Neurobiology and the Treatment of Mood and Anxiety Disorders. How Talking Therapies Change the Brain.

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Summary

Advances in neurobiological research supported by neural imaging studies indicate how adverse experiences affect the brain. These findings indicate the effect of severe stress (emotional and/or physical) on brain functioning, neural firing and ultimately neural structure.

Recent research indicates that talking therapies significantly enhance positive behavior, brain functioning and even brain structure especially in the prefrontal cortex regions, orbito frontal cortex, anterior cyngulate gyrus, hippocampus and amygdala.

The role of neurotransmitters (with reference to a few essential transmitters – glutamate, gamma-aminobutyric acid, serotonin, adrenalin, dopamine and norepinephrine), cortical blood flow and unhelpful/negative thought loops are explored and linked to the basic neural building blocks of anxiety and depression. The neurobiological effect of talking therapies with emphasis on neurogenesis and neuroplasticity will be explored.

The paper focuses on the need for utilizing neurobiological data to enhance therapeutic outcomes with more clients in less time in more cost effective way. Specific therapeutic strategies are briefly introduced.

1. Introduction

In 1952 the then famous clinician and researcher Hans Eysenck answered the question, how psychotherapy changes us by stating “it does not” and indicated that “Psychotherapy is a mere passing of the time” (Eysenck 1952).

Since 1974 with the discovery of Fluoxetine (Prozac) a further shift happened away from talking therapies towards managing the so called “chemical imbalance in the brain” with chemical interventions. Drug therapies became the primary mode of intervention. Prominent during this time was the work of psychiatrist Aaron Beck who focused on “indisputable evidence” of the effect of his approach – cognitive behavioral therapy. This dovetailed well with the dawn of the Diagnostic and Statistical Manual of Mental Disorders – the brain child of Robert Spitzer and others. The ultimate method of choice for treatment was a combination of drugs and CBT. Between drug treatment and CBT everything could be cured and empirically tested by means of randomised controlled studies – in essence CBT is a method, a textbook strategy to be followed. CBT was seen as the saving grace for talking therapies. Evidence based strategies became the buzzword in an era where the scientific method ruled.

During the pax medica time (the golden era of the medical model) the concept of a “chemical imbalance” in the brain was referred to as “the problem” and the drug as “the solution”. Many studies were published indicating the superiority of drug therapy over placebos or talking therapies. In 2008 1 in 20 males and 1 in 10 females in the USA were taking antidepressants (Barber 2008). However a fascinating study by the University of Oregon in 2008 indicated that positive research outcomes demonstrating the superiority of drugs over psychotherapy

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and or placebos were 12x more likely to be published that studies that indicated no or negative results (Turner, E.H. et. al. 2008). Recent research indicates that the trouble with current antidepressant treatment lies in the faulty assumption that our cell circuitry is intact and will faithfully relay meds-enhanced neurotransmitter activity to their intended targets.

Recent advances in neurobiological research and neural imaging opened new avenues to our understanding of human functioning, wellness and mental illness. It also shed new light on the role of the social environment and external stimuli on behavior. The deterministic view of the superiority of genetic predispositions in predicting future behavior has dramatically reduced due to recent brain studies regarding plasticity.

2. Neurobiology and brain structures

Neurobiology provides us with an insight into brain structures as well as the impact of the social environment on these structures. It also provides us with information how different structures "behave" in the wake of external triggers. Recent research indicates structural changes and damage to certain brain areas as result of trauma. For example Wayne Drevets from the National Institute for Mental Health in the USA and his team of researchers found that the sub genual area of the left prefrontal cortex is up to 40% smaller in adult survivors of early childhood emotional trauma. This is due to significant loss of glial cells. These cells have a household function in the neural system providing glutamate for the neurons which is a critical component in the firing process of some neurotransmitters. Decrease in gray matter and neural activity in the indicated area of the left prefrontal cortex has a critical impact on the person's ability to problem solve and generate rational solutions to triggers of distress as well as regulating activity in the right prefrontal cortex triggered by the thalamus and amygdala through the orbitofrontal cortex. The result of this is an increase in cortical blood flow in the right prefrontal cortex which manifests itself in negative thought loops, inability to regulate the stress response resulting in emotional and physical symptoms of pathology - panic attacks, generalized anxiety, dissociation, depression etc (Frodl, T et.al. 2010).

Researchers found that major depression and anxiety not only affects behaviour or neural functioning but also affects neural structure. A clear correlation has been established between decrease in hippocampal volume and depression. While some studies indicate an increase in depressive symptomatology as result of reduction in hippocampal volume other studies indicate a reduction of hippocampal volume as result of severe depression. (Fernandes et.al. 2008; Warner-Schmidt & Duman 2006).

Neurobiological studies into the groundbreaking work on attachment theory by John Bowlby (1969,1988) indicate the impact of maternal separation on the brain on many areas – increased neuronal and glial death, decreased neurotrophin levels in the ventral hippocampus, decreased glial density, reduced GABA receptors, reduced benzodiazepines receptors, increased anxiety and over-response to stress, decreased synaptic density in the medial pre frontal cortex decreased activation of the nucleus accumbens (Champagne et.al. 2008; Garoflos et.al. 2008; Cameron, Fish & Meaney 2008).

3. Neurobiology and neurotransmitters

The last decade has seen many groundbreaking studies (some winning Nobel prizes for medical science) published regarding the role of various neurotransmitters in the brain as well as how they relate to the rest of the body. Currently more than 60 neurotransmitters have been identified. These transmitters cause the neurons to fire in certain patterns. Neuro researchers found:

- that glutamate is the amino acid central in the brain to neural plasticity and new learning;
- how monoamines (including dopamine, norepinephrine, and serotonin) play a major role in cognitive and emotional processing (Massey et.al. 2004);
- how dopamine in particular is critical in motor activity and reward reinforcement and how too much dopamine causes depression and memory impairment;
- that norepinephrine in particular is a key component of the emergency system of the brain and important in our understanding of stress and trauma and how high levels of Ne result in anxiety, panic and enhances memory of traumatic events;
- how serotonin in particular plays a vital role in arousal – the sleep-wake cycle, mediation and regulation of mood and emotion and how selective serotonin reuptake inhibitors cause higher levels of available serotonin and higher potentiation of neurogenesis;
- how GABA – gamma-aminobutyric acid inhibits the function of other neurotransmitters, acts as a peacemaker in the brain and calm systems down and how under activity of GABA leads to high anxiety and increased stress;
- that cortisol – a stress hormone, provides the energy for the stress response and how sustained high levels of glucocorticoids in early life have a negative impact on brain development and increases vulnerability to stress (Cozolino 2010).

The fascinating reality is that these transmitters and neuromodulators can be controlled – not only through chemical interventions but more so through environmental stimuli – negative reactions as result of negative experiences and positive changes through positive interventions – nutrition, exercise and self management strategies and talking therapies. A basic understanding of the brain function in terms of these transmitters empower clients, therapists, family and carers to shift less helpful behaviour patterns and achieve more effective patterns.

4. Neurobiology, neural plasticity and neurogenesis

The ability of neurons to change the way they are shaped and relate to one another as the brain adapts to the environment through time is called neural plasticity. It refers to the amazing ability of neurons to change its function and even its structure in response to changing environments (recovery after trauma). It was once believed that neural plasticity only existed in very young individuals and that once neural pathways were formed, they were set and could not be altered. Modern brain studies, however, revealed that nerves continually rearrange themselves throughout the course of life, allowing one's brain and nervous system to adapt to an endless number of different situations. This process is part of what makes humans so able to adapt to a broad range of circumstances; the very physiology of the brain changes in response to a given set of conditions.

Neurogenesis refers to the birth of new neurons via cell division. High levels of cortisol, lack of blood flow or buildup of harmful free radicals can all lead to neural death. Till the late 90's the common perception was that new neurons are no longer created after early development (Michael & Moore 1995). More recent studies indicate that humans maintain the ability to create neurons in areas involved with new learning such as the hippocampus, amygdala and cerebral cortex (Gould 2007). The Nobel-prize winning research of Eric Kandel (1998) refers to the discovery of seasonal neurogenesis as one of the great paradigm shifts in modern biology.

Recent neuroimaging studies have also demonstrated that psychotherapy significantly changes functions and structures of the brain, in a manner that seems to be different from the effects of pharmacotherapy. Interventions like nutrition, exercise, stress management and talking therapies and enriched environments have a significant impact on neurogenesis.

These studies form the basis for a new approach to neuropsychotherapy to enhance outcomes for clients.

5. Neurobiology and mirror neurons

The discovery of the so called mirror neurons provided another valuable insight into the neurobiology of the brain. Using microsensors, scientists were able to trace the firing of single neurons. They discovered that some neurons fire both in response to an observation of a highly specific relationship between an actor and an object and when the action is performed by the observer. These mirror neurons connect our visual and motor systems with frontal systems which are responsible for goal-directed behaviour. This discovery leads to many fascinating concepts – eg. the role in communication and learning. We know we learn by observation – now we have an understanding why.

Mirror neurons act like the Bluetooth of the brain. My brain is not physically linked to yours with a wire – but that does not mean we are not interconnected. So if I am well – and I spend effective time/ interact with you – your mirror neurons kick in and if this interaction continues in a constructive manner – my wellness – activates – your neurons to fire in a way to promote your wellness in terms of specific behaviours. The psychotherapeutic value in terms of the role and function of mirror neurons need to be explored further although the indicators are clear as to the value of talking therapies and therapeutic interventions (Lacoboni 2008). The existence of these neurons holds an important key to our understanding of wellness or unwell-ness for individuals but also in a society as a whole (Cozolino, L. 2010).

6. Neurobiology and talking therapies – the emerging paradigm

These above mentioned findings (and many related studies) form the building blocks of the new mental health renaissance. Neurobiological studies indicate the close alliance between “nature” and “nurture” as well as the impact on the brain when we interact with our environment, intervene through talking therapies etc. Eric Kandel indicated how psychotherapy is successful in bringing about changes to the brain. He the states: “…when a therapist speaks to a patient and the patient listens, the therapist is not only making eye contact and voice contact, but the action of neuronal machinery in the therapists brain is having an indirect and one hopes, long lasting effect on the neuronal machinery in the patient’s brain; and quite likely vice versa. Insofar as our words produce changes in our patient’s mind, it is likely that these psychotherapeutic interventions produce change in the patient’s brain. From this perspective the biological and sociopsychological approaches are joined” (Kandel 1998). Many recent studies show that talking therapies have therapeutic value and impact brain functioning and structure (Arden 2010).

Recent findings in how we can change our brains empower us to progress further from a helping model to a recovery model and from a recovery model to a model that enhances quality of life. Research indicate that psychotherapy is effective and produces long term changes in behavior by producing changes in gene expression that alter the strength in synaptic connections and structural changes that in turn alter the anatomical pattern of interconnections between nerve cells of the brain. Clinicians may need to consider utilizing neurobiological information to enhance psychotherapeutic outcomes – the emerging paradigm of what we call “neuropsychotherapy”.

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