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Could Tourette syndrome and Schizophrenia be treated with feedback signals as shown for Parkinson?

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ABSTRACT

From a physiological point of view our brain is a symmetric organ; however, asymmetry in the brains organization may play a crucial role in allowing our mind to be able to control muscles, balance and our conscious. Indeed, the absence of asymmetry could underlie a diverse group of diseases such as Parkinson, Tourette, and Schizophrenia.

Our body is symmetric around a vertical central plane, the exceptions being our innards where we among other asymmetrical physical features have an asymmetrical located heart and liver. It is easy to understand why we only have one heart; the coordination of the heart-beat rate of two or more hearts would be very complicated, and just a slight out of rhythm in the beating of for example two hearts would be detrimental. This observation raises the question about how the brain signals are coordinated since the brain by physiological characterization seems to consist of two symmetrical hemispheres; and since it is an organ where coordination must be important. Importantly, each hemisphere controls, in general, the opposite half of the body corresponding, similarly for the vision where there is a crossover of the neural paths, such that right eye's information is dealt with by the left brain hemisphere, and visa verse for the right eye's information. Importantly, a blot-cloth limiting the blood supply to the left-hemisphere will cause a loss of functional movements in the right body half mainly. However, although each hemisphere controls one side of the body, coordination has to be present to allow the precise movement of our extremities. One way this could be achieved, is that although the main signals for controlling one side of the body is generated by the corresponding brain hemisphere, a parallel "weaker" movement "signal" is generated in the opposite hemisphere as a type of verification and/or control signal. There would be several advantages of such an arrangement; one is that this second signal would act as a quality control signal, ensuring that the movements we are making are not putting us in danger. Here the fact that the visual input is crossed with regard to the hemisphere is likely to be important; visual input is essential to the fine coordination of movements and the crossover could ensure a better coordination. Another advantage.. would be that such an organization would allow one side of the brain "to know" what the other side is doing, such that the two "body halves" can work together more efficiently. One observation that supports that such coordination of movements occur, and is "hard wired" and not learned, is that for some mammals like the wilder beast, newborn calves are able to walk and run shortly after birth. This would be impossible if the brain first had to learn now to coordinate the movement of the two body halves. If such parallel signals are generated, it is important that there is asymmetry in the intensity of the signals such that the correct hemisphere is dominant. One could imagine that if this verification process is defective or the asymmetry of the values of the two inputs is not present then the coordination process malfunctions. Interestingly, brain-defects exists where movements of specific muscles are affected for both side of the body, suggesting that this "coordination" must occur for each set of the striped muscles in a separate potentially central part of the brain (corpus callosum). Furthermore, if it is the loss of asymmetry in dominance in the two signals, a situation will arise where it is not uncoordinated movements that occur but instead, constant adjustments of the movements or actions; a bit like trying to drive a car with two steering wheels and two drivers. The shaking observed for Parkinson could indeed be due to loss of asymmetry in the neural signals controlling fine movements of the extremities. Here, recent discoveries have shown that control of movements can be achieved by introducing a noise feedback signal; a device can be attached to for example the hands of the patients, that gently shakes the extremity, and this shaking removed the Parkinson symptoms. One possibility is that this shaking allows the brain to re-establish an asymmetry in the processing of the two signals mentioned above, identifying the correct signal to be dominant.

One interesting question is whether such lack of asymmetry could explain other brain defects. Here, Turrets syndrome is a possible candidate. Tourette syndrome is characterized by jerky movements called tics, as well as, by uncontrolled verbal utterings. Interestingly, Tourette patients are frequently excellent sportsmen, and in one case a patient reported that his symptoms disappeared when he was wearing roller-skates. Thus, one possibility is that Tourette syndrome has something to do with the control of balance; the jerky movements and utterings being due to the patients feeling a loss of or lack of balance, and the tics and utterings are similar to those healthy people make when they loose balance. Again, the wearing of roller-skates could like the shaking for Parkinson reintroduce asymmetry in the processing of information needed to maintain balance or the feeling of balance, suggesting that there are two centers for "balance" (one for each hemisphere of the brain) and one is dominant in healthy individuals.

Another brain dysfunction that could be due to lack of asymmetry is Schizophrenia. Schizophrenia normally manifests itself in the teenage years, or later in life due to brain damage. When we are children we tend to learn without or with little judgment of the actions we are observing; this changes during the teenage years. During these years there is a reorganization of the brain that correlates with the gaining of the ability to both morally and practically judge the consequence of our own and others actions, including the increased ability to "read" other people's emotion from their facial expression. It is known that while the two brain hemispheres are physiological symmetric, one is dominant with regards to art, emotions, social interactions, while the other with regards to math, logic, and reasoning. It is possible that this asymmetry is established or increased during the teenage years. When judging social events or interactions, it must be very important that the brain knows which signals relate to "reality" and which signals are from other brain inputs. This could again be achieved by asymmetry, here not between two signals, but potentially between many signals, the "reality signal" being dominant. This dominant center that must deal with the "social" information obtained from hearing, feeling, smelling and visual senses, but might not be the dominant or as dominant in people with Schizophrenia, and thus patients might experience that the other signals take over and they lose connection to the surrounding world. If this is indeed is the case, one would expect that patients that experience schizophrenia to benefit, in a similar way to Parkinson and Tourette patients, from sensory input during their episodes, and here both faces, sounds, tastes, colours, tactile stimuli's could all be beneficial. Such sensory input would forcing them to focus on their surroundings (reality) and not their other mental inputs.