The Importance of Hormones and Neurotransmitters for Proper Brain Function

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Hormones and a Smarter You
The Brain is the New Heart?

- Our healthcare system is obsessed with cardiology. Everyone monitors their cholesterol, and heart disease is considered the number one killer in the United States.

- But let’s not forget that the head is connected to the body!

- All diseases affect or are affected by the brain. Therefore, monitoring brain health is just as important – if not more so in many instances – than monitoring heart health.
Core Cardiac Domains

- Valves
- Coronary Arteries
- Ejection Fraction
- Blood work
- Electrophysiological
Core Brain domains: Integrating the Brain into Healthcare

- Electrophysiology
- Memory
- Attention
- Temperament and Type
- Axis 1 & 2
- IQs
P300 and Brain Speed

- The P300 wave is an event related potential that can be recorded via EEG as a positive deflection in voltage at a latency of roughly 300 + age msec.

- The presence, magnitude, topography, and time of this signal can measure processing speed, power, synchrony and rhythm.

- The generation of the P300 event-related potential is influenced by the glutamatergic, GABAergic, cholinergic, noradrenergic, dopaminergic, and serotonergic systems.

- P300 Latency is primarily cholinergic.

The P300 test of brain speed is functionally the cholesterol test of the brain. Someday we envision that just as how most Americans know their cholesterol levels, everyone will know their brain age, how many years they are away from dementia. Cholesterol, the first precursor to steroid hormone pathway and a marker of decline in our steroid manufacturing, is a tremendous global marker of both heart disease and physical wellbeing. Brain processing speed delay is antecedent to both memory and attention decline, and will become the marker that every human being will measure.
The Human Computer Reaction

You only have 100 ms to lose in the course of your life.

Brain speed and reaction time deteriorate with aging.

Most of us will lose 7-10 ms each decade.
P300 Latency and Voltage average, by age group

P300 Voltage

We look at the **voltage of the P300 wave**. Whereas normal expectations are 10 mV (millivolts), deviances indicate abnormal brain wave function:
Neuro-electrical cognitive decline is associated with a dynamically increasing number of illnesses.
P300 Predicts PET Scan Hypometabolism

• PET hypometabolism is an indicator of mild cognitive impairment and frequently dementia.

• P300 declines are antecedent to memory loss, so P300 indices were compared to PET scan results.


<table>
<thead>
<tr>
<th>P300 Measure</th>
<th>Hypometabolism</th>
<th>Non-Hypometabolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency (ms)</td>
<td>346 (p=.003)</td>
<td>323</td>
</tr>
<tr>
<td>Voltage (mV)</td>
<td>3.25 (p=.0005)</td>
<td>5</td>
</tr>
</tbody>
</table>

• Hypometabolic patients’ brain speeds are consistent with those 20-30 years older (23ms difference between the two groups).

• Order of brain deterioration: microcellular, electrophysiological (P300 and qEEG), metabolic (PET), anatomical (MRI).

Neuropsychiatric evaluation of the dementing process needs to begin at age 40 or earlier to have an impact on dementia.

BEAM: Brain Diagnostic Evaluation

- Spectral analysis: including changes in frequency of the alpha wave
- P300: voltage (strength) and latency (delay in the wave echo)
- Evoked potentials (using visual and auditory provocations): numbers
  
  Grade of abnormality: Grade 1 through Grade 7

- EEG Electroencephalography:

  People go on seizure medications when there are arrhythmias in their brains, which can be detected with a computerized EEG (BEAM).

Clinical significance of focal topographic changes in the electroencephalogram (EEG) and evoked potentials (EP) of psychiatric patients

Gerez M, Tello A Brain Topogr. 1992 Fall;5(1):3-10
• EEG - (Limited Value)

• P300 Voltage - Energy, Power, Metabolism

• P300 Time - Speed, Youth, Cognition

• Evoked Potentials - Arrhythmia/Brain Rhythm

  Anxiety, Seizures

• Spectral Analysis - Synchrony (On/Off Switch)

  Mind-Body, Relaxation

**P300 (latency) event-related potential: an accurate predictor of memory impairment.** Braverman ER, Blum K Clin Electroencephalogr. 2003 Jul;34(3):124-39
BEAM

- Voltage – Catecholamines
- Speed – Cholinergic
- Rhythm – GABAergic
- Synchrony - Serotoninergic

Brain Evaluation & Assessment Method

- Brain Electrical Activity Mapping (BEAM)
- Millon Clinical Multiaxial Inventory (MCMI-II)
- Myers-Briggs Type Indicator (MBTI)
- Wechsler Memory Scale-Revised (WMS-R)
- Test of Variables of Attention (TOVA)
- Cognitive IQ Assessment (GAMA)
The Origins of Brain Electricity

• Electrolytes and ions
• Neurotransmitters
• Hormones
• Electromagnetic fields
• Spinal Cord to Brain “Edge”

• The P300 wave originates in the right frontal lobe, travels to the left frontal lobe and moves to the central portion of your brain and then to the parietal lobes.
Aged Brain

↑ Latency / ↓ Voltage

Normal Brain
Every disease wears out your head. And the more diseases you accumulate—hormonal or otherwise—the more damaged your brain function will be.
Disease = Accelerated Aging

• Everyone has heard of menopause.

• But most hormones – not just estrogen – have a “pause.”

• The pauses we experience as we age affect every single organ system and lead to uncountable diseases.

• Each gland and organ system ages at a different rate in different people.

• Hormones affect and are affected by all neurotransmitter systems.
Age Prints, and Causes of Pauses?

Causes:

• Genetic & Environmental
• Endocrine disruptors
• This leads to neurotransmitter imbalances
• What we commonly consider to be “normal aging.”

Each person has a unique age print – where their oldest parts are age accelerators and eventually lead to death.
Comparison by Age of Male and Female Sex Hormones

Hormone Production and Circulation

Adult Normal Level

Testosterone

Estrogen

Age

10 20 30 40 50 60 70 80 90 100
Genetic vs. Environmental Causes

- Some pauses are **genetic**, and some are **environmental**.
- **Male menopause** (andropause) is mostly caused by **environmental factors**.
- **Female menopause** is mostly caused by **genetic factors**.

- **Endocrine Disruptors:**
  - **Pesticides**
  - **Plastics and cosmetics containing phthalates**
  - **Car exhaust, paints, plumbing, canned foods**
  - **Hair dyes, newspaper print, tap water**
Leptin and Obesity Measurement

- 50% of women classified as non-obese by BMI but obese by body fat percent from DEXA scans. For men, it’s not nearly as bad – 25%, but still a significant amount of misclassification.

- Adding gender and leptin to the BMI equation increased the sensitivity of the formula to 76% from 57%.

Results obtained by PATH Foundation NY
<table>
<thead>
<tr>
<th>Pause</th>
<th>Decline In</th>
<th>Onset Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electropause</td>
<td>Electrical activity of brain waves</td>
<td>45</td>
</tr>
<tr>
<td>Biopause</td>
<td>Neurotransmitters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dopamine: 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acetylcholine: 40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GABA: 50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serotonin: 60</td>
<td></td>
</tr>
<tr>
<td>Pineal Pause</td>
<td>Melatonin</td>
<td>20</td>
</tr>
<tr>
<td>Pituitary Pause</td>
<td>Hormone feedback loops</td>
<td>30</td>
</tr>
<tr>
<td>Sensory Pause</td>
<td>Touch, hearing, vision, taste and smell sensitivity</td>
<td>40</td>
</tr>
<tr>
<td>Psychopause</td>
<td>Personality, health and mood</td>
<td>30</td>
</tr>
<tr>
<td>Thyropause</td>
<td>Calcitonin and thyroid hormone levels</td>
<td>50</td>
</tr>
<tr>
<td>Parathyropause</td>
<td>Parathyroid hormone</td>
<td>50</td>
</tr>
<tr>
<td>Pause</td>
<td>Decline In</td>
<td>Onset Age</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Thymopause</td>
<td>Gland size and immune system</td>
<td>40</td>
</tr>
<tr>
<td>Cardio/Vasculopause</td>
<td>Blood flow</td>
<td>40</td>
</tr>
<tr>
<td>Pulmonopause</td>
<td>Lung elasticity and function with increase in blood pressure</td>
<td>50</td>
</tr>
<tr>
<td>Adrenopause</td>
<td>DHEA</td>
<td>55</td>
</tr>
<tr>
<td>Nephropause</td>
<td>Erthyropoietin level</td>
<td>40</td>
</tr>
<tr>
<td>Somatopause</td>
<td>Growth hormone</td>
<td>30</td>
</tr>
<tr>
<td>Gastropause</td>
<td>Nutrient Absorption</td>
<td>40</td>
</tr>
<tr>
<td>Pancreopause</td>
<td>Blood sugar level</td>
<td>40</td>
</tr>
<tr>
<td>Pause</td>
<td>Decline In</td>
<td>Onset Age</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Insulopause</td>
<td>Glucose tolerance</td>
<td>40</td>
</tr>
<tr>
<td>Andropause</td>
<td>Testosterone in men</td>
<td>45</td>
</tr>
<tr>
<td>Menopause</td>
<td>Estrogen, progesterone, and testosterone in women</td>
<td>40</td>
</tr>
<tr>
<td>Osteopause</td>
<td>Bone density</td>
<td>30</td>
</tr>
<tr>
<td>Dermopause</td>
<td>Collagen, Vitamin D synthesis</td>
<td>35</td>
</tr>
<tr>
<td>Onchopause</td>
<td>Finger and toe nails</td>
<td>40</td>
</tr>
<tr>
<td>Uropause</td>
<td>Bladder control</td>
<td>45</td>
</tr>
<tr>
<td>Genopause</td>
<td>DNA</td>
<td>40</td>
</tr>
</tbody>
</table>
• Everyone has a unique “pause print.”

• Bioidentical hormone replacement is not the same for everyone, and it is important to get a full brain and body health check up in order to decide which hormones will work for you.

• Remember – you are only as young as your oldest part!

Find silent disease before it silences you.
### Hormonal Changes According to the Medical Literature

<table>
<thead>
<tr>
<th>Decrease</th>
<th>No Change</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin growth factor</td>
<td>Epinephrine</td>
<td>Insulin</td>
</tr>
<tr>
<td>Vitamin 25(OH) D</td>
<td>Thyroxine</td>
<td>Vasopressin</td>
</tr>
<tr>
<td>Testosterone(m)</td>
<td>Glucagon</td>
<td>Cholecystokinin</td>
</tr>
<tr>
<td>Estradiol (f)</td>
<td>Glucagon like Peptide 1</td>
<td>Atrial naturetic peptide</td>
</tr>
<tr>
<td>DHEA &amp; its sulfate</td>
<td>Thyrotropin</td>
<td>Norepinephrine</td>
</tr>
<tr>
<td>Triiodothyronine</td>
<td>Calcitonin</td>
<td>Epinephrine (&gt;80yo)</td>
</tr>
<tr>
<td>1,25(OH)2 Vit D</td>
<td>ACTH</td>
<td>FSH</td>
</tr>
<tr>
<td>Inhibin</td>
<td>Prolactin(f)</td>
<td>LH(f)</td>
</tr>
<tr>
<td>Arginine Vasopressin</td>
<td></td>
<td>Parathormone</td>
</tr>
<tr>
<td>Pregnenolone</td>
<td></td>
<td>Cortisol</td>
</tr>
</tbody>
</table>

*These changes create the pauses of aging!*

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What are Hormones, Anyway?

- Hormones are chemical messengers secreted by endocrine glands.
- Hormones can be classified according to how they are synthesized.
- The three main categories are: peptide and polypeptide hormones, steroid hormones, and amine hormones (derived from tyrosine and tryptophan).
Steroid Hormones (all derived from cholesterol)

- Androstenedione
- DHEA
- DHEA-Sulfate
- Estriol
- Estrone
- Cortisol
- Aldosterone
- Pregnenolone
- Progesterone
- Testosterone
- Vitamin D
Sex Steroid Synthesis in the CNS

Cholesterol → P450scc → Pregnenolone

- 3B-HSD

Pregnenolone → P450c17 → Progesterone

- 3B-HSD

Progesterone → 17B-HSD → Androstenedione

- 3B-HSD

Androstenedione → P450arom → Estradiol

- P450arom

Androstenedione → P450-AROM → Estrone

- P450-AROM

Testosterone

- 17B-HSD

DHEA

- 3B-HSD

Enzymes indicated in Yellow

Peptide and Polypeptide Hormones

- Calcitonin
- Erythropoietin
- Human Growth Hormone
- IGF-1
- Incretin
- Insulin
- Parathyroid Hormone
- Oxytocin
- DDAVP (Vasopressin)
Amine Hormones (Tryptophan and Tyrosine derivatives)

- Melatonin
- Thyroid Hormone – Thyroxine (T4)
- Thyroid Hormone – Tri-iodothyronine (T3)
The Brain Pulses out Hormones!

• The four main neurotransmitter systems: Cholinergic, Catecholaminergic, Serotonergic, GABAergic. Each system affects different hormones in different ways.

• In some instances, “neurotransmitters” behave more like hormones (e.g. epinephrine and norepinephrine, and dopamine when it acts as a releasing hormone from the pituitary gland).

Fixing more than one part of the brain results in a synergistic (EDGE) effect
Hormones Involved with the Catecholamine System: Brain Voltage

- Testosterone/Estrogen
- DHEA
- Thyroid
- Cortisol
- HGH
- Erythropoietin
- Insulin
- TRH
- IGF-1
- Cholecystokinin
- HCG
- Prolactin
- GnRH


Dopamine D2 receptors contribute to increased avidity for sucrose in obese rats lacking CCK-1 receptors. Hajnal A, De Jonghe BC, Covasa M. Neuroscience. 2007 Aug 24;148(2):584-92


Hormones Involved with the Cholinergic System – Brain Speed

- Human Growth Hormone
- Vasopressin
- DHEA
- Calcitonin
- Parathyroid Hormone
- Estrogen
- Prolactin
- T3 & T4


Enhanced plasma DHEAS, brain acetylcholine, and memory mediated by steroid sulfatase inhibition Rhodes ME, Li PK, Burke AM, Johnson DA Brain Res. 2997 Oct 31;773(1-2):28-32

Effect of parathyroid hormone and calcitonin on acetylcholine release in rat sympathetic superior cervical ganglion Stern J E, Cardinali DP Brain Res. 2994 Jul 11;650(2):267-74

Acetylcholine & Catecholamines

• **Donepezil**, an *acetylcholinesterase inhibitor* used in the treatment of Alzheimer’s disease, *improves P300 latency*.

• Clark Randt showed that *catecholamines help memory*, and impacts brain voltage and speed to a degree.


Norepinephrine biosynthesis inhibition: effects on memory in mice Randt CT et al *Science* 1971 Apr 30;172 (982):498-9
Hormones Involved with the Serotonergic System – Brain Synchrony

- Progesterone
- Human Growth Hormone
- Pregnenolone
- Melatonin
- Leptin
- Aldosterone
- Prolactin
- Estrogen


Effect of parathyroid hormone and calcitonin on acetylcholine release in rat sympathetic superior cervical ganglion Stem JE, Cardinale DP Brain Res. 2994 Jul 11;650(2):267-74

Hormones Involved with the GABAergic System – Brain Rhythm

- Progesterone
- Pregnenolone
- GHRH
- Prolactin
- Estrogen

**Neurotransmitter regulation of anterior pituitary hormones** Tuomisto J, Mannisto P Pharmacol Rev. 1985 Sep;37(3):249-332

**Sex steroids effects on the content of GAD, TH, GABA(A), and Glutamate Receptors in the Olfactory Bulb of the Male Rat** Guerra-Araiza C, Miranda-Martinez A, Neri-Gomez T, Comacho-Arroyo I Neurochem Res. 2008 Mar 25

**Ovarian hormones and migraine headache: understanding mechanisms pathogenesis - part I** Martin VT, Behbehani M Headache 2006;46(1):3-23
Dopaminergic (catecholamines)  >  +  
Cholinergic                   
GABAergic  >  -  
Serotonergic 

Endorphins – “spare tires”

Clark Randt showed that adrenaline helps with memory.

E=MC²  
Cognitive Energy=Brain Speed x (Voltage)²
Chemicals Influence all Neurotransmitter Systems

- For example, *nicotine* has effects on all of the following systems:

<table>
<thead>
<tr>
<th>Acetylcholine: arousal, cognitive enhancement</th>
<th>Dopamine: pleasure, appetite suppression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serotonin: mood modulation, appetite suppression</td>
<td>GABA: reduction of anxiety and tension</td>
</tr>
</tbody>
</table>

Nicotinic acetylcholine receptors of the ventral tegmental area are involved in mediating morphine-state-dependent learning. Rezayof A, Darbandi N, Zarrindast MR Neurobiol Learn Mem. 2008 Apr 25
## Guide to Brain Chemistry

<table>
<thead>
<tr>
<th>Test</th>
<th>Brain-Mind Domain</th>
<th>Dopamine ♦ Power ♦</th>
<th>GABA ♦ Calming ♦</th>
<th>Acetylcholine ♦ Speed ♦</th>
<th>Serotonin ♦ Rest ♦</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEAM</td>
<td>Electrophysiology</td>
<td>Voltage</td>
<td>Rhythm</td>
<td>Speed</td>
<td>Synchrony</td>
</tr>
<tr>
<td>MBTI</td>
<td>Dominant Temperament</td>
<td>NT</td>
<td>SJ</td>
<td>NF</td>
<td>SP</td>
</tr>
<tr>
<td>WMS</td>
<td>Memory Dominance</td>
<td>Working</td>
<td>Verbal</td>
<td>Immediate</td>
<td>Visual</td>
</tr>
<tr>
<td>TOVA, CNSVS</td>
<td>Attention Measure</td>
<td>Variability</td>
<td>Commissions</td>
<td>Omissions</td>
<td>Reaction Time</td>
</tr>
<tr>
<td>GAMA</td>
<td>IQ Dominance</td>
<td>Abstract</td>
<td>Emotional</td>
<td>Creative</td>
<td>Perceptual</td>
</tr>
</tbody>
</table>

# Neurochemical Imbalances and Resulting Temperaments

<table>
<thead>
<tr>
<th>General Term</th>
<th>Millon Temperament</th>
<th>Neurotransmitter Imbalance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dopamine</td>
</tr>
<tr>
<td>Eccentric</td>
<td>Schizotypal</td>
<td>↓</td>
</tr>
<tr>
<td>Loner</td>
<td>Schizoid</td>
<td>↓</td>
</tr>
<tr>
<td>Painfully Shy</td>
<td>Avoidant</td>
<td>↓</td>
</tr>
<tr>
<td>Abuse-Me</td>
<td>Self-Defeating/Masochistic</td>
<td>↓</td>
</tr>
<tr>
<td>Nurturing</td>
<td>Dependent</td>
<td>↓</td>
</tr>
<tr>
<td>Procrastinator</td>
<td>Passive-Aggressive</td>
<td>↓</td>
</tr>
<tr>
<td>Drama Queen</td>
<td>Histrionic</td>
<td>↑</td>
</tr>
<tr>
<td>Suspicious</td>
<td>Paranoid</td>
<td>↑</td>
</tr>
<tr>
<td>Self-Absorbed</td>
<td>Narcissistic</td>
<td></td>
</tr>
<tr>
<td>Perfectionist</td>
<td>Obsessive-Compulsive</td>
<td>↓</td>
</tr>
<tr>
<td>Dukes-Up</td>
<td>Aggressive/Sadistic</td>
<td>↑</td>
</tr>
<tr>
<td>Rule-Breaker</td>
<td>Antisocial</td>
<td></td>
</tr>
</tbody>
</table>
# The 4 Brain Humors: Brain and Body Repair Mechanisms

<table>
<thead>
<tr>
<th>System</th>
<th>Natural</th>
<th>Pharmaceutical</th>
<th>Hormonal</th>
<th>Electrical Treatments &amp; Lifestyle Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dopamine</strong></td>
<td>Caffeine</td>
<td>Wellbutrin</td>
<td>Testosterone/Estrogen DHEA Thyroid</td>
<td>Weight bearing exercise Teas Spices: Cumin, etc</td>
</tr>
<tr>
<td>&quot;Voltage, Energy &amp; Power&quot;</td>
<td>Rhodiola Rosea Folic Acid Tyrosine</td>
<td>Tenuate Provigil Cymbalta Adderall</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Serotonin</strong></td>
<td>Fish Oils Tryptophan Magnesium</td>
<td>Paxil Effexor Meridia</td>
<td>Progesterone Pregnenolone</td>
<td>CES/TENS Sleep Complex Carbs</td>
</tr>
<tr>
<td>&quot;Symmetry, Sleep &amp; Rest&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acetylcholine</strong></td>
<td>Fish Oils Choline Lipoic Acid Acetyl-Carnitine</td>
<td>Aricept Exelon Statin Drugs Namenda</td>
<td>Estrogen Parathyroid</td>
<td>Aerobics Spices: Sage Eggs, etc</td>
</tr>
<tr>
<td>&quot;Speed, Youth &amp; Memory&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GABA</strong></td>
<td>Inositol CoQ Theanine</td>
<td>Depakote Topamax Tegretol</td>
<td>Progesterone Human Growth Hormone</td>
<td>CES Spices: Cinnamon</td>
</tr>
<tr>
<td>&quot;Rhythm, Calmness &amp; Stability&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hormones in Neurogenesis

- Steroids <When injected with their own steroids, teenager’s brain speeds are given a jolt>
- Human Growth hormone
- Pregnenolone
- Androstenedione
- Calcitonin
- Dehydroepiandrosterone (DHEA)
- DHEA – Sulfate (DHEA-S)
- Erythropoietin
- Estriol
- Estrone

- Hydrocortisol/Aldosterone
- Insulin – like Growth Factor (IGF)
- Incretin
- Insulin
- Melatonin
- Parathyroid Hormone
- Progesterone
- Testosterone
- Thyroid: T3, T4
- DDAVP
- Estrogen <during menopause as well as normal period>
Neurotransmitters and Other Chemicals in Neurogenesis

- Neurotransmitters
  - Oxytocin
  - Catecholamines
  - Adrenaline

- Others
  - Donepezil
    <Acetylcholinesterase Inhibitor>
  - Antidepressants
    <Stimulates neurogenesis>
  - Vitamins: D2, D3
The PATH to Achieving Total Health:
Lines of Defense

1st Line of Defense - Nutrition/lifestyle changes:
regular exercise including weight-bearing and aerobic activity,
following the Rainbow Diet, spiritual health.

2nd Line of Defense - Vitamins and supplements:
Brain Print and Age Print the brain and the body,
and follow a supplement regimen to fit your unique chemistry.

3rd Line of Defense – Hormone Replacement with Bioidenticals:
Pause Print the Body and replace hormones as you age to keep your body and mind young.

4th Line of Defense: Neuro psychoactive medications that fit your brain chemistry.

Image from: www.masteryourlife.com
Conclusion

- **Hormones, neurotransmitters, your brain, mind and body** constantly participate in an *everlasting chain of reactions* that affects all aspects of your health and well-being.

- A *mechanical or chemical imbalance* in the chain can lead to problems *anywhere in your body* and affect your *mental health*.

- Establishing a “brain-print” and “pause-print” is extremely important in order to set up a baseline for comparison.

- **Knowing the Brain Code** and its relevance to *your specific chemistry* will enable you to *prevent or reverse disease* and *work with your personality and temperament* to achieve the maximum *quality of life*.