PsychoNeuroImmunolgy (PNI) and Homoeostasis

For a summary on this topic please see the pdf called 'nerves hormone and immunity' at the bottom of this link

https://www.coachingforwellbeing.co.uk/index.php/blog/83-immune-system-covid-massage-bbc-hereford

Emotions and bodily functions are inextricably intertwined in a bidirectional network in which each can alter the other. Usually this process takes place at an unconscious level but can also surface as conscious under certain conditions or be brought to consciousness by intention.

Psychoneuroimmunology (PNI) is the term created by the scientists in the 1980's when they (finally) realised that our emotions can affect the body. The immune, nervous and endocrine systems (which had previously been studied separately) in fact talk to each other cell to cell as well as via the nerves and the blood.

The old picture gives us the impression that we are ruled from the brain; the new picture allows the concept of continuous messages passing between cells as the need arises and at a far faster rate than the old picture can accommodate.

Old thinking

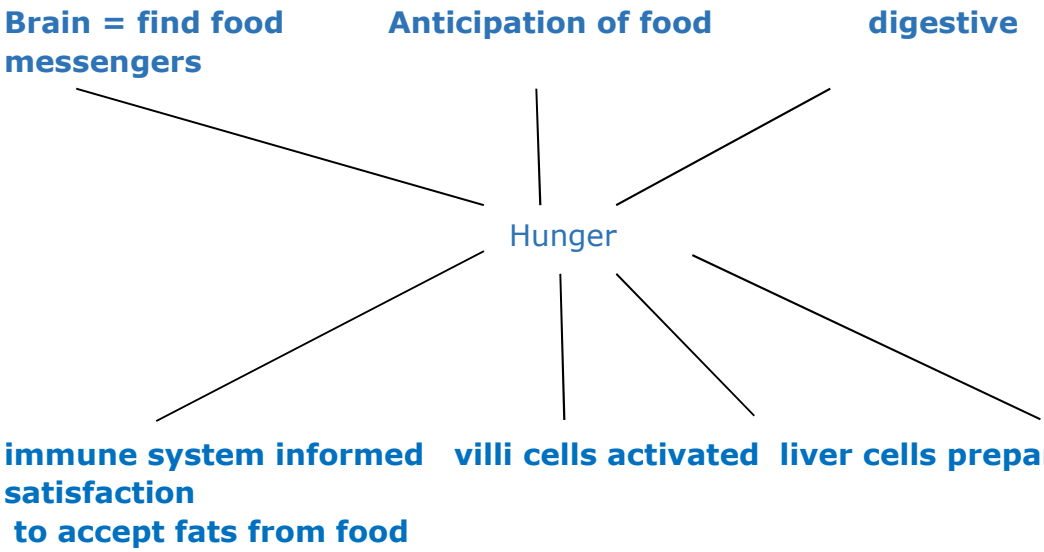
Hunger
Brain says find food > Brain detects food via taste and smell > Brain says eat food

Peristalsis of oesophagus, churning of stomach etc stimulated via autonomic nervous system >Brain tells endocrine to produce relevant digestive hormones

Food products reach liver where they are processed

Immune ? no function

New thinking



The old concept is that one thing triggers another while the new concept shows how all the effects happen at around the same time and indeed are continually feeding back to each other in order to give fine tuning via the cells themselves rather than being mediated by the brain. 3D rather than 2D

Recently D'Acquisto said "Besides the evidence provided by these studies, the idea that certain emotional traits are correlated with specific immune responses should come as no surprise. In fact, the two systems develop almost side by side, and when one becomes defective, the other one often does the same; ie, one mirrors the other".

This idea is not new and, as an Aromatherapist I have known, and worked with, this concept for many years. It has informed my practice.

The brain and immune systems working together

Psychoneuroimmunology investigates interactions between *behaviour* and the immune system, mediated by the endocrine and nervous systems.

On the one hand, the brain modulates the immune system by hardwiring sympathetic and parasympathetic nerves (autonomic nervous system) to lymphoid organs.

On the other hand, neuroendocrine hormones such as corticotrophin-releasing hormone (CRH) or substance P regulate the balance of our cytokines (immune messengers) as a part of Homoeostasis.

The immune system modulates brain activity including sleep and body temperature. They have a close functional and anatomical link within the foetus thus the immune and nervous systems act in a highly reciprocal manner. From fever to stress, the influence of one system on the other has evolved in an intricate manner to help sense danger and mount an appropriate adaptive response.

Over recent decades, reasonable evidence has emerged that these brain-to-immune interactions are highly modulated by psychological factors which influence immunity and immune system-mediated disease.

Research in this field will allow a better understanding and appreciation of the immunological basis of mental disorders and the emotional side of immune diseases

Because emotional responses are learnt via pathways that bypass the frontal, logical, neocortex emotional responses can occur without the involvement of the higher processing systems of the brain.

When we see/hear a fearful stimulus (eg a snake) the neural pathway goes straight to the amygdala through the visual thalamic pathway; the sound also goes from the thalamus to the visual cortex.

By the time the logical frontal cortex has figured out what has happened the amygdala has already started to defend you and run from the snake! The information received from the thalamus is unfiltered and has to create a fast clear response. The job of the logical cortex is to consider the situation and prevent an inappropriate response.

Our response to threat/stress

The stress *response* begins in the hypothalamus which triggers the pituitary to release the hormones which govern the endocrine system releasing adrenaline from the medulla and corticosteroids from the cortex of the adrenals The heart, stomach, small intestines and other organs can communicate with the brain via the cytokines travelling along the vagus nerve. This is a very fast mode of communication.

The **HPA** axis – **H**ypothalamus releases CRH which causes the **P**ituitary to release ACTH which in turn causes the **A**drenals to release cortisol to meet the life and death.

Low CRH gives a hyperactive immune response. Patients with Chronic fatigue syndrome, fibromyalgia and SAD seasonal affective disorder exhibit a hyperactive immune system.

There seems to be a lack of response to CRH by the Pituitary with a resulting decrease in cortisol levels and a higher immune system activity – which is not necessarily helpful and may lead to an increase in inflammation throughout the body! The body is at high alert.

Memory is formed via the Amygdala and fearful experiences impact on our memory. Without arousal we fail to notice what's going on, we don't attend to the details. Being emotional is a highly aroused state and supersedes concentration.

It has been shown that;

Severe stress following bereavement can bring out diabetes in one week.

A woman with partnership problems may develop breast cancer.

Nervous depression is associated with immune depression

Stress, if too prolonged affects the balance of all three systems

Stress which is self-induced (over active pusher) may lead to mental disorders as well as the more widely known physical effects

Even a small degree of depression results in multiplication of the gut flora which becomes pathogenic and liberates an endotoxin which migrates to the CNS and produces severe depression.

Odours eg smell of death, hospitals, may cause stress to sensitive individuals

Fragrance can cause a positive effect

There is no such thing as a positive or negative emotion as long as you express the emotion you feel and the immune system will be supported. It only takes 5 days of keeping an emotion inside to create a chronic situation.

Both clinical and experimental studies indicate that stress and depression are associated with increased circulating concentrations of cytokines such as IL-1B, IL-6, ang G-IFN and positive acute phase proteins plus hyperactivity of HPA axis

If you'd like to know more about the workings of the immune system..
B cells (Bursa) produce antibodies specifically matched to each antigen. Antigens bind to the invader cell and neutralise or destroy the antigen. When they come into contact with the antigen they swell and multiply into **plasma cells** which secrete the antibodies. A few of the antibodies are attached to the surface of the B calls for recognition purposes – the **memory cells** utilised in immunisation The term *humoral immunity* describes antibody action.

T cells = cell mediated immune reactions killing or engulfing Bacteria, fungi, parasites and viruses

Helper and suppressor cells –turn on or off reactions in the immune system.

T helper cells (monocytes) may induce B cells to respond to the presence of an antigen and stimulate activity in other T cells.
T suppressor cells regulate the immune response by turning off certain cell activity when the immune response has done its job. They help to maintain the delicate balance of the immune response.

The ratio of T helpers : T suppressors is an indicator of the general state of the immune system. **Normally 1.8:1**
AIDS often show a ratio of 1:1
Natural killer cells are able to kill foreign cells on contact by producing a cytotoxin without antibody stimulation.

Macrophages are large white blood cells produced in the marrow and respond to antigens. Like PAC men they goggle up cells = **phagocytosis** and neutralise the antigen before releasing the remains from the cell.

As the immune cells originate in the early foetus how much did your parents contribute to your original store of antibodoies? According to the germline theory a child inherits all its antibodies from the parents, but according to the somatic mutation theory the mother only passes on a few antibodies through the placenta and the milk which supports the argument for breast feeding

If the macrophages and the T and B cells are akin to the troops in a combat situation then the lymphatic system can be considered their command
Primary force = thymus and bone marrow
Secondary force = lymph nodes, spleen, tonsils, appendix and Peyers patches in the small intestines. In the **lymph nodes** there are webbed areas holding the

various activated B cells T cells and macrophages which trap antigens and filter them out of the clear lymph.

After an injury has occurred and the fluid, which has left the capillaries to fight off infection in the tissues, needs to return to the bloodstream it is not always able to pass back through the capillary walls due to the high pressure in the capillary. This excess is picked up by the **lymphatic capillaries in the form of lymph**. They have larger pores in their walls and the pressure inside them is lower. The larger pores also mean that larger molecules and fragments of damaged cells and bacteria can pass into the lymphatic capillaries and thus be removed.

The resulting lymph is filtered, and checked for foreign cells by the **lymph nodes** then collected at the **lymphatic ducts** before entering the right and left subclavian veins and returning to the blood stream.

Lymph nodes are strategically placed throughout the body made of lymphatic tissue and surrounded by a tough wall of white fibrous tissue. They vary in size and are an important defence against septicaemia. They remove and destroy harmful micro-organisms, tumour cells, damaged or dead tissue cells, large protein molecules and toxic substances preventing them from reaching the blood stream and causing septicaemia. They produce new lymphocytes and antibodies and add to lymph when necessary. Lymphatic tissue cells within the node itself may become activated to produce antibodies for several years or even a lifetime

The Spleen
Is considered a non-essential organ yet it is the largest lymphatic organ. The other organs which can perform the same functions are bone marrow, lymphatic tissue and the liver. Only blood flows in but both blood and lymph flow out. In particular it destroys thrombocytes and erythrocytes and iron is sent to the liver for recycling

The role of the lymphatic system in digestion
In the small intestine small lymphatic vessels are in contact with the intestinal wall within the villi (minute projections of the absorptive intestine wall). Fatty nutrients and fat soluble vitamins are absorbed into the lymphatic system and are transported to the liver where the fat soluble vitamins are stored and the fats are processed for further distribution.

Action of the hormones and peptides
We don't tend to think of hormones and food together but have you tried to eat when you're full or walking up hill or when your new born baby is crying – impossible isn't it? The first is CCK (cholecystokinase) the second is probably prolactin a peptide. A peptide is a short protein. Peptides produced by the brain are called neuropeptides.

Candace Pert, the woman who identified the endorphin receptor and Author of Molecules of emotion said "It would seem that peptides serve to weave the body's organs and systems into a single web that reacts to both internal and external environmental changes with complex, subtly orchestrated responses. Peptides are the sheet music containing the notes and phrases and rhythms that allow the orchestra- your body to play as an integrated entity in unison and harmony. The music which results is the feeling you experience subjectively as your emotions"

The immune system is like a floating endocrine system. Lymphocytes can produce ACTH (a peptide) previously only thought to be produced by the pituitary. There are receptors on immune cells for virtually every drug or neuropeptide which we had identified in the brain.

Interleukin – 1 (IL-1) (a peptide) is produced mainly by macrophages and mediates the inflammatory reactions caused by injury, trauma or an activated immune system. In a cascade it causes fever, activates the T cells, induces sleep and puts the body in a generally healing state of being allowing it to mobilise its energy reserves to fight pathogenic intruders with maximum efficiency. There are many IL-1 receptors in the brain. Thus the immune system can communicate with the nervous system, the brain and the endocrine system.

The immune system needs to know what is and is not self. It's cells move unlike the brain cells. Every neuropeptide receptor which we can find in the brain is present on the cell membrane of a monocyte of the immune system. These emotion affecting peptides actually appear to control the movement and actions of the monocytes which are of utmost importance to the health of the body.

They communicate with the other lymphocytes, the B cells and T cells by interacting through peptides called cytokines, (composed of lymphokines, chemokines and interleukins) and their receptors. This enables the immune system to launch a well co-ordinated attack against disease. Immune cells also store and secrete the neuropeptides themselves ie the chemicals that we conceive of as creating mood in the brain. ie 2 way communication

Other cytokines mediate the allergic response. Each individual cytokine is a distinct protein molecule encoded by a separate gene that targets a particular cell type. The action of a cytokine can be either stimulated or inhibited according to the presence of other cytokines and the current state of metabolic activity.

This flexibility allows the immune system to take the most appropriate actions to stabilise the local cellular environment and to maintain homoeostasis. During illness or inflammation the blood brain barrier becomes more permeable and cytokines may be carried across into the brain with nutrients from the blood. Cytokines made in the lining of the blood vessels of the brain can stimulate the release of secondary chemical signals in the brain tissue around the blood vessels.

Fulvio D'Acquista is looking at how emotions affect our immune system using the term Affective immunology
He did an experiment using mice and says "First, stroking caused a marked reduction in the noradrenergic tone of lymphoid organs. Noradrenaline acts as immunosuppressant to the immune system, and the reduction in its levels in the thymus caused a significant change. Yet, there is some indirect evidence that supports this idea (boosting the immune system can have a positive effect on emotional wellbeing) that in line with our investigation on mice, studies on both children and adults with HIV have shown that massage therapy can increase the blood cell count of CD4 cells and result in an improved emotional state.

There are other ways to increase the number of T cells in the body. One such example is the administration of IL-7, a cytokine that enhances CD4 T-cell numbers. Studies on experimental models of HIV infections, such as simian immunodeficiency virus (SIV)-infected monkeys, have shown that like massage,

IL-7 is effective in increasing the number of CD4T cells in these animals It would be interesting to investigate if such therapy also improves emotional state and whether this approach can be used in humans.

This is an interesting idea considering that recent studies have shown a correlation between major depressive disorder and lower levels of IL-7.

Amygdala triggered arousal produces the feelings that come from the awareness that something is good or bad. Four of the systems that appear to contribute to arousal are in the brain stem.

Each release a different neurotransmitter.
Acetyl choline, noradrenaline, dopamine and seratonin.
The axons of these regions end in widespread areas of the forebrain. Arousal contributes to attention, perception, memory, emotion, and problem solving. Once the amygdala has been activated it is able to influence the cortical areas that are processing the stimuli that are activating it so it can direct attention to emotionally relevant stimuli to which the amygdala is assigning significance. This relates to long term memory and to the anterier cingulate cortex which is associated with anxiety.

Interactions between the Acetyl choline area in the fore brain and the amygdala seem to be particularly strong in the nucleus basalis. Damage here prevents stimuli that warn of danger. Once the fear system is switched on it is reinforced so something bigger is needed to switch it off. This keeps us focused in the danger.

Bodily feedback It is now known that the autonomic nervous system (ans) which controls the viscera has the ability to respond selectively so that different emotions (anger, fear, disgust, sadness, happiness) can be distinguished to some extent on the basis of different ans responses. We now know that there are steroid and peptide hormones released by the body organs during emotional arousal that travel in the blood to the brain.

It is conceivable that different emotional systems in the brain results in different patterns of hormone release, which in turn produce different patterns of chemical feedback to the brain that could have unique effects in different emotions. **But these effects are too slow to account for the actual emotion experienced.**

This is shows the importance of the receptors as they're both in the organs and in the brain at the same time; plus the immune effects.

Damasio the ‘somatic marker hypothesis’ calls upon the entire pattern of somatic and visceral feedback from the body. He proposes that such information underlies the 'gut feelings' and plays a crucial role in our emotional experiences and decision making processes

Donald Hebb '49 Learning at the level of the synapse "cells that fire together wire together"