INNOVATION IN PSYCHIATRY: THE NEED AND THE WAY FORWARD

WHAT IS THE NEED?

To cure mental disorders we need to discover their causes. For this to happen we need to move from a descriptive conceptualization (diagnosis) of psychiatric disorders to an etiological (cause-related) diagnostic conceptualization. For example , in internal medicine, stomach-ache is the symptom and Appendicitis is the disease. It is named after the pathology and its location . The appendix is an organ in the body and it is infected and inflamed. In psychiatry depression is the symptom and it is also the diagnosis, however it is not an organ in the body and it doesn't refer to any pathological mechanism that we can conceive. In fact the diagnosis in psychiatry doesn't surpass the description of symptoms, their causes are unknown. This is a vicious cycle, the diagnosis stays at the descriptive level because the causes are unknown, and the causes are not discovered because the diagnostic conceptualization does not refer to physical pathology and mechanisms.

How can such a vicious cycle be broken to enable psychiatrists to advance and discover the real causes of psychiatric illness? An old Chinese adage states that "Wisdom begins by calling things by their correct name." i.e., in psychiatry it would mean to start naming mental disorders as brain-related disorders. But can that be done? In my mind there is enough preliminary knowledge coming from computational neuroscience to begin and reformulate mental disorders as brain disorders It maybe rudimentary, preliminary and inaccurate, but it is enough to break the vicious cycle impeding psychiatrists from breaking loose of descriptive-psychiatry constraints. In fact beginning to reconceptualize mental disorders as brain disorders with the little we know now, embarks psychiatrists on the journey and path to discovery. Thus even if initially the conceptualization will be primitive, it will lead to full discoveries in the future. In fact this is the only conceivable way forward.

An example of this direction can be given in Psychosis, where there is a large body of research suggesting that psychosis is related to (caused by) disconnection dynamics in the brain (Canu et al 2015), i.e, different brain systems act statistically independent from each other. Even though this is a crude notion of the etiology of psychosis it is a starting point.

POINTERS TOWARD THE SOLUTION

In recent years there are two major emerging fields of progress in psychiatry, 1) Computational Psychiatry and Digital Mental Health. Computational psychiatry can be described as an extension coming from computational neuroscience where mathematical models of the brain implemented by computer

power simulate the brain structure and activity resulting in computations that mimic human cognition and intelligence. This is also the origin of artificial intelligence (AI). In computational psychiatry such models from computational neuroscience serve to generate hypotheses about brain pathology that disrupts and disturb the simulated cognitive and mental functions. A good example of applicability of computational psychiatry has already been mentioned above where psychosis is formulated as disconnection dynamics in the brain with different brain systems acting statistically independent from each other. In effect the network level conceptualization of mental disorders can be much more developed to encompass most mental disorders (Peled 2013). It can also deepen extending to detailed algorithms for example disconnection dynamics actually entails a well-defined disturbance to "small world network" organization with precise measurable alterations of clustering coefficient (nearby connections) and long pathways (longer extending connections). Thus computational psychiatry is certainly a good intermediate level of brain organization that can generate understandable causal relationship to psychiatric phenomenology discovering the brain-related causes of mental disorders. Digital Mental Health is basically an implementation of psychiatric activity using the Internet of Things (IOT) a combination of sensors, operators and computer programs connected with each other over the web. Such combination can direct meaningful intelligent behaviors in the physical world, for example "Smart Homes" where different functions at your home can be regulated by digital constructs. These technologies are applicable to medical practice including psychiatry. Sensors can collect psychiatric phenomenology and suggest or deliver therapeutic interventions acting as consultant devices for clinicians and even replacing some of the clinician functions. Especially important in digital mental health is the capacity for collecting large-data sets that can be used for statistics, statistics that offers valuable information about prognosis and treatment-response predictors. When applied to singular findings of individual patients these statistics have the ability to inform about patients' prognosis and treatment.

GOING FORWARD

The way forward requires combining digital mental health technology and computational psychiatry. With all the ingenuity of digital mental health it remains an "As-Good-As" technology in comparison to psychiatric skills. In other words this technology does not go beyond the current psychiatric state-of-the-art where diagnosis remains at the descriptive level and does not provide a way forward towards etiological psychiatry. In order for psychiatry to move forward it must combine computational psychiatry to digital mental health; first by re-conceptualizing mental disorders in terms of brain

network disturbances, and then by devising the way in which digitally collected large-data of objective phenomenology can inform about, and validate, the predicted brain network disturbances.

BRAIN PROFILING

Brain Profiling is a digital mental health application that collects large-data of psychiatric phonology and translates it to brain-related network level disturbances, thus making the link between patients' suffering (phenomenology) and its presumed causes in the brain, i.e., the patient's brain disturbances. Brain Profiler re-conceptualizes mental disorders in terms of brain network disturbances, and then by digitally collecting large-data of objective phenomenology inform about the predicted testable brain network disturbances.

Adding electrophysiological brain imaging available by consumer EEG devices, large-data of brain imaging is accumulated by the Brain Profiler and finally large-data-sets of phenomenology synchronized with actual large-data from brain imaging, will inform about the causal relationships of brain disturbances and patient's phenomenology.

Any future intervention to cure mental disorders will involve correcting brain disturbances by optimizing brain network organization. These will probably involve brain-pacing technology. Such technology will probably combine brain-plasticity-inducing medications, experience-dependent-plasticity induction (e.g., virtual controlled experiences) and even directly injecting nanotechnology agents acting in the brain tissue at ion-channels cellular-level and other molecular and sub-molecular structures. None of these technologies can act without clear algorithmic knowledge about the brain disturbances, thus Brain Profiler is predicted to become the platform on which all brain pacing therapeutics will depend in the future.

ORGANIZE THE INOVATION PATH

Brain Profiling-like strategies can be many. It is suggested that effort will be directed to developing such strategies involving combined digital computer technology and computational-neuroscientific insights. As the Brain Profiler App is already up and running, with a number of users, it can constitute an operational valid instrument used to go forward in the discovery process. See http://www.brainprofiler.com/

References

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Peled A. Brain "Globalopathies" cause mental disorders. Med Hypotheses. 2013 Dec;81(6):1046-55.