthy most of the time. Why is that? How do they manage? And does their brain play a key role in their well-being? I believe that these simple questions deserve sensible answers (unlike the situation portrayed in Fig. 1) because of their potential value for medicine and society.

### SALUTOGENESIS

Antonovsky (1979) proposed an important explanation to account for the fact that some people stay relatively well despite the trials and tribulations of their lives. He coined the term “salutogenesis,” from *salus*, the Latin word for health and well-being, to emphasize the focus of his model on health rather than on disease (i.e., pathogenesis) (Heim 1994). The impetus for the salutogenic model came from Antonovsky’s experiences with refugees who immigrated to Israel from concentration camps after World War II. He noted that despite their horrendous experiences, some of the refugees were relatively well. Having been trained in both sociology and medicine, Antonovsky wondered whether a person’s general outlook could play a crucial role in his or her well-being. Years of research led Antonovsky and his colleagues to propose that a key factor for salutogenesis is a person’s sense of coherence (SOC), defined as “a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that one’s internal and external environments are predictable and that there is a high probability that things will work out as well as can reasonably be expected” (Antonovsky 1979). Much subsequent work has confirmed that a person’s SOC—which consists of comprehensibility, manageability, and meaningfulness—is an important component for one’s health and well-being (Antonovsky 1987, 1993; Bengtsson-Tops and Hansson 2001; Mehlum 1998; Schnyder et al. 2000; Strang and Strang 2001).

#### *Hardiness*

Kobasa and coworkers at the University of Chicago also wondered about who stays healthy under stress (Kobasa, Hilker, and Maddi 1979). They found that the general outlook of people who tend to stay well even in stressful situations con-



FIGURE 1

*“When we were little,” the Mock Turtle went on at last, more calmly, though still sobbing a little now and then, “we went to school in the sea. The master was an old Turtle—we used to call him Tortoise—”*

*“Why did you call him Tortoise, if he wasn’t one?” Alice asked.*

*“We called him Tortoise because he taught us,” said the Mock Turtle angrily: “really you are very dull!”*

*“You ought to be ashamed of yourself for asking such a simple question,” added the Gryphon. . . .*

NOTE: FROM “ALICE’S ADVENTURES IN WONDERLAND,” FIRST PUBLISHED 1866 BY MACMILLAN AND CO., LTD. REPRODUCED WITH PERMISSION.

sists of three factors that they identified as control, commitment, and challenge. In their terminology, “control” denotes the person’s belief that he or she is able to influence the course of events; “commitment” captures the person’s curiosity about and sense of meaningfulness of life; and “challenge” encompasses the person’s expectation that it is normal and beneficial for life to change (Kobasa, Hilker, and Maddi 1979; Kobasa, Maddi, and Courington 1981; Kobasa, Maddi, and Puccetti 1982). It is striking that the components of hardiness resemble in so many ways those of SOC. As far as we know, the outlook of a hardy person need not be realistic or correct in order for it to be effective in promoting well-being; what appears to matter most is the strength of the person’s salutogenic convictions.

### *Coping*

Lazarus and coworkers at Berkeley noted that a person’s ability to withstand potentially stressful situations depends strongly on how the person views such situations (Folkman and Lazarus 1980), and decades of research on cognitive and

behavioral therapy have left no doubt that one's appraisal of a situation plays a key role in one's well-being (Beck 1993, 1997; Clark 1999; Wells-Federman, Stuart-Shor, and Webster 2001). Everyone appraises situations in their own distinct way, and those appraisals are decisive for whether or not a particular situation is stressful. A pathogenic appraisal can start a vicious circle of stress, whereas a salutogenic appraisal can relieve counterproductive emotions and provide opportunities for coping suitably with the situation. An example of how a positive appraisal can affect one's well-being can be seen in a hilarious scene of a movie called *Planes, Trains and Automobiles*, starring Steve Martin and John Candy. In it, the two men are compelled to spend a night together at a motel because Martin's convertible car was ravaged by a fire that was caused in part by his passenger, Candy. After driving through a snowstorm in the roofless vehicle, they arrive late at night at a motel. Martin is clearly deeply distressed by the entire situation, whereas Candy appears to have taken it all in stride. Candy stretches his arms above his head and proclaims exuberantly, "With all this fresh air, we're gonna sleep like babies!" That's certainly a salutogenic outlook!

#### *Social Support*

Social support is another factor that has salutogenic properties (Heckman et al. 1996; Hollnagel and Malterud 1995). Cobb at Brown University defined "social support" as information leading a person to believe that he or she is cared for and loved, is esteemed and valued, and belongs to a network of communication and mutual obligation. Social support has been shown to be closely associated with quality of life (Heckman et al. 1996), primarily because it gives people a feeling that their situation is more meaningful and manageable (Strang and Strang 2001). Social support also has been claimed to protect people from the health consequences of life stress, in addition to speeding recovery, improving compliance with prescribed medical regimens, and reducing the need for medication (Cobb 1976). Once again, there appears to be no requirement that beliefs nurtured by social support are valid in order for them to be salutogenic (Hollnagel and Malterud 1995); the main requirement seems to be that the person holding such beliefs be convinced of them and feel that they are in some way beneficial.

#### *Religion*

Religious beliefs can also be salutogenic (Strang and Strang 2001). A strong belief in God has, for example, been shown to benefit depressed people, reducing the severity of their illness and lessening their feelings of hopelessness (Murphy et al. 2000). Being a member of a religious organization can have salutogenic effects by providing a sense of belonging. A belief in God can also provide a sense of meaningfulness in life, and religious beliefs can strengthen one's SOC by providing a unifying concept with which to interpret events.

The concept of God usually includes a supernatural being that is benevolent towards humankind, provided that certain principles are upheld. Evidently, the

human brain can readily create such a notion and rapidly come to believe in it (Ingle 1971). The question of whether supernatural beings such as God actually do exist is not at issue here. The issue is whether having a belief in God is a functional salutogenic mechanism of the brain. When asked whether she hoped to win an election in 2004, the current president of the Philippines, Gloria Arroyo, replied, "My father taught me to do your best and let God take care of the rest. At the appropriate time, He'll give me the right signal" (Weymouth 2001). Given the turbulence of the political scene in the Philippines during recent years, having a strong belief in the guidance of God probably is one of President Arroyo's functional salutogenic mechanisms, enhancing her SOC despite the realities of the situation.

The concept of God is usually a mixture of thoughts and feelings that can have strong effects throughout the body. Whatever salutogenic effects believing in God may have, they can probably be accounted for by a well-known psychological principle known as Thorndike's Law of Effect, which states that organisms tend to repeat and learn responses that lead to tension reduction and the completion of motivated activity (Gross 1992; Shaffer and Shoben 1956). A person may learn to believe in God because that belief reduces inner tension by giving a feeling of being protected from harm. According to psychological theory, beliefs are learned because they are "rewarding." Beliefs can, for example, produce a feeling of having more control over things, which can bolster self-confidence and thereby reduce anxiety caused by the uncertainties of life. We do not yet know how belief in God is represented in the brain, although neuroscientists have studied religious experiences such as the feeling of "oneness" with the Universe that can be experienced during meditation (Newberg et al. 2001). Belief in God is certainly a complex process that probably involves many brain regions and neurotransmitters, in addition to being markedly different from person to person. It may be difficult, therefore, to pinpoint the neuronal basis of its salutogenic effects.

#### *Happiness, Humor, and Love*

At least three additional factors play a role for functional salutogenic mechanisms of the brain, namely happiness, humor, and love. Happiness has been studied in the brain by numerous investigators. Brain scanning, for example, has been carried out on subjects while they viewed happy faces or recalled happy life events (George et al. 1995). Happiness appears to affect neuronal activity under those conditions mainly in prefrontal, temporal, and parietal regions of the cerebral cortex. In another study, brain imaging took place while subjects thought about intense personal episodes of happiness (Damasio et al. 2000). Under those conditions, happiness was associated with activity in the temporal and parietal cortex, as well as in the cingulate gyrus and insula. Evidently, happiness is not confined to a particular brain region.

Humor has also been found to affect brain activity in a number of ways. In one study, brain scans took place while subjects read statements such as the fol-

lowing: “Sign in a Hong Kong tailor’s shop: ‘Please have a fit upstairs’” (Shammi and Stuss 1999). Grasping the humorous point of such statements depended on the right frontal lobe, a region thought to be involved in integrating cognitive and affective information and in producing self-awareness. In another study, brain scans occurred while subjects listened to statements such as “Why did the golfer wear two sets of pants?” The answer is “Because he got a hole in one” (Goel and Dolan 2001). Getting the point of the humoristic sentence involved neuronal activity mainly in the ventral prefrontal cortex, which is commonly viewed as part of the brain’s reward system (Goel and Dolan 2001). Thus, a variety of brain regions appear to be involved in mediating happiness as well as one’s sense of humor.

Now, what about romantic love? Mutual romantic love is salutogenic (Smith and Hokland 1988), and its neural basis has been studied. People who professed to being truly, deeply, and madly in love have been examined recently by brain imaging while they viewed photographs of either their loved one or someone else of the same gender as their loved partner (Bartels and Zeki 2000). A strong feeling of romantic love was found to be associated with neuronal activity in several regions of the cerebral cortex and subcortex, including the anterior cingulate cortex, the amygdala, the caudate nucleus, and the putamen. Thus, salutogenic properties of romantic love also appear to depend on widespread networks of neural connections.

### *Selective Perception*

A remarkable feature of the human brain is its ability to exclude items from awareness. As Hoffmeyer (2000) pointed out, “even when our consciousness is not aware of it, our body and brain continue to interpret the world around us, alerting our consciousness only when necessary.” Thus, all sensory, motor, and cognitive processes are the result of the brain’s complementary properties of inclusion and exclusion of neuronal activity.

Selective perception is a particularly crucial component of functional salutogenic mechanisms. It serves to exclude threatening items from awareness so that one’s SOC can be maintained, despite realities and uncertainties of a situation. The brain’s capacity to manipulate awareness by selectively excluding stimuli is pivotal for functional salutogenic mechanisms, and several salutogenic phenomena such as the placebo effect, faith healing, and self-healing psychotherapies probably depend on it (Beyerstein, 2001; Felmeden et al. 2000; Glass and Arnkoff 1997; Levy 1997; Sidani and Stevens 2000; Storck, Csordas, and Strauss 2000). Of course, selective perception can also have deleterious effects and contribute to errors of reasoning, even among scholars and famous neuroscientists (Fischer 1971; Karczmar 2001). But the potential dangers of selective perception do not negate its salutogenic actions.

Because the brain is constantly engaged in selecting neural activity by complementary inhibitory and excitatory mechanisms (Karczmar 2001), neuronal

assemblies involved in awareness are remodeled by experience (Boonstra et al. 2001; Hebb 1964; Yoshimura et al. 2001). These mechanisms of neuroplasticity operate at all levels of the nervous system, from the afferent activity of peripheral sensory receptors to the efferent activity directed toward neuroendocrine organs, blood vessels, and muscles. Although the selectivity of perception probably makes it impossible to be aware of everything that is happening throughout the body (Arbib 2000), it is evident that these regulatory processes are essential for one's health, and that they provide the basis for functional salutogenic mechanisms of the brain.

### **THE NEUROBIOLOGICAL BASIS OF SALUTOGENESIS**

Relatively few studies have been carried out on the brain in relation to health, so it is not yet possible to describe the central pathways and neurotransmitters responsible for functional salutogenic mechanisms. One might, nonetheless, gain some understanding of the neurobiological basis of functional salutogenic mechanisms by means of converse reasoning, although such an approach could be unsound (Ingle 1958, 1972; Levy 1997).

Numerous studies have shown that apathy, passivity, attention deficits, motor retardation, and dysphoria typically occur as a result of damage to brain regions such as the amygdala, frontal cortex, mediodorsal thalamus, and ventral basal ganglia (Gentilini, De Renzi, and Crisi 1987; Ghika-Schmid and Bogousslavsky 1997, 2000; Robinson and Starkstein 1989). These regions are also involved in the regulation of emotion in healthy subjects under normal conditions (Byrum, Ahearn, and Krishnan 1999; Damasio et al. 2000; Drevets 1998; Drevets et al. 1992; Heilman 1997; Paradiso et al. 1997). Since destruction of these regions can disrupt salutogenesis, one could speculate that they might provide the neuroanatomical basis of salutogenesis. Time will tell whether this notion is correct.

### **THE EVOLUTION OF SALUTOGENESIS**

How then did functional salutogenic mechanisms of the brain evolve? According to Darwinian principles (Darwin 1859), organisms having functional salutogenic mechanisms would, by definition, be better equipped than organisms lacking such mechanisms for succeeding in competitive struggles. Thus, an organism with a salutogenic brain would experience the world as manageable and coherent. Clearly, that would have marked survival value. Throughout evolution, salutogenic mechanisms of the brain would be inclined to appraise events in ways that would enable the organism to use energy effectively for competing successfully for opportunities of mating and for satisfying basic needs required for survival. Thus, functional salutogenic mechanisms could have provided organisms with a self-perpetuating cycle for enhancing self-confidence and well-being, whereas pathogenic brain mechanisms would have left their owners in dismay and disarray.

Functional salutogenic mechanisms of the brain may have provided our ancestors with selective perception, religious notions, feelings of love, and a strong SOC, cognitive processes that can be expected to continue to affect human evolution. Perhaps it would be wise, therefore, to study functional salutogenic mechanisms of the brain more often by asking questions that focus on health rather than on disease. Although the complexity of the brain may make it difficult for neuroscientists to describe all aspects of functional salutogenic processes (Anderson et al. 1999), further studies can be expected to provide information of benefit for all.

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