

From Coprolalia to Glossolalia: Structural Similarities Between Gilles de la Tourette Syndrome and Speaking in Tongues

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Ethnographic observations of religious glossolalics and Tourette Syndrome victims found motor and vocal behavior similarities between them, even though the two sets of behavior are assigned opposite values by those experiencing them. Glossolalia is thought to be good, an expression of God, while Tourette Syndrome is considered evil and of the devil. This paper explains in neurological terms the disjunction in values assigned to similar behavior. Temporary hemisphere disjunction is offered as an explanation for belief in a supernatural cause for these behaviors. Labelling them as good and evil results from differential stimulation of the pain or pleasure system. The neurophysiological relation of movement to affect further biases the oppositional labelling of their experience.

Gilles de la Tourette Syndrome (GTS) is a motor disorder characterized by a variety of involuntary motor and vocal tics. It is also known as "foul mouth disease" because 60 percent of GTS victims display uncontrolled coprolalia (the utterance of obscene language) as a symptom. This symptom and all the attendant motor and vocal tics make GTS a most unwelcome disease that penetrates every aspect of the lives of its victims and their families.

Glossolalia, or speaking in tongues, on the other hand, is welcomed, even sought out by its practitioners. It, too, is a form of unusual vocal (and motor) behavior. To a degree it is also involuntary, and the entire life of the glossolalic, like that of the GTS victim, is colored by the practice of glossolalia.

The striking behavioral similarity between GTS and glossolalia is hidden by the fact that they are treated as two distinct and unrelated phenomena. GTS is a disease, while glossolalia is a religious manifestation; and, the distinction between them seems to necessitate different paradigms and methodologies.

This paper will show, however, that the behavioral similarity mentioned above is neither transitory nor accidental, but derives from common neurological processes involving brain lateralization, the reward and punishment

systems, and the cerebellular role in mediating movement and affect. The distinctively-opposed value perceptions held by victims of GTS and practitioners of glossolalia are rooted in variations of these neuroprocesses.

GTS

GTS is a relatively rare disease. The Tourette Syndrome Association reported 392 cases known in the United States between 1965 and 1976 (Shapiro, Shapiro, Brun, and Sweet, 1978). It is possible that the rarity of the syndrome may be more apparent than real because of the difficulty of distinguishing GTS from other physiological and psychological disturbances; however, recent media attention to GTS may result in a greater number of diagnoses.

GTS presents a variety of distinguishable motor and vocal tics ranging from simple muscular tics to complex, stereotypic movements. Shapiro describes one case as having "spasmodic jerking of the head, neck, shoulders, arms, torso, and various facial grimaces; odd barking and grunting sounds, frequent throat clearings and periodic forceful protrusion of the tongue" (Shapiro et al., 1978, p. 1). From an experimental patient population of 145 Shapiro distinguished 61 vocal utterances (exclusive of coprolalia), 30 separate coprolalic word-types, and 37 types of complicated movements (Shapiro et al., 1978, p. 139). In an effort to deal with the idiosyncratic nature of the tics, their waxing and waning over time, and the tendency for symptoms to change and replace one another, Golden (1977, p. 552) developed a two-level taxonomy of the GTS tic repertoire:

1. Motor tics—eye blinking, facial grimacing, head nodding, arm, mouth, and body tics, copropraxia (touching the anal or genital area or making obscene gestures), smelling, touching, and stereotyped movement.
2. Vocal tics—inarticulate sounds, throat clearing, sniffing, coughing, laughing, stammering, coprolalia, echolalia (repeating others' words), and talking to oneself.

From the 1920s to the 1970s the etiology of GTS was largely assumed to be psychopathological (see Shapiro et al., 1978, for a complete diagnostic history of GTS); but the growing understanding of brain anatomy, physiology, and chemistry is resulting in an increased emphasis on a neurological etiology for GTS. It is now possible to manage, at least partially, some of the symptoms of GTS with haloperidol, but the drug is not effective with every victim. In addition, there are a number of unpleasant side effects (e.g., insomnia, nervousness, fatigue, muscular weakness, depression, tremor, shuffling, drooling) that make the drug untenable for some GTS victims.

Glossolalia

Glossolalia, or speaking in tongues, is a manifestation of religious trance

or "dissociation" (Goodman, 1972). Although glossolalia is a cross-cultural phenomenon, this paper specifically attends to the glossolalic behavior of a middle-class Texas Pentecostal Church (Womack, 1980).

Although glossolalia is, by definition, primarily a vocal phenomenon (Bryant and O'Connell, 1971; Jaquith, 1967; Samarin, 1968), it is intimately tied to non-vocal motor behavior. Parts of the body are used in what Goodman (1972) calls "driving behavior" that produces trance states: feet stamp, heads sway, hands clap. At other times the entire body moves, runs, or rhythmically jumps, an act known in the Texas Pentecostal Church as "dancing with the Spirit" (Womack, 1980). On yet other occasions the body is hypertonic, which is manifested in either rigidity or minute shivers.

Control and "Otherness"

Both GTS and glossolalia are characterized by unusual motor and vocal behavior. Those who experience both phenomena positively value the behavioral manifestations of glossolalia and negatively value those found in GTS. These diametrically opposed emotional attributions are not merely reflections of society's approval of glossolalia and opprobrium of GTS. Ethnographic interviews with both glossolalics and GTS victims indicate that these diverse values are reflections of the internal experience of GTS or glossolalia.

The outstanding characteristic of both phenomena that leads to this internal perception is the involuntariness essential to both glossolalia and GTS. For both the glossolalic and the GTS victim there is a sense that some force beyond the individual's will is in control of his or her behavior.

Christian glossolalia supposedly occurs when the Holy Ghost enters into, speaks through, and moves a person. It is a trance experience in which the individual is taken over by a supernatural agency. Bourguignon (1968, 1975) calls such an experience a "possession trance." The Texas Pentecostals do not term their trance experiences (called "Having the Holy Ghost") as possessions. Indeed, the word "possession" has negative connotations for them—as it is associated with witchcraft, "mumbo-jumbo," and "weird-os." Yet nonetheless, the idea of being "controlled" by the Holy Ghost is acceptable to them. As one Pentecostal woman said, "The Holy Ghost is in me. I feel his presence. He's in control of me." And when the Holy Ghost enters the Pentecostals, they enter a trance which they regard as involuntary.

Yet, Larry T., a victim of GTS, made a similar statement about his constantly occurring tics, "It feels like there's somebody else in there controlling me." His explanation of his experience seems to duplicate those of the Pentecostals. In both cases, behavior during seizure or possession is largely uncontrollable.

However, both glossolalics and GTS victims have some degree of control over their behavior. Glossolalics sometimes experience trances during such activities as riding buses, doing dishes, eating out, or working at their jobs.

One Texas Pentecostal was at work welding a pipe when the Holy Ghost entered him. He reported that tears were running down his face during the two minutes he spoke in tongues. Most Pentecostals, however, say they can minimize these experiences since the most obvious and unusual expressions of having the Holy Ghost can be transformed into a minimal, transient phenomenon no more apparent or disruptive than a *petit mal* seizure. Nevertheless, the Pentecostals report that once the Holy Ghost enters them, some manifestation of the experience has to be expressed. As one informant stated, "You have to put it out, or you bust."

GTS victims are also sometimes capable of attenuating their vocal and motor abnormalities. There is a particularly strong, and understandable, imperative to do this when the symptoms are coprolalic. Thus, a man might forestall an attack of coprolalic utterances until he can find a private place to relieve himself of a hoard of obscenities. Another may avoid outright coprolalia by whistling while thinking the words, or by muttering them under his breath. Some victims of the syndrome can partially control their tics while in public, but will compensate by experiencing a greater than normal number of tics while in the safety of their homes. While not completely able to eradicate his tics, Larry T. can control them to the extent that he can localize his energy on a more unobtrusive set of muscles. While in public he channels this energy to neck tics and high-pitched grunts which he feels are more socially acceptable. But there is a price to be paid for whatever control can be gained, namely accumulated psychic energy that must eventually be released. Larry says that he can stop his tics for about five minutes, then "they gotta come out"; and, when released, the tics are stronger and more frequent than if they had gone uncontrolled.

In both glossolalia and GTS, control can be used for production as well as attenuation of the abnormal state. The purposive seeking of trance states (and thereby glossolalia) through manipulation of the body and the external environment is by now common knowledge. Some GTS victims also undergo similar manipulations as a strategy for releasing, in a safe place, the psychic energy that would normally be present periodically throughout the day in the form of multiple tics. Some behavior therapies use massed practice in which the patient practices their tics — until the tics, hopefully, becomes volitional (Shapiro et al., 1978).

Nevertheless, in neither case is the individual seeking to promote a trance or tic actually controlling the experience. He or she is simply enhancing the occasion of the experience. Once the trance or seizure is "upon them" they are once again left with the feeling that "someone's controlling me."

Labelling

Both the GTS victim and the Pentecostal glossolalic feel themselves to be

other-controlled during their seizures and trances. Both groups utter unusual, unpredictable sounds and execute unusual, spasmodic movements; and yet there is a world of difference between the values they assign to such movements.

A Pentecostal woman says of her trance, "It's a joy unspeakable." Another woman says having the Holy Ghost is "tingling, warm, rested, joy, a rush of every emotion" (Womack, 1980, p. 304). Every trance experience is valued as a moment of transcendence. It is believed to be that moment when God, as the Holy Ghost, is physically present in their bodies, and the words they utter are the words of Him. It is physical proof that they are living according to God's rules. The moment in which the Holy Ghost is in them is the pinnacle of their lives.

In the case of GTS, however, behavior which is similar to glossolalic behavior is seen only as a source of anguish and ridicule, resulting often in broken families, creating a life in which the sufferer cannot work, or marry, engage in sports, or carry on satisfying social relations. Life is described as a living hell. Perhaps the worst result of all is the doubt, guilt, and self-hatred many victims experience. Larry T. said, "There is a soft, plodding guilt. I did something wrong, but what?" For Larry and others like him the "something" that is controlling him is perceived as bad, as a punishment for some unknown crime.

The movie *The Exorcist* was based on the biography of an actual victim of GTS. Explaining the story as a supernatural phenomenon, rather than as a medical problem, was not just an example of dramatic license: GTS has often been thought of by both by-standers and victims as the work of the devil. Larry T. describes his childhood symptoms as being exactly like those seen in *The Exorcist* (except for the cinematic stunts), and feels that it is a devil of sorts who controls him. He adds that he uses the term as a metaphor, perhaps for some cerebral malfunction or a subtle neurochemical imbalance; nevertheless, behind those modern equivocations he still believes he is being punished by something evil.

Thus, the two views that glossolalics and GTS victims take toward their experiences are polar opposites. Though both are often judged to be supernatural in origin, they are assigned opposite values by those experiencing them. But why are they so different when the actual behavior is very similar? Schachter (1966, p. 177) says that "given a state of physiological arousal for which an individual has no immediate explanation, he will 'label' this state and describe his feelings (emotions) in terms of cognitions (knowledge) available to him." This concept provides the basis for a socio-cognitive explanation of the differences in the values glossolalics and GTS victims assign to their experiences. Because the glossolalics are so imbued with religious ideas, and are primed for religious interpretations, any anomalous, pleasant state can easily be categorized by them as being "of God." On the

other hand, they may similarly label their anomalous, unpleasant experience as being "of the devil."

Nevertheless, this explanation is not comprehensive enough because it does not account for why, in both cases, the ultimate explanation for the anomalous experience is supernatural. According to the logic of Schachter's argument, glossolalics and GTS victims might just as well label the experiences simply as "good" or "evil." The supernatural component is an outgrowth of the perception of both groups that some "other" resides in them and is controlling them. It is this perception of "two beings in one" that provides the key to the neurophysiological aberrations that underlie both glossolalia and GTS.

Neurophysiology of Glossolalia and GTS

Three components of GTS and glossolalia are crucial to understanding the importance of the neurophysiological substrates of this behavior. The first involves the relationship between perception of internal "otherness" and brain laterality. The second point of discussion concerns the labelling of other-controlled behavior as good or bad. It is hypothesized that this labelling is a manifestation of the stimulation of either the pain or pleasure system of the brain. The third consideration is the role of movement, by the cerebellum, in effecting the pain/pleasure system. The sections below will discuss in detail these neurophysiological components that are common to GTS and glossolalia.

Lateralization. Gazzaniga's (1976) severing of the brain's corpus callosum pointed to a division of labor within the two brain hemispheres—the left brain being responsible for speech and quantification, the right hemisphere dominating in spatial perception and construction, and non-verbal thinking. Subsequent "split-brain" operations and experiments contributed further hemispheric distinctions: the left brain was more analytical; the right intuitive, holistic, and the seat of emotive memory (Galín, 1976, p. 396). Implicit in this model are realms of dominance for each hemisphere, with the left hemisphere being assigned a position of major dominance while the right hemisphere is spoken of as the "minor hemisphere."

Nebes (1978, p. 100), however, calls this "pseudo-dominance." Other studies began to indicate that the exclusivity of each hemisphere was questionable. Some of these studies were conducted on hemispherectomized, rather than commissurotomed or hemisphere anesthetized, patients, the advantage to the former being that with one hemisphere removed there is no chance that experimental findings could be an artifact of the inhibitory effects of the other hemisphere.

In the matter of speech, assumed to be the prerogative of the left hemisphere, Nebes' experiments indicated that certain degrees of language under-

standing and production were available to the right hemisphere. He added that the right hemisphere could "elicit semantic information from pictures and . . . form complex semantic associations, perhaps in the absence of the verbal symbols that seem to mediate this type of function in the left hemisphere." Nebes (1978, p. 125), as well as Branch, Miller, and Rasmussen (1964) and Jones (1966), also found evidence of bilateral speech. In addition, there are indications of writing ability being present in the right hemisphere even when speech appears to be absent (Levy, Nebes, and Sperry, 1970; Nebes and Sperry, 1971). Hiller (1954), Smith and Burkland (1966), and Smith (1966) all showed that verbal comprehension was present in the right hemisphere.

Other indicators of hemispheric dominance were also challenged. Weinstein (1978) stated that an injury to either hemisphere can affect sensory, motor, perceptual, spatial, or cognitive brain functions. And Perria, Rosadini, and Rossi (1961) discovered a most unusual finding: anesthetizing the left hemisphere resulted in feelings of guilt and depression, but right hemisphere anesthetization produced euphoria.

Nevertheless, many studies of brain lateralization elaborate a model of a sharply dichotomized brain that does not seem to have as much base in reality as a model that would account for the functional plasticity of the brain even after severe lesions. In addition, much of this research is conducted on grossly altered brains that produce a complete disjunction between the hemispheres. (This is true even of temporary anesthetization.) Models are lacking for those occasions in which *both* hemispheres are operationally intact, but there is incomplete or incorrect integration between the hemispheres. Such a model would be more applicable to GTS and glossolalic behavior. Unlike split-brain subjects, neither GTS victims nor glossolalics are permanently confined to one hemisphere.

In these individuals one finds more of a switching back and forth between one mode of consciousness and another. For instance, many Pentecostals arrive at church thirty minutes before the service in order to "warm-up" spiritually. They go into prayer rooms in which they enter a state that induces glossolalia. One minute they may be in full trance and the next minute they are in the hall, laughing, and discussing everyday topics with their friends. GTS victims show similar dramatic alterations: one minute they are lucid, likable people, and the next second they are in the full grip of a wide range of uncontrollable disorienting activities. This lability of affect and behavior is a sign of an abrupt change between normal waking consciousness and an abnormal state of consciousness. It is possible that the rapid, non-gradual nature of the change results from a temporary disjunction in communication between the brain hemispheres.

Jaynes (1977) presents a model of the bicameral mind of early man and woman in which ideas coming from the right hemisphere were not integrated

with the left hemisphere so that the original inner voice, that which we know as consciousness, was assumed to come from outside the self, and construed as a god. In time the hemispheres were integrated and the inner voice was recognized as a part of the self. The evolutionary scenario Jaynes provides is open to debate, but it is possible that the existence of incomplete commissural transmission, or integration, could result in one part of the brain not knowing, or only partially knowing, what the other is doing. Sperry and Gazzaniga's (Gazzaniga, 1970) experiments with hemispheric intercommunication in commissurotomed patients include examples of people being shown nude pictures to the right hemisphere. Upon seeing these photographs they would react emotionally, but were unable to answer why they were acting in such a manner. Half of their experience was consciously, or at least linguistically, denied to the other half.

The Pentecostal and GTS experiences are similar—at least insofar as segments of one's behavior or experience are not fully attributable to oneself. At the same time, individuals are aware (unlike Sperry's and Gazzaniga's patients) that something quite definite is occurring. They simply do not perceive themselves as being in control. In the Sperry/Gazzaniga case there is a total disjunction of consciousness; while in the case of glossolalia and GTS the disjunction is only partial. Further, there is a total disconnection between the hemispheres in the former case, while in the case of GTS and glossolalia we know that if there is a disjunction, it is not permanent because there are ample demonstrations of brain integration. In some fashion communication between the hemispheres is being temporarily blocked or short-circuited.

A temporary stoppage in inter-hemispheric communications is a boon for the Pentecostals. During the breakdown they are voicing the thoughts and feelings of the right hemisphere, but because integration is disrupted, they are interpreted as expressions of God rather than self. It is this nonawareness of the origin of right hemisphere states that probably gives rise to the sense of the ineffable (Ludwig, 1966) that is one of the characteristics of altered states of consciousness in general.

Pain and pleasure. A lack of hemispheric integration is a "blessing" to the glossolalic, and a "curse" to the GTS victim. Once again, we see the enormous discrepancy between the value perceptions of the two. It is possible that, apart from the social labelling process mentioned above, two contradistinctive brain areas are being activated in the two behavior systems, with GTS triggering the pain centers while glossolalia stimulates the pleasure centers.

A neurophysiological explanation for these opposed values may be found deep within the limbic system of the brain in a multineuronal pathway known as the medial forebrain bundle, and the lateral hypothalamus (Olds, 1962). Experimental work involving artificial stimulation via electrodes placed in the brain of several animal models shows that subjects will repeat-

edly self-stimulate the "pleasure center." Stimulating the "pain center," on the other hand, will bring about immediate cessation of self-stimulation, or negative behavior such as uncontrollable aggression, hostility, and fear (Olds, 1956). However, because of the rich interconnections within the limbic system, and between the limbic system, cerebrum, and cerebellum, it is more correct to speak of reward and punishment systems than discrete pain and pleasure centers.

This complex interneuronal system has a dual significance for the perceptions of good and evil as they are experienced by the GTS victim and the glossolalic. On the one hand, the complexity of the interconnections increases the opportunity for malfunction. A primary neurophysical mechanism found at all levels in the central, autonomic, and peripheral nervous systems enables each neural synapse to "make decisions" as to whether to propagate or cancel a neural message according to a summation of excitatory and inhibitory input. Thus, the more neurons, with their multiple synaptic junctions, that are included in an interconnection, the more information that can be processed. Conversely, the more processing available, within this system, the greater the opportunity for malfunction.

Movement. On the other hand, this complex interconnection is significant for the perception of good and evil because it provides the basis for an integral link between movement and affect. GTS is a motor disorder, and glossolalia occurs with movement that is, in some form, extraordinary. In neither case are the movements peripheral to speech behavior or emotional perceptions. They are integral expressions of the multi-synaptic connections that ultimately lead to labelling the glossolalic or Tourette experience as an expression of God or Devil.

Movement is the integrated product of the motor cortex of the cerebrum and the cerebellum. Even though these are relatively separate in the brain—the motor cortex in the anterior dorsal brain (front top), and the cerebellum some distance away in the ventral caudate (bottom tail)—they are joined by interconnecting fibers that allow particularly rapid neural transmissions. These fibers form a circuit of transmission from the cerebrum to cerebellum and back to cerebrum in about 1/50th of a second. Eccles (1973, p. 131) calls this circuit a "dynamic loop" that provides an "extremely fast and reliable input from the cerebrum to the cerebellum."

Defects in movement can originate at either end of the loop, although most current research points to the basal ganglia in the cerebrum as the culprit in GTS (Shapiro et al., 1978, pp. 200-202). The cerebellum, which is in charge of blending the cerebrum's orders for discrete movements "into a harmonious whole" (Eccles, 1973, p. 130) may be arrested in the task by contradictory, incomplete, or incorrect messages from the cerebrum.

Other research suggests that the cerebellum may be intimately connected to the limbic pain/pleasure response (Prescot, 1976). Prescot states that "the

cerebellum is involved in complex emotional behavior. It may well serve as a master regulator mechanism for sensory-emotional and motor responses," (see Restak, 1979, p. 124). Prescott believes that movement-deprivation in infancy and early childhood will result in malformed or underdeveloped cerebellar structures that will lead to negative emotional output and compensatory self-stimulation. It is also possible that movement defects or irregularities, as in GTS or glossolalic behavior, can have a similar result.

Negative or unpleasant emotions will occur as different parts of the limbic system are stimulated. Heath (1977) pictures seesaw effects to pleasure/displeasure sensations as a result of excitation and inhibition produced by stimulation of separate limbic nuclei. Stimulation of the septum produced pleasure, and stimulation of the amygdala and hippocampus resulted in displeasure. In GTS it is possible that a malfunctioning cerebellum (perhaps due to incorrect orders from the basal ganglia) is connected only, or predominately, with the pain centers of the amygdala and hippocampus.

It is also possible that the tics are a form of inadequate self-stimulation in which the body is trying, without success, to effect pleasurable emotions through movement. A similar but more successful strategy is used in such activities as physical exercise, rocking children, massage, dancing, and so forth. Glossolalics use the cerebellar-limbic connection to create a positive state of emotions through repetitive movement. Such movement is part of the repertoire of "driving techniques" that synchronize EEG patterns and tune the autonomic nervous system. The repetitive movement that accompanies glossolalia is similar to the kinds of rhythmic movement which Heath (1977) has shown to produce emotions of pleasure.

Thus, both glossolalic movements—jumping, clapping, shaking, spasmodic thrusts of the limbs—and the tics that characterize GTS, can also be seen as self-stimulations (whether deliberate and controllable or not) for the purpose of arousing pleasurable emotions. That this is not accomplished in GTS is possible due to a cerebellar output that has been altered because of lesions or malfunctions in the basal ganglia.

The role of the cerebellum in producing movement and emotion implies that there is a strong functional relation between movement and emotion. Because of the neurophysical malfunction in GTS, the normal pathway between the cerebellum and the limbic system has been altered so that pleasurable emotions are inhibited, or unpleasant emotions are exacerbated. Since there is no indication of neural damage in glossolalic behavior, it would seem that the cerebellar-limbic connection is intact. Indeed, the exaggerated degree of movement accompanying glossolalic utterances may enhance the cerebellar stimulation of the pleasure system.

The difference in the final cerebellar-limbic output (which is due to neural damage in the case of GTS) experienced in the one case as pain, in the other as pleasure becomes the basis for the internal labelling of the speech-motor

experience as either positive or negative. A temporary break in communication between the brain hemispheres causes a lack of integration of internal experience, with the output of the right hemisphere not being fully perceived as an internal and autonomous production. When pain or pleasure responses are applied to these non-integrated experiences, and are then coupled to social labelling, the extraordinary experiences become God/pleasure or the Devil/pain.

Conclusion

Several caveats should be offered here. First, presenting neurobiological hypotheses is doubly dangerous because they are themselves built upon hypotheses and observations that are still on the proving grounds. Perhaps they might be better labelled metahypotheses. They are useful, however, so far as their generality allows them sometimes to pull together the diverse neurobiological sciences and to make those sciences more accessible to non-neurobiologists. Anthropological metahypotheses are especially useful because they apply hypotheses and observations derived from experimental and clinical situations to the crucible of real-life experience. Conversely, the same real-life situations may give rise to hypotheses that can be tested in controlled, replicable laboratory situations.

A second caveat that must be given to all anthropologists who try to link life experiences with laboratory experiments is to beware of reductionism. This paper has sought to explain in neurophysiological terms that which would usually be dealt with in symbolic anthropology, the perception and labelling of good and bad. It is not meant to denigrate the symbolic domain. It is simply an attempt to add another dimension to that rich realm. Even after offering a neurological explanation of the "otherness" component of GTS and glossolalia and the inherently different perceptions of pain and pleasure, a final social-symbolic-historical dimension must be added to call those perceptions God or Devil.

Finally, and as an adjunct to the warning against reductionism, it is advisable to bring the human dimensions of glossolalia and GTS into focus again. GTS is believed to be a disease, but the fact that it has been discussed in reference to glossolalia does *not* imply that the latter is also the result of a malfunctioning brain. It could be a perfectly healthy (even holy as some would have it) neurological expression of a belief in God that is mediated by an alteration in hemispheric intercommunication. And this, in itself, is not necessarily a malfunction. In the permanency of a hemispherectomy or a commisurotomy this would be the case. But when a hemispheric disjunction is temporary, there is no intrinsic dysfunction. The difference between a permanent and a temporary break in hemispheric communication is somewhat like the difference between dieting and starvation.

Even though GTS is still a relatively mysterious disease, there is a significant body of knowledge concerning its neurochemistry and neurophysiology. There is much less known about the neurobiological substrates of glossolalic behavior. It has been possible to use the more extensive neurological knowledge about GTS to reveal possibilities about glossolalia. To complete the circuit, perhaps these hypotheses can be reapplied to the problem of Gilles de la Tourette Syndrome.

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