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The Basics of Brain Waves

"...this dynamic system is the self in each of us."

W.J. Freeman in How Brains Make Up Their Minds

Brain waves are generated by the building blocks of your brain -- the individual cells called neurons. Neurons communicate with each other by electrical changes. We can actually see these electrical changes in the form of brain waves as shown in an EEG (electroencephalogram).

Brain waves are measured in cycles per second ([Hertz](#); Hz is the short form). We also talk about the "frequency" of brain wave activity.

The lower the number of Hz, the slower the brain activity or the slower the frequency of the activity.

Researchers in the 1930's and 40's identified several different types of brain waves.

Traditionally, these fall into 4 types:

- Delta waves (below 4 hz) occur during sleep
- Theta waves (4-7 hz) are associated with sleep, deep relaxation (like hypnotic relaxation), and visualization
- Alpha waves (8-13 hz) occur when we are relaxed and calm
- Beta waves (13-38 hz) occur when we are actively thinking, problem-solving, etc.

Since these original studies, other types of brainwaves have been identified and the traditional 4 have been subdivided.

Some interesting brainwave additions:

- The Sensory motor rhythm (or SMR; around 14 hz) was originally discovered to prevent seizure activity in cats. SMR activity seems to link brain and body functions.
- Gamma brain waves (39-100 hz) are involved in higher mental activity and consolidation

of information. An interesting study has shown that advanced Tibetan meditators produce higher levels of gamma than non-meditators both before and during meditation.

Are you wondering what kind of brain waves you produce?

People tend to talk as if they were producing one type of brain wave (e.g., producing "alpha" for meditating).

But these aren't really "separate" brain waves - the categories are just for convenience. They help describe the changes we see in brain activity during different kinds of activities.

So we don't ever produce only "one" brain wave type.

Our overall brain activity is a mix of all the frequencies at the same time, some in greater quantities and strength than others.

The meaning of all this? **Balance** is the key. We don't want to regularly produce too much or too little of any brainwave frequency.

How do we achieve that balance?

We need both flexibility and resilience for optimal functioning.

Flexibility generally means being able to shift ideas or activities when we need to or when something is just not working.

Well, it means the same thing when we talk about the brain.

We need to be able **to shift our brain activity to match what we are doing**. At work, we need to stay focused and attentive and those beta waves are a Good Thing. But when we get home and want to relax, we want to be able to produce less beta and more alpha activity. To get to sleep, we want to be able to slow down even more.

So, we get in trouble when we can't shift to match the demands of our lives.

We're also in trouble when we get stuck in a certain pattern. For example, after injury of some kind to the brain (and that could be physical or emotional), the brain tries to stabilize itself and it purposely slows down. (For a parallel, think of yourself learning to drive - you wanted to go r-e-a-l s-l-o-w to feel in control, right?). But if the brain stays that slow, if it gets "stuck" in the slower frequencies, you will have [difficulty concentrating](#) and focusing, thinking clearly, etc.

So flexibility is **a key goal for efficient brain functioning**.

Resilience generally means stability - being **able to bounce back from negative events** and to "bend with the wind, not break". Studies show that people who are resilient are healthier and happier than those who are not.

Same thing in the brain. The brain needs to be able to "bounce back" from all the unhealthy

things we do to it (drinking, smoking, missing sleep, banging it, etc.) And the resilience we all need to stay healthy and happy starts in the brain.

Resilience is **critical for your brain to be and stay effective.**

When something goes wrong, likely it is because our brain is lacking either flexibility or resilience.

So -- what do we know so far?

We want our brain to be both flexible - able to adjust to whatever we are wanting to do - and resilient - able to go with the flow.

To do this, it needs access to a variety of different brain states.

These states are produced by different patterns and types of brain wave frequencies. We can see and measure these patterns of activity in the EEG.

EEG biofeedback is a method for increasing both flexibility and resilience of the brain by using the EEG to see our brain waves.

It is important to think about EEG neurofeedback as training the **behaviour** of brain waves, not trying to promote one type of specific activity over another. For general health and wellness purposes, we need all the brain wave types, but we need our brain to have the flexibility and resilience to be able to balance the brain wave activity as necessary for what we are doing at any one time.

What stops our brain from having this balance all the time?

The big 6:

- Injury
- Medications, including alcohol
- Fatigue
- Emotional distress
- Pain
- Stress

These 6 types of problems tend to create a pattern in our brain's activity that is hard to shift.

In chaos theory, we would call this pattern a "chaotic attractor". Getting "stuck" in a specific kind of brain behaviour is like being caught in an attractor.

Even if you aren't into chaos theory, you know being "stuck" doesn't work - it keeps us in a place we likely don't want to be all the time and makes it harder to dedicate our energies to

something else -> Flexibility and Resilience. Next, let's take a closer look at