

HOW TO CHANGE A BRAIN THAT RESISTS CHANGING

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EXPLORING BOTTOM-UP AND TOP-DOWN BRAIN SIGNALING.

Our human brain is excellent at building patterns based on experience. These neurological patterns are both time and energy saving which is of great benefit. Our brain, even in adulthood, is also capable of ongoing neuroplastic change when provided with effective stimulation. This neuroplastic change allows for ongoing adaptation, learning, growth and creativity.

There are times when existing patterns (habits, beliefs) do not serve well in current problem solving. These patterns must be surrendered to allow new more effective patterns to grow into place. The process of building and retaining patterns and the process of making changes in patterns generates a competitive environment within the brain.

The domain of patterned **integration** is referred to as a "top-down" neurological dynamic process. The domain of sensory **information** is referred to as a "bottom-up" neurological dynamic process. The top-down cognitive resistance to required change can be "relaxed" or "softened" using bottom-up sensory stimulation and reward. Once "relaxed" further bottom-up information can be instructive in forming new effective neurological, behavioral and psychological patterns.

"YOU CAN'T THINK YOUR WAY OUT OF THE PROBLEM BUT YOU CAN FEEL YOUR WAY INTO THE SOLUTION."



INTRODUCTION:

The profound mystery of the brain is exceeded only by the controversial theories of mind. In this document, the concepts of brain and mind are simplified to avoid unproductive debate. The position here is that, at the very least, a well-functioning mind is intimately related to a well-functioning brain.

Current science is advancing a number of insights into dynamic brain functioning. These contemporary scientific models will be relevant to the topic of this paper.

Perhaps the most influential current understanding is that the adult human brain is capable of positive functional and structural adaptive change when provided with appropriate forms of stimulation. This phenomenon is known as "neuroplasticity."

At the same time, it is also recognized that our brain excels at creating organized patterns and management processes to make effective predictions in perception and action. With repetition, this organization is constantly reinforced and strengthened, making any modification or change in the organization increasingly more difficult.

Consequently, the knowledge that our brain tends to make accurate predictions in perception and action based on sustained, habitual, organized patterns while also being fully capable of adaptive modifications and change raises the question: **"How to Change a Brain that Resists Changing?"** This is the topic of this document.

STARTING WITH THE BASICS :

Our human mammalian brain developed over long periods of time. Anatomically, our brain developed from the bottom up. The early organizational spine slowly "mushroomed" up (a little evolutionary humor) into the primitive "lower brain" and eventually into the later "higher brain." Even now, we have all of these elements fully functioning in a simultaneous and cooperative fashion.

Interestingly, the anatomical "bottom" growing up into an anatomical "top" is also reflected in the functional neurological physiology of the brain, which is explored in this paper. Hence, the subject of "bottom-up" and "top-down" brain signaling.

The model of "bottom-up" and "top-down" signaling in any complex system is well known and applied in many fields, including cybernetic information processing, economics,

psychology, software coding, product development, and humanistic studies, to name a few. The model can be applied to manners of thinking, teaching, and even leadership.

In this paper, we are focusing on the application of the "bottom-up/top-down" processing model as it relates to our functional brain.

Fundamentally, "bottom-up" is the information that we derive through our senses and "top-down" is the organization and integration of that information – so, **"bottom-up" provides information and "top-down" provides integration** – obviously both are critical.

This simplistic dualistic model serves as an excellent starting point and will remain the core of much of our exploration. However, it should come as no surprise (more about "surprise" later in the paper) that the relationship has a good deal more subtlety and complexity.

ABOUT "BOTTOM-UP":

In **bottom-up processing**, no learning is required, and perceptions are solely based on new stimuli from one's current external environment. The driving force of perception in bottom-up processing is the stimulus that is currently being experienced. (1)

In this definition, the term "environment" can be expanded to include the realm outside of the physical body, **plus** the sensate experiences that occur within the soma, such as pain, pleasure, diffuse emotional expressions, and positional proprioception.

"Bottom-up" experience is essentially "sensate" and restricted to the **present moment**.

ABOUT "TOP-DOWN":

In **top-down processing** we know that previous knowledge, experience, and expectations are essential in creating perceptions about new stimuli, so the driving force in top-down perception is one's previous knowledge, experience, and expectations. (2)

"Top-down" organization and integration is restricted to the **reference of the past and anticipation or projection into the future**.



IS "BOTTOM UP" PURE & IS "TOP-DOWN" WISE?

The answer to both questions is "NO." "Bottom-up" sensate information is rarely "pure," and "top-down" organizational integration is not always "wise."

"Bottom-up" sensate information is subject to many lenses and filters imposed by the biological characteristics of the organism, as well as the perspectives imposed by our new good friend, "top-down" patterns and predictions. It is definitely a combination of nature and nurture.

"Top-down" organizational integration is subject to a wide range of encoding and situational interpretations that may or may not accurately apply to the demands of perception and actions.

As it turns out, the quest for ongoing life requires a sustained series of "trial and error" experiments and working with a brain that is constantly "jumping to conclusions."

The Neo-Darwinian concept is simple enough – the organism will do whatever it takes to help ensure survival because, in the hierarchy of needs, being alive is the first and most important rung on the ladder.

And so, here we encounter the perennial challenge of "ontology" and "epistemology."

"Ontology" asks what is true and real, while **"epistemology"** is concerned with how to gain this knowledge in a reliable way. Ontology deals with "what is real?" and epistemology deals with "how do you know that?"

Boiling it down, in principle, "bottom-up" works on the ontology aspect, and "top-down" works on the epistemology aspect. Together, we should be able to not only survive but also continue learning and growing in adaptation to the ever-changing experiences of life.

ABOUT JUMPING TO CONCLUSIONS:

Let's start with a very simple (and possibly silly) example. I am walking in my garden and I look down and see a snake. I jump away and look back down again. On second sight, I realize that it is actually my old garden hose. The takeaway here is "better safe than sorry."

Apparently, based on the "library" of my personal experiences (my mother's fear of snakes and the inherited species-based protection mechanism against snakes),

I have an imprinted pattern that allows for a shortcut from "bottom-up" sensory information to "top-down" patterning.

This pattern acts rapidly to protect me with an important perception. The upside of this protection mechanism is that I can be safe when encountering a snake, but the downside is that I can easily make mistakes, come to wrong conclusions, and act inappropriately.

From a Neo-Darwinian perspective, this helps ensure a higher probability of survival. In biophysics, this minimizes energy expenditure while triggering faster reflex responses.

For a better understanding of "jumping to conclusions," we will need to explore something a bit more technical called Predictive Coding.

PREDICTIVE CODING:

While avoiding overly detailed information, let's take a look at the principles underlying the organizational **integration** that characterizes "top-down" brain signaling.

You may recall that the "higher brain" is primarily responsible for "understanding" what is happening in the world as the flow of "bottom-up" stimulation provides information through the senses.

In cybernetics, this can be described as attempting to "find a signal in the noise."

The higher brain employs an "epistemological" method to make an "ontological" discovery.

In simplified terms, "bottom-up" information becomes meaningful for two possible reasons: 1) the information is associated with a new experience that carries a concentrated quality of either pleasure or pain, and/or 2) the information is similar to a past meaningful experience.

If either or both of these conditions are met, our brain imprints and stores this experience as a coded neurological pattern that can be readily accessed in the future when needed. This process is rapid and energy-efficient.

However, as demonstrated by the case of my mistaken identity of the garden hose as a snake, these "top-down" coded patterns can be tricky.

While "top-down" patterns can be effective and efficient, they may not always be correct.

These imprinted "top-down" patterns allow our brain to anticipate probable future experiences and make reasoned predictions on how to respond to them with maximum speed and minimum energy.



Often, things work out well, and the "top-down" pattern functions effectively (like when acing your tennis serve repeatedly). However, there are times when it fails, leading to a "prediction error" or what can be called a "surprise" in advanced brain models. The brain does everything it can to avoid "prediction errors" and "surprises," a concept we will further explore.

When the brain makes a prediction and the resulting perception or action is correct (confirmed by "bottom-up" sensory information), it generates a "reward" and reinforces the pattern, making it more reliable and resilient.

However, when the brain makes a prediction and the resulting perception or action is incorrect (informed by "bottom-up" sensory information), it feels "bad" and generates "punishment." The pattern is questioned because a prediction error has occurred.

Our brain really likes rewards and really doesn't like punishment – so, obviously, our brain really wants its predictions to be correct and will attempt to avoid the bad news and the associated punishments – **which is one of the main reasons that our brain will resist changes in its 'top-down' patterns...** even when the prediction is an error !!!

WHEN OUR BRAIN GETS IT RIGHT ...OR WRONG:

Generally speaking, feeling "bad" does not feel "good." Organisms do their best to avoid pain and seek out pleasure, and our brain is no exception.

When you make a prediction for a perception or action, being correct "feels good." Therefore, it is understandable why there is a tendency to protect your prediction, even in the face of a "prediction error" that feels "bad."

A stored "top-down" pattern is technically known as a "prior," which is an apt term as it refers to something that comes before. A "prior" is the result of meaningful past experiences that the brain has deemed significant enough to keep ready for potential reuse. "Priors" are registered with the anticipation of similar future rapid problem-solving.

However, not all "priors" are equal. Some are considered "reliable," while others are deemed "unreliable." These states are not absolute; they exist on a continuum, akin to a "dimmer switch" with various shades of gray.

The rating of a top-down "prior" as reliable or unreliable directly influences reactions to bottom-up sensory information.



If a "prior" is coded as "reliable" and is used in a prediction that ultimately fails, resulting in a "prediction error," the top-down "new brain" will resist the bottom-up information from the "old brain" and attempt to "cancel" the prediction error report.

This response reminds me of a quote from the famous anthropologist Margaret Mead, who reportedly said when presented with controversial research information, "This is the kind of proof I wouldn't believe even if it is true." It highlights the awareness of her own strong bias.

Having a strong "reliable prior" can be advantageous or detrimental. It can be beneficial, for example, if a visual experience is distorted by hallucination, and you deny the bottom-up information and cancel out the impression because it is inaccurate or invalid. Conversely, it can be harmful if you are so committed to a belief that you deny obvious and accurate information regarding the facts of an event.

As mentioned earlier, a "prior" can also be "unreliable." In such cases, when the top-down "new brain" makes a prediction that results in a prediction error, the "old brain" bottom-up sensory information gains extra validity. Against anticipation, the brain will sometimes reluctantly accept the error and yield to a "change of mind" (and a change of brain).

To provide a more practical appreciation, let's group a few alternative terms for a "prior": pattern, order, perspective, interpretation, behavior, habit, belief, point of view, confirmation bias, my reality, who I am.



HOW "TOP-DOWN" HUNTS FOR MEANING IN "BOTTOM-UP":

Basic Predictive Coding follows a relatively simple approach to gather bottom-up information and integrate top-down experiences. However, as mentioned before, "bottom-up" information is not always pure, and top-down integration is not always wise."

For a better understanding of the "hunt for meaning," we need to introduce a principle called "Active Inference."

First, it is necessary to clarify the relationship and difference between the concepts of "to imply" and "to infer." This will help us appreciate the "inference" aspect of Active Inference and why it is described as "active."

"To imply" (with the noun form being "implication") can be defined as suggesting the truth or existence of something not expressly stated. It refers to when someone doesn't directly state something but instead provides hints or subtle information in their statement.

The "implication" comes from the speaker and is intended to indirectly influence the listener. It is like hiding meaning within the message that the listener must decode to understand.

"To infer" (with the noun form being "inference") can be defined as deducing or concluding information from evidence and reasoning rather than from explicit statements. The "inference" is created by the listener when they seek information from the speaker's message that is not explicitly conveyed.

Now, let's examine the "active" aspect of Active Inference. In the general definitions mentioned earlier, the act of "inference" is more reactive and responsive to the initial input of sensory information. One could say that it involves a passive response by the listener to the messaging initiated by the speaker. This implies that the listener is initially neutral or unbiased, and the act of inferring is a secondary reaction to the message. Hence, one could call it "Passive Inference."

However, in the case of Active Inference, this passivity is not applicable. The "inference" element is specifically described as "active." So, what does that mean?

With this in mind, considering the top-down "new brain" as the listener and the bottom-up "old brain" as the speaker, Active Inference signifies that the top-down "new brain" is prepared to engage with bottom-up information while having a filter in place.

The top-down dynamic has shifted from passive to active, actively searching for possible implicit meaning in the stream of bottom-up sensory information. The top-down "new brain" apparently has suspicions about the accuracy or factual basis of the bottom-up "old brain" sensory flow.

Alternatively, it could be suggested that the top-down "new brain" is not so much questioning the purity of the bottom-up information as it is driven by an agenda. If this is the case, the strong probability of a "confirmation bias" must be considered.

The brain is no longer open-minded to the discovery of new information; rather, it has an agenda to solidify preexisting beliefs and behaviors, regardless of any evidence to the contrary.

With the confirmation bias in place, the interpretation of bottom-up sensory information becomes biased and skewed toward reinforcing assumptions based on past experiences, while showing strong resistance to new information that would require modifications and changes in the mind/brain.



IT'S NOT ALL BAD BUT... IT'S ALSO NOT ALL GOOD:

Top-down "new brain" organization and integration is the bedrock of sanity and fundamental survival – and that is wonderful and amazing – thank you.

Bottom-up "old brain" sensory information is the fertile soil of experience and the ever-renewing delight of life – and that is also wonderful and amazing – thank you, again.

I suppose what we have here is the infamous "double edge blade" meaning it can cut both ways (good or bad).

Having a huge library of top-down, time-saving, patterned neurological short cuts is more than a lifesaver – it means we can continue to accumulate more and more efficient and effective ways of navigating life as we gather more and more skills.

All is good as long as the organized patterns are an effective predictor of the flow of experiences – but...let's here quote Charles Darwin – "It is not the strongest or the most intelligent of the species that survives but the one most adaptable to Change".

Preexisting organized, top-down patterns will certainly throughout life encounter experiences that challenge predictions and express as prediction errors – the ability to abandon the patterns and permit the creation of new patterns while being guided by the flow of bottom-up sensory information is crucial.

As discussed above, when the prediction proves correct, it feels good and the brain "likes it" (attraction/pleasure). When the prediction proves incorrect and generates a prediction error, it feels bad and the brain doesn't like it (aversion/pain) – keep in mind that the "proving" of either is generated with the flow of bottom-up information validation.

That seems simple enough as a premise for deciding to abandon a non-functioning pattern – however remember the power of Active Inference that seeks out validating compliance in the flow of bottom-up information – "confirmation bias" is a powerful filter on experience – the adage "Seeing is believing" can be easily flipped into "Believing is seeing" and injecting a sobering realization that much of conscious experience is actually being twisted into a forced confirmation of the "truth" we hold dear...at all costs.

A question comes forward – is it possible to experience prediction errors in such a way that they do not produce an uncomfortable state.

"IT IS NOT THE STRONGEST OR THE MOST INTELLIGENT OF THE SPECIES THAT SURVIVES BUT THE ONE MOST ADAPTABLE TO CHANGE."

Charles Darwin

CAN BEING WRONG FEEL GOOD?

There's got to be more than pain to get you to know that you are wrong – what about pleasure and reward?

If pain is the only messenger, eventually we will block the knowledge that gives us the truth at all costs – the "truth" just hurts too much.

Decreasing the punishment/discomfort of "error" may not be a solid reward, but it definitely results in relief – which is certainly welcome.

So, maybe the motivation to change what's not working can be a blend of decreasing the "discomfort" of error and increasing the pleasurable reward of making a positive change.

In the Predictive Coding and Active Inference models, a fundamental premise is that our brain attempts to minimize prediction errors – the term "prediction error" sounds negative (generally, no one really thinks that an error is a good thing) – however, the term "surprise", in some sense, doesn't sound too bad at all – maybe even good – a "surprise" birthday party can be delightful – winning the lottery (against all statistical odds) is a "surprise" few people would decline.

Basically, "surprise" is an unexpected outcome – it can be experienced as positive, negative, or neutral depending on the context – characterizing a "prediction error" as a "surprise" gives us a lot more latitude when we approach our brain with the process of accepting the necessity of change.

We can stretch the possible polarity of perspectives on "prediction error" and "surprise" even further – "prediction error" can be interpreted more strongly as a "violation" (negative) – "surprise" can be interpreted more strongly as "novelty" (positive).



IF YOU WANT THINGS TO BE DIFFERENT, YOU ARE GOING TO HAVE TO CHANGE:

The scientific fact is that our adult human brain is still capable of change. Fortunately, not just negative degenerative change, but also positive regenerative change.

Our brain can do an amazing number of things but can't do everything at once. When it comes to changing the brain, some **competition** between old functional patterns and new emerging patterns can be expected.

Because neuroplasticity processes are inherently competitive, there will always be winners and losers. Whether it's good news or bad news depends on which team you're rooting for. So, don't expect old habits (even if they're not working anymore and maybe even causing problems) to give up without a fight.

Our human brain begins to decline as early as 30 years old. It can progress slowly or decline abruptly in steps and stages. The consequence may be a self-reinforcing downward spiral of degrading brain functioning. Disuse increases, processing becomes less efficient, neuromodulatory activities weaken while becoming noisy, and negative learning accumulates.

Human brain decline and degeneration is a bit like "physiological gravity." You can rise above it, but it will take a clever use of effort.

The brilliant William James explained over 120 years ago, "Plasticity is when the system is weak enough to yield to influences but strong enough to not yield all at once."

So, yielding to influences is an unavoidable part of the game. Theoretically, yielding to negative influences should inherently feel bad, and yielding to positive influences should feel good. This neat and neat theory becomes much more complicated against the competitive terrain of brain neurology.

Recall the top-down "confirmation bias" described above. Once patterns are imprinted, they will seek to persevere themselves. Bottom-up sensory information will attempt to provide reports of "surprising prediction errors," but the top-down "beliefs" of validity will typically put up a fight to maintain authority. This is one of the main reasons why old habits are so hard to change, even when they are negative and causing distress.

WHAT CAN MAGIC TRICKS AND COMEDY TEACH US ABOUT BRAIN CHANGE?

Top-down organizational patterns excel at anticipating the probable characteristics of future experiences. They even project into the future with "active inference" and actively seek preferred outcomes. In other words, top-down processes are built upon expectations.

When a perception is logged or an activity is performed, there is an expectation of outcome. The perception and action are considered factual and accurate. The expectation of outcome can be so strong or rigid that it can be seen as a rule or law.

If the bottom-up sensory information attempts to prove it wrong, the interpretation from the perspective of the rule/law is seen as a violation. It's not just a violation of the truth, but perhaps even a violation of reality.

Anyone familiar with popular "magic" knows that it is an illusion, not real. Yet, it is astounding nevertheless. Illusory magic tricks are fundamentally based on misdirection. The audience is given a collection of expectations based on assumptions, fortified through apparent perceptions and actions influenced by misdirection.

Then comes the surprise, which is essentially a violation of expectation. It is confounding yet delightful, a prediction error that is entertaining and satisfying.

Comedy may be a form of illusory cognitive magic. The comedian sets up a field of expectation and moves the audience into a setup for the joke. A certain obvious outcome is anticipated, and then comes the punchline, an unexpected twist that is a surprising aspect of the truth.

Humor is often defined as a benign violation of cultural rules and laws. It goes against cultural expectations but does so without causing harm. As humor evolves along with the culture, the challenge becomes determining the relative assignment of harm. The violation may no longer be considered benign but now unacceptably hurtful.

So, what can magic tricks and comedy teach us about brain change? It appears to be closely related to expectation and misdirection. Are we approaching life with true or false expectations? Are we perceiving and acting under the influence of misdirections that set us up for unwelcome punchlines?



A controversial quote, often attributed to Shakespeare, "A tragedy is a comedy misunderstood," points out the role that perception and the anticipated expectation of outcome play in our life experiences and our responses to our own prediction errors. Shakespeare often utilized the dramatic device of "misunderstanding" in his works. Do we operate under the shadow of misunderstandings in our own lives?

Is there a way to proceed towards positive adaptive brain changes that may be closer to the delight of magic and the laughter of humor? Can we somehow reduce the stubborn resistance to positive change? Maybe the internal neurological competition that occurs within the brain when patterns require change can be influenced to make it less of a battle and more of a dance.

"A TRAGEDY IS A COMEDY MISUNDERSTOOD"
Shakespeare

PATTERN RECOGNITION, ANTICIPATION MACHINE, PREDICTION GENERATOR:

These are just some of the names assigned to our brain, but we must be careful because these names and concepts are accurate essentially for the "new brain" and its top-down organizational integration.

In this paper, we have made repeated references to the bottom-up dynamics of the "old brain" which are primarily sensual as compared to the top-down dynamics of the "new brain" which are primarily conceptual.

Here is an analogy - consider our brain to be a rally car with a driver and a navigator - the driver is the top-down new brain and the navigator is the bottom-up old brain - in an odd twist, in this analogy, the driver happens to be blind - because of being blind, the driver must rely on the navigator to know what actions to take.

Going back (above) to the ontology/epistemology dynamic... the blind driver has no way of knowing "what is out there" (ontology) so he relies on the navigator to describe everything for him (epistemology) - the driver has a very good memory and compiles left turns and right turns in an effort to more rapidly respond to the navigator's information - at a certain level of experience, the driver begins to take risks and projects forward into the near future and makes turns based on anticipation and expectation - the driver must now rely even more closely on the navigator's information because of risking possible errors - the navigator must also increase the reporting because he is not just given primary

directions, he is also, as rapidly as possible, giving prediction error feedback - hopefully, the driver is not too stubbornly attached to his predictions... otherwise... smash!



OUR PATTERN COLLECTION :

It is critical that we build up an effective and efficient library of experiences for quick and accurate reference - that's the main task of the top-down new brain.

It is also critical that this library remain open for expansion and revision as we live our lives - this is where our bottom-up old brain plays its role.

To help make it a little more personal... we have discussed above "perceptions" and "actions" quite a lot... now, let's consider these "patterns" as they relate to our "beliefs". "Beliefs" are the domain of the cognitive top-down new brain - it is the merged realm of ideas and perceptions that have a powerful effect on motivated actions.

There is a class of "beliefs" known as "axioms" - an axiom is a statement or proposition which is regarded as being established, accepted, or self-evidently true - another definition could be that an axiom is a self-evident truth that requires no proof.

That is pretty heavy stuff when you have a hard look at ontology and epistemology (what's really happening and how do we know?).



It is easy to understand that if an existing "belief" (aka pattern, prediction) sits in your mind/brain at the level of an "axiom"... it is going to be very tough to modify - any challenge to its validity can result in charges of "mental sacrilege"... perhaps even in punishable heresy.

We all have a hierarchy of belief - that is entirely normal and healthy - in cybernetic/information systems theory, our brain is always "seeking signal in the noise" - it is always attempting to "make sense out of nonsense".

The progressive work of the early psychologist, Jean Piaget, offers a fascinating exploration of how we all, as children, attempt to make sense of the world and its natural phenomena - essentially, we make up stories of why things are the way they appear to be with all sorts of fantastic and creative concepts - one of the major challenges is to explain the "hidden causes" of things... like why do clouds move and where does the Sun go every evening.

It is a charming reflection on childhood innocence, no doubt - with a little honesty, we can all accept that, as adults, we do much of the same - we humans are storytelling animals - it is our way of not going insane amidst the cognitive confusion of so many unexplained experiences.

How many Shakespearean "misunderstandings" are lodged in the "axioms-only" section of our personal brain pattern library? - when it comes to cognitive competition on the battlefield of adaptive change, the "axiom soldiers" will put up one hell of a fight.

**WE HUMANS ARE "FEELING CREATURES THAT THINK,
AND NOT THINKING CREATURES THAT FEEL".**

HOW DO WE SOFTEN UP HARD CORE PATTERNS THAT NEED TO CHANGE?

We humans are social animals - we rely strongly on our cultural context and philosophy - it is reasonable to say that the strong majority of our industrialized countries have a materialistic, scientific, and reductionist view of life. The prevailing outlook is fundamentally rooted in logic and rationalism. Considering the simultaneous prevalence of religious beliefs and practices throughout these same societies, we are indeed curious beings.

Materialism is very well suited for the top-down new brain - in fact, this top-down new brain development is likely the actual physical seed of materialistic modernism.

Modern contemporary society rewards analytical, top-down rationalism but is very, very suspicious, even paranoid, when it comes to intuitive, body-based intuitive knowing.

Whether it is viewed as the visible/invisible, mind/brain, spiritual/scientific, Apollonian/Dionysian, etc., etc. dualistic conflict, our modern society demands "proof" of the need for change before it risks the leap into the unknown.

The hidden "itch" is the residual fundamental mistrust of the body - the body of unrestricted desire, of corrupted appetite, of sinful temptation, of disease and death. How can bottom-up information be trusted when the senses are the ambassadors of the flesh?

Here's where changing a stubborn, axiomatically-resistant brain gets very interesting - physiologically (and probably psychologically), **we humans are "feeling creatures that think, and not thinking creatures that feel".**

So, here is the "punch line" in the existential joke - **"you can't think your way out of the problem, but you can feel your way into the solution".**



UNSTICKING A STUCK BRAIN:

Neurofeedback is a form of biofeedback in which a practitioner assists a client/patient in adjusting their brainwaves to a more positive profile. There is a variety of methodological approaches and interpretations of the application of neurofeedback.

One such method is known as "Multi-Modality Intensive Neurofeedback." In this case, "multi-modality" means that along with the basic neurofeedback device and technique, other devices and/or processes are integrated into the experience.

In neurofeedback, there are times when achieving the desired change in brainwave conditions is difficult. The brain can be "stuck" in certain patterns that resist the desired change or modification in the fundamental neurofeedback method alone. Multi-Modality Intensive Biofeedback can be effective in "unsticking" resistant aspects of brain wave behavior.

The basic approach is to use another device/process to first "un-stick" the stubborn pattern. Then, when the "glue is softened," introduce the desired brain wave pattern. Following the introduction, reinforce the desired brain wave pattern.

Modalities such as PEMF (Pulsed Electro-Magnetic Field), flickering light, and pulsed sound are examples of modalities that can serve the purpose of the process described above. Basically, there are three steps in the process: 1) disconnect, 2) reconnect, 3) reinforce.

The "disconnect" is also known as "destabilize," "dis-habituation," or "de-habituation." By whatever name, the purpose of step #1 is to weaken or "break apart" the stubborn maladaptive brainwave pattern. To achieve this, the "destabilizing" signal will interfere with the pattern. Often, the interference will be achieved using chaotic or even random impulses for a brief period of time.

This "destabilization" will leave the brain seeking a re-ordering of signaling. In a way, it creates an "appetite" for order following the "disorder" created by the destabilizing signals. This "hunger for order" (seeking signal in the noise - cybernetics) is the opportunity to introduce the target or desired set of brainwaves, hence the #2 "reconnect" stage. Once the "reconnect" has taken place, the system is rewarded with reinforcements meant to fortify the now modified brainwave behavior.

The three-step process exemplified in Multi-Modality Intensive Neurofeedback reduces the top-down habituated controls at the core of the stubborn, resistant neural patterns and increases the bottom-up information influences in the adaptive changes in the brain.

DISCONNECT > RECONNECT > REINFORCE

HOW FAST CAN OUR BRAIN CHANGE ? :

Throughout this paper, we refer to "neuroplastic" brain change. So, how fast can a brain actually change? Fundamentally, there are four stages of neuroplastic change, and each has its own timeline.

Functional Neuroplasticity:

- Takes place in "moments" (seconds to minutes to hours).
- Preexisting under-functioning synaptic connections that already exist are aroused into higher levels of efficient function.
- Related physical neuronal pathways already exist.
- Anatomically, each neuron has upwards of 10,000 dendritic synaptic connections.
- Analogy: The routes and roads already exist but have not been used much for a period of time.

Synaptic Neuroplasticity:

- Takes place over days to weeks.
- New and different synaptic pathways are created to accommodate new demands.
- Related physical neuronal pathways already exist.
- Analogy: The roads already exist, but new different routes are created using the same roads.

Neuronal Neuroplasticity:

- Takes place over months.
- New and different physical nerves (neurons) are created to allow the new synaptic connections and patterns.
- Analogy: For the new routes to be created, new roads must be built.

Systemic Neuroplasticity:

- Takes place over years.
- The new physical neurons and their evolving signal connections and pathways are integrated into all of the global systemic metabolic, adaptation, and self-regulatory aspects of the organism as a whole.
- Analogy: The new roads and routes are incorporated into the entire city transport system with adaptations in traffic flow and commuting patterns.



WHAT ABOUT PSYCHEDELICS FOR BRAIN CHANGE?

The topic is moving through many societies in waves of hope and promise. Of course, most people of a certain age will respond to the idea of psychedelics based on either positive personal experiences or controversial stories from 50 years ago.

In relation to the topic of our paper, it is definitely worth looking briefly in this direction. Not so much to explore psychedelic compounds, but instead to inspect what psychedelics and new psychedelic-related research can tell us about our brain and how to help it change when it needs to.

Karl Friston, the genius responsible for 95% of all the brain imaging technology on the planet, along with Robin Carhart-Harris, a brilliant brain researcher specializing in psychedelic effects, discuss an effect they call **R.E.B.U.S.**

REBUS is a rather clumsy acronym for Relaxing Existing Beliefs Using psychedelics. The imaging and evidence-based research clearly demonstrate that the effects of psychedelics "relax" typical boundaries that restrict wider ranges of neural communication in the brain.

Sincere psychological and psychiatric studies are yielding very promising results in the treatment of difficult conditions such as PTSD, Major Depressive Disorder (MDD), and Approaching Death Anxiety while using certain psychedelics in a systematic and controlled manner.

I believe even more importantly that **the psychedelic state is a natural, normal capacity of the human brain**. Psychedelic compounds give quick access to this capacity, but they do not create it. **There is a long list of methods or vehicles** (beyond the scope of this current paper) that **demonstrate unequivocally that this so-called psychedelic state is a natural feature of the human brain**.

From this informed perspective, the acronym REBUS could well be refined as Relaxing Existing Beliefs Using **SOMETHING** and not exclusively psychedelics.

For the average person, we are best to visit this state periodically and for relatively short periods of time. For seasoned individuals with a history of structured practices and development, entering these states (because they are varied and nuanced) for longer periods of time is known to be positive and even beneficial.

Various groups such as matured Tibetan monks, yogic adepts, and certain indigenous shamans exhibit the capacity to "loosen the common constraints" of the top-down new brain. Admittedly, the experiential states are complex and not simply comparable; however, the ability to make potent neurological shifts without the medium of a psychedelic compound is proven.



A LITTLE ABOUT THE ENTROPIC BRAIN AND ANARCHIC BRAIN MODELS:

Without elaboration, the following is information regarding the similar brain models known as Entropic Brain and Anarchic Brain. These models have an interesting relationship to our topic.

As mentioned above, these brain models are products of the research of Robin Carhart-Harris at Imperial College, UK (Entropic Brain) and augmented by Karl Friston (Anarchic Brain).

These brain models are the result of psychedelic research into brain behavior and information dynamics in systems behavior. They provide a unique perspective on brain change activities that have an insightful link to bottom-up information and top-down integration processes.

The name Entropic Brain rests upon the principle of "entropy," hence its name. Here "entropy" is not the original thermodynamic usage or even the statistical usage but instead "informational entropy." In a way, the use of "entropy" in this brain model is more metaphorical than actual. Essentially, here "entropy" relates to increased "disorder" or "uncertainty."

The foundation of the Entropic Brain Model is the premise that the human brain developed in stages. The earlier stages were capable of deriving important ongoing information from the environment through the Primary Consciousness senses. This relates to our "bottom-up" dynamic discussed repeatedly throughout this paper. Anatomically, this "old brain" is basically "subcortical" and generates what Carhart-Harris terms "Primary Consciousness."

The later stages of brain development resulted in the "new brain" that is mostly "neocortical." This aspect acts to organize and integrate information in practical and reliable patterns. This relates to our "top-down" dynamics. Carhart-Harris labels this domain as the generator of "Secondary Consciousness."

According to the Entropic Brain Model, we spend the majority of our time in the organized Secondary Consciousness aspect of our brain. Perhaps we can also call Secondary Consciousness "Common Consciousness." When problems occur that require access to new and novel information, we are capable of shifting into Primary Consciousness, which is often referred to as Uncommon Consciousness or even Non-Ordinary Consciousness.

The experience of Primary/Uncommon Consciousness need not be fully "psychedelic" (although it can be). It can also be simply more "open-minded" and "insightful/intuitive." The division between Primary and Secondary Consciousness is not strictly absolute, like black/white. There is a "gray zone" of relativity that permits degrees of access to one from the other.

The "buffer" between Secondary/Common and Primary/Uncommon is a zone of "criticality." This "shift zone" can be imagined as more dense in some people and more porous in others. The interpretation is that some of us have difficulty in passing into and through the "critical zone" and shifting into the lucid information-rich possibilities offered by Primary Consciousness, while others have a relatively easier ability to slide into the "critical zone."

Essentially, it is much easier to change the brain with access to Primary Consciousness and harder to accept and make changes when you are locked in Secondary Consciousness.

A little more about the Anarchic Brain Model. This model parallels the Entropic Brain Model in most every way. The difference may be more poetic than factual. The word "anarchy" means "no leader" (for example, monarchy means a single leader). Here, the Common/Secondary "top-down" aspect of the brain is considered the normal "leader" of the brain functions. So, when a person shifts towards Uncommon/Primary "bottom-up" dynamics, they are moving away from the "leadership of patterns and predictions" and into an exploration of new possibilities and change.

The "take-away" here is that our human brain is naturally designed to move in and out of integrated organization and exploratory information. Psychedelic compounds do not MAKE the brain act in strange ways. Rather, a psychedelic compound helps open the doors of "rooms in the brain" that are naturally there.

Generally speaking, short passages and returns in and out of Primary/Uncommon Consciousness are not only fruitful in adaptive brain change but are actually a "built-in" biological function that we experience every 24 Circadian Cycle. That subject is next.

IF YOU WANT THINGS TO BE DIFFERENT, YOU ARE GOING TO HAVE TO CHANGE:



OUR NATURAL CIRCADIAN CYCLE & HYPNAGOGIA:

The neurological "glue" that helps hold together our brain patterns and habits naturally "softens" a few times every day and night. Our human Circadian Cycle is a biological "pace maker" that guides us through metabolic regulation every 24-hour spin of the Earth.

We have four basic Circadian states:

1. Waking,
2. Sleeping,
3. Sleeping Dreams,
4. Waking Dreams.

Each state provides significant biological benefits. The disturbance or diminishment of any one of the four results in metabolic disequilibrium and dysfunction.

"It turns out that for every two hours a person is awake and interacting with the world, the brain on average needs to go 'offline' for an hour—disconnected from the outside world—to process and contextualize those experiences." (8)

Sleeping Dreams have always presented controversial interpretations ranging from the irrelevant to the profound.

"We argue that dreaming allows the sleeping brain to enter an altered state of consciousness in which it can construct imagined narratives and respond emotionally to them. While dreaming, the brain identifies associations between recently formed memories (typically from the preceding day) and older, often only weakly related memories, and monitors whether the narrative it constructs from these memories induces an emotional response in the brain. If an emotional feeling is detected, the brain tags the association as potentially valuable, strengthening the link between the two memories and making the association available during subsequent wakefulness." (8)

"The neurochemical modulation of the brain is altered during sleep, and especially during rapid eye movement (REM) sleep, when the release of norepinephrine and serotonin in the brain is shut off while levels of acetylcholine reach their peak in regions such as the hippocampus. These shifts bias memory networks toward the activation of normally weak associations, perhaps explaining the bizarreness of many dreams, especially during REM sleep." (8)

"Unlike problem-solving during wakefulness that relies on imagining and planning, dreaming stops short of offering definitive solutions to our current concerns.

THERE IS WAY OF KNOWING WITHOUT THINKING.

Instead, our dreams serve to explore the solution space, helping us to discover new possibilities." (8)

Even less understood and more mysterious is the category of "Waking Dreams" – "Waking Dreams" is a novel term for what is usually collectively referred to as "hypnagogia," "para-hypnagogia," and "hypnopompia."

In our Circadian Cycle, "Waking Dreams" are conventionally designated at the transition from Waking to Sleep (hypnagogia) and Sleep to Waking (hypnopompia). These terms are derived from the Greek and mean exactly as just described. "Para-hypnagogia" refers to the occurrence of these "Waking Dreams" during periods of Waking.

Waking Dreams predictably involve a combination of lower alpha brain waves and higher theta brainwaves. The low alpha relates to a calm relaxed but aware state, and the higher theta relates to a dreamy creative internalized state. The combination is a unique neurological state that relaxes rigid top-down neocortical organization.

All aspects of "Waking Dreams" can be optimized with awareness and intention. The first step is to recognize that this type of state exists, is normal, and cyclical within the basic 24 "earth day." The imagery and information that presents itself are typically fleeting and require effortless attention to recognize.

Waking Dream experiencing can be visual, auditory, and/or informational (ideas and concepts). Unlike Sleeping Dreams, which are more immersive and emotional, Waking Dreams tend to be more emotionally neutral and observant.

There are many well-known examples of famous scientists and artists using the Waking Dream state as a source of information and inspiration.

In the same way, certain people and traditions give value to the effort of exploring more deeply Sleeping Dreams as "Lucid Dreams." The ability to increase the clarity and awareness of the Waking Dream state that results in "Lucid Waking Dreams" is possible.

The experiences of Waking Dreams promote opportunities to rest in states that permit increased access to neuroplastic adaptive brain change dynamics.



SOFTEN THE GLUE OF PATTERNS THAT NEED TO CHANGE:

Perhaps by now, you may be seeing where this is going. Basically, get out of your "thinking" head and into your "feeling" body. It could be one way of saying it. We are not saying to cut off your head, just let it reunite with all the rest of you. Let **ideas** step aside for a while to let **sensations** move onto the dance floor in your mind.

You can't think your way out of the problem, but you can feel your way into the solution. There is a way of knowing without thinking.

Let's see if action and perception can be swirled together with the flow of bottom-up sensory information in a more open and regular fashion.

Of all the senses, our human vision and hearing dominate our information flow. Over 50% of the cortex is devoted just to vision. Together, they form the First Language. At the most primitive level, organisms relate and communicate via mechanical vibration (sound) and electromagnetic radiation (light) - vibration and radiation.

The conjoined experience of sensory vibration and radiation (sound and light) is saturated with meaningful information. The perception that is normally external can be turned to the internal with the result of neuroception or interoception as the medium of conscious experience.

And once you get back into the "feeling" states of First Language, perhaps let the neuroceptive/interoceptive "feelings" bubble up into the Second Language of somatic movement. Let the "feelings" transform into dance. Dance like no one is watching. Move the energy and let it all start to soften the glue of the habits in your head.

SOFTEN THE GLUE OF PATTERNS THAT NEED TO CHANGE:

At one level, these actions are all about the sourcing, sharing, integration and application of "information" - the concept of information can be very abstract and hard to capture at a practical level - the brilliant Gregory Bateson made clear for me in a couple of short sentences.

Information is news of change.

Information is a difference that makes a difference.

If our brain is to change, it needs information to guide the change - this information is implicit in experiences that involve various aspects of dynamic change - or, the reverse, if there is no change, there is no information

INFORMATION IS A DIFFERENCE THAT MAKES A DIFFERENCE.

SOFTEN THE GLUE OF PATTERNS THAT NEED TO CHANGE:

Top-down mechanisms are those initiated via mental processing at the level of the cerebral cortex. In the case of clinical hypnosis, imagery, or meditation, for example, we are primarily referring to conscious and intentional mental activities, although unconscious neural processes are also thought to be involved. In contrast, bottom-up mechanisms are initiated by stimulation of various somato-, viscer-, and chemo-sensory receptors that influence central neural processing and mental activities via ascending pathways from the periphery to the brainstem and cerebral cortex. (10)

However, these two dynamics are not entirely separate in our body but are, in fact, integrated and interwoven on many levels.

The examples below indicate the predominant dynamic in the approach (top-down or bottom-up) with the knowledge that neurological processes at this level are extraordinarily complex and still subject to ongoing discovery.



SOME TOP-DOWN PROCESSES:

A top-down process has the effect of reinforcing patterned organization in the brain – as we have seen throughout this paper, such organization permits prediction with anticipated outcomes.

The following is a short list of popular processes that utilize top-down neurological processing – these processes all have potentially positive benefits while also being limited in their outcomes – it is important to align expectations and claims against the factual capacities of these processes.

- **Brain Entrainment** is a top-down neurological technique. Conventional Brain Entrainment processes are fundamentally based on the Frequency Following Response (FFR) which was first observed almost 90 years ago in the 1930s – the FFR lay dormant until the 1960s when it was revived and renamed Brain Entrainment. The principle is straightforward...apply a regular and unchanging signal to the brain for an extended period of time (average 6 to 8 minutes) – in the first stage, the signal is superimposed on the brain (stop the signal and brain stops following) and then after the initial period, the brain will maintain the frequency for a short period without the impulse of the signal. As is obvious, with no change in the signal, there is no information generated to enable change – the repetitive signal is an organizational reinforcement.

- **Guided Imagery** is a top-down neurological technique. Guided Imagery (also known as Mental Imagery and/or Visualization) is a form of cognitive manipulation – neurologically, Mental Imagery shares some activity with normal visual perception; however, the prominent difference between normal external visual perception and Mental Imagery is that Mental Imagery relies purely on top-down processing without any bottom-up processing.

- **Dual-Voice** (or Cross-talk) is a top-down neurological process. The principle purpose of Dual-Voice is to psychologically manipulate the potential reactivity or resistance to a command or suggestion – the second voice is processed at a liminal level that blends subliminal and conscious recognition and processing – if a command/suggestion poses a probable challenge at some level of integrity, ethics, morals, or personal safety, the second or "dual-voice" will deliver a counteracting message to decrease potential resistance to the main message.

In cartoon versions, this dynamic is often portrayed comically as an angel on one shoulder and a devil on the other – they whisper comments into your ear – in other cultural expressions, it is referred to as "the little voice inside your head" – Dual-voice (or Cross-talk) as a method attempts to externalize the "little voice in your head" and does its best to offer angelic and not devilish suggestions.

- **Mindfulness Meditation** is a top-down neurological process for early or short-term practitioners. In top-down meditation practice, we are constantly attempting to approximate what we think we are supposed to be doing and what we think is supposed to be coming out of it. In short, we are bringing the managerial function of the left brain to our practice, to control and manage our meditation in a top-down way. (9) Mindfulness Meditation is one of the most popular current meditation styles – technically, in the field of applied neurology, it is considered an "emotional regulation" process – short-term practitioners typically utilize various forms or interpretations of focus attention in their practice – such conscious manipulation recruits top-down neocortical mechanisms. In neuroscience, one way to talk about this is as a "top-down" process—the process of meditation is carried out under the watchful and judgmental eye of the executive function of the cerebral cortex – in top-down meditation practice, we are constantly attempting to approximate what we think we are supposed to be doing and what we think is supposed to be coming out of it – in short, we are bringing the managerial function of the left brain to our practice, to control and manage our meditation in a top-down way. (9) (Note: long-term Mindfulness Meditation practitioners appear to shift their approaches in such a way that a more free and permissive bottom-up neurological process is used.)

- **Hypnosis** is a unique form of top-down regulation in which verbal suggestions are capable of eliciting pronounced changes in a multitude of psychological phenomena. Hypnotic suggestion has been widely used both as a technique for studying basic science questions regarding human consciousness but also as a method for targeting a range of symptoms within a therapeutic context. (11)



Top-down regulation refers to the process whereby mental representations cascade downstream to override physiology, perception, and behavior. Although persistent reductionism in psychology and neuroscience traditionally led researchers to favor bottom-up explanations in which psychological phenomena are based on low-level neurobiological mechanisms, there is now widespread recognition that mental representations, such as expectations, regularly impact perception. (11)

- **Autogenic Training** is a top-down neurological technique.

It was developed in the 1920s from the systematic observation of hypnotized patients by neurologist H. Schultz, but in contrast to hypnosis, it is based exclusively on autosuggestion.

In the early stages, physical processes are influenced by basic exercises - weight, warmth, breathing, abdominal, heart, and forehead exercises are used - after concentrating on the feelings generated by these exercises for some time, the patient actually senses them, and the body reacts - the more advanced levels of autogenic training are based on the use of imaginative techniques (see above Guided Imagery). (12)

- **Deep Breathing** is a top-down neurological technique.

It is also known as diaphragmatic breathing, is a technique that is based on the notion that mind and body integration produce relaxation. The technique requires participants to contract the diaphragm, slowly inhaling and exhaling. Deep breathing appears to amplify blood oxygen levels, massages the inner organs located in or close to the abdomen, and possibly stimulates the vagus nerve. (13)

- **Psychotherapy** is a top-down neurological technique.

A top-down approach in psychotherapy starts with looking at how the mind is interpreting information - the therapeutic interventions are all about changing your thoughts. If you think "right", you'll be able to make healthier choices, and everything will be okay - a top-down approach may involve the use of Cognitive Behavioral Therapy (CBT) - as the Mayo Clinic defines it, "CBT helps you become aware of inaccurate or negative thinking so you can view challenging situations more clearly and respond to them in a more effective way." (14)

- **Cognitive Behavioral Therapy (CBT)** is a top-down neurological technique.

CBT is a talking therapy that can help you manage your problems by changing the way you think and behave - CBT is a classic example of a "top-down" mode of therapy, working with cognition and the "thinking brain" to create change - top-down approaches generally involve the body and the nervous system very minimally, if at all.

SOME TOP-DOWN PROCESSES:

Therapies using bottom-up pathways have also been shown to positively influence autonomic (e.g., vagal) tone - bottom-up treatment interventions are believed by a growing number of complex trauma practitioners to regulate and adjust the visceral responses associated with complex trauma - this happens by resetting trauma-related emotional and sensory states stored within the limbic system and peripheral nervous system. (15)

Neuroscience research findings based on advanced technology such as functional magnetic resonance imaging (fMRI) suggest that the limbic system can be consciously accessed through **interoceptive awareness** - interoceptive awareness is a person's awareness and perception of the internal experience. It allows humans to integrate body sensations, thoughts and feelings. (15)

- **Multi-Sensory Enrichment** is a bottom-up neurological process.

Sensory Enrichment is a sub-set of Environmental Enrichment which is the stimulation of the brain by its sensory input - there are 3 components to general environmental enrichment: Sensory enrichment, Activity enrichment and Social enrichment.

- **Brain Engagement** is a bottom-up neurological process.

Brain Engagement is a new and novel term that describes a form of bottom-up brain signaling that utilizes light and sound stimulation to trigger positive neuroplastic changes in the brain. Unlike conventional Brain Entrainment (based on the classic Frequency Following Response) which produces a sustained and unchanging signal, Brain Engagement uses a series of compositional sets of brain signals that have various degrees of dynamic "delta" (aka "change") factors that initiate and direct the brain into progressive responses.

Based on advancing neuroplastic methodology, Brain Engagement recruits active attentional states combined with relative degrees of "marginal demand" and produces a type of attractive sensory-based "brain exercise".



- **Brain Priming** is a bottom-up neurological process.

Priming is defined as a change in behavior based on previous stimuli - priming, which may occur even after a single learning episode, is a type of implicit learning - the general theory underlying priming is that the brain, which has been primed by a prior method of activation, is generally more responsive to the accompanying training. (16)

Priming stimuli can be from the same modality as the accompanying task (modal-specific) or from a different modality (cross-modal) (16) - this means the priming stimulation can be directly associated with the secondary action (modal-specific) or can be indirectly associated (cross-modal).

For example, rehearsing a basketball free throw with mimicking movements would be modal-specific because the motor priming is directly related to the actual mechanical movements of shooting the basketball - on the other hand, using memorized semantic phrasing or coaching associated with relaxation and confidence would be a cross-modal priming because it has no direct influence on the motor commands required to shot the basketball but instead created a more relaxed neurological state.

Forward associative priming (aka "cross-modal") ..implicit learning...neural priming in PFC (prefrontal cortex) may reflect the benefits of reduced uncertainty that emerge when learning from the past provides greater 'bottom-up' predictive information.

There are number of types of Brain Priming: 1) Stimulation-based motor priming, 2) Motor Imagery & Action Observation; 3) Movement-based priming, 4) Pharmacology-based priming (consider "Microdosing" as a likely priming method in this context), 5) Semantic priming, 6) Sensory priming.

Uniquely designed light & sound stimulation can act effectively as a form of Sensory Priming.

The concept of "microdosing" of a psychedelic compound may be considered a unique form of "pharmacological brain priming" - the microdosing approach proposes to gently "soften the glue" of habitual neurological structures and permit the slow but effective modification of patterned responses.

The concept of "microdosing" may also extend into an interesting combination of "sensory brain priming" and "pharmacological brain priming" by the application of specially designed light and sound experiences that move the brain towards the "zone of criticality" that separates Secondary Consciousness from Primary Consciousness.

- **EMDR (Eye Movement Desensitization & Reprocessing**

is a bottom-up neurological process. Picture your brain as a staircase - each step is a stage of physical brain development which starts in the womb and ends, on a physical level, around age 25 - each stair step going up is an advanced stage of development. (17)

1st Stair: The brainstem (the "reptilian" brain) is the oldest part of your brain. It's responsible for most of your automatic functions, such as your heart rate, body temperature, and blood pressure. In addition, your brainstem coordinates movement, controls arousal, and processes sensory information. Imagine a toddler sitting on the 1st step: This is your brainstem. (17)

2nd Stair: The limbic system (the "emotional brain") is known for its link to emotional experiences and regulation. It's also responsible for motivation and storing explicit memories. Imagine an emotional teenager who's desperately trying to figure it all out standing on the 2nd stair: This your limbic system. (17)

3rd Stair: The cortex is the youngest part of your brain and often perceived as the smartest - it's responsible for attention, perception, awareness, thought, memory, language, judgment, and consciousness. Imagine a 40-year-old adult who's great at "adulting" standing on the 3rd stair: this is your cortex. (17)

Bottom-up approaches seek to access and heal trauma on the lower stair steps, where it lives and thrives. Simply put, walking up the brain's stairs instead of down allows you to address the impacts of trauma at their source.

EMDR is a psychotherapy technique designed to relieve the distress associated with disturbing memories - short for Eye Movement Desensitization and Reprocessing, it involves recalling a specific troublesome experience while following a side-to-side visual stimulus delivered by the therapist - the resulting lateral eye movements are thought to help reduce the emotional charge of the memory so that the experience can be safely discussed, digested, and stripped of the power to trigger anxiety and avoidance. (17)



- **Psychedelics** are a bottom-up neurological process.

According to the entropic brain hypothesis, psychedelics increase brain entropy and therefore result in more diversity and vividness in subjective awareness. The REBUS theory proposes a specific role of increased entropy and decreased “top-down” control of the default mode network (DMN) as central to psychedelic drug effects on the contents of consciousness, such as perceptual alterations. REBUS is slightly more precise than the entropic brain hypothesis insofar as it specifies the primary locus of entropy that is impacted by psychedelics, which is in the “precision weighting of prior beliefs encoded in the spontaneous activity of neuronal hierarchies,” primarily in the DMN. REBUS proposes that a relaxation of top-down priors allows bottom-up information to exert more influence in brain function, learning, and perception. (19)

- **Somatic Therapy** is a bottom-up neurological process.

It shares numerous elements of the EMDR rationale – Somatic therapy is a form of body-centered therapy that looks at the connection of mind and body and uses both psychotherapy and physical therapies for holistic healing. In addition to talk therapy, somatic therapy practitioners use mind-body exercises and other physical techniques to help release the pent-up tension that negatively affects a patient’s physical and emotional well-being. (18)

Practitioners of somatic therapy address what they see as a split between the body – instead, they believe mind and body are intimately connected, though not always in apparent ways –thought, emotions, and sensations are all believed to be interconnected and influence one another. (18)

If talk therapy has reached its limits for a patient, somatic therapy holds that the body is a largely untapped resource for psychotherapy – these resources include what can be learned from one’s gestures, posture, facial expressions, eye gaze, and movement. (18)

Somatic therapies of different kinds have been practiced for centuries.

- **Bodywork & Massage** Various types of bodywork and massage have been found to increase vagal activity and HRV – Delaney and colleagues reported increased HRV following myofascial trigger point therapy in a healthy sample of men and women – similarly, two recent studies reported increased HRV in healthy men following treatment with needle acupuncture. (10)

CONCLUSION

Ironically, our adult human brain is capable of change while at the same time does its best to build patterns that resist change.

There are two types of “brain change: a) State Change, b) Trait Change.

- State Change is of the “easy come, easy go” category – for a State Change, the inducing stimulus must be active – these states are far more transitory and can be relieving if positive and discomforting if negative.
- Trait Change is built over time and can be thought of as a neurological “habit” – traits tend to persist – the original inducing stimulus does not need to be present.

Any neuroplastic change in the brain will be met with “competition” – our brain will attempt to maintain existing patterns and yield to new information only if repeated and reinforced – “old habits die hard”.

Not only is our brain capable of neuroplastic change, it is also capable of an impressive general temporary, dynamic processing shift – the Primary Consciousness and Secondary Conscious (see Entropic Brain Model above) show that information rich “Non-Ordinary States” are a natural capacity of the brain – such Non-Ordinary States are capable of “softening the glue” or “relaxing beliefs” and as such make positive change easier – just because this state is uncommon does not make it abnormal.

So, the conclusion here is that when changing the brain, using bottom-up sensory information stimulation to direct the brain towards desired change will have an impressive outcome. In anticipation of the competitive resistance expected from top-down pattern preservation, various methods that “relax” existing beliefs, habits and patterns will likely increase the willingness of the brain to surrender old under-performing patterns and create new effective neuroplastic changes.



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