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Mental Organs and the Origins of Mind

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Future Minds

When I teach evolution, I ask my students to write anonymous essays addressing the following questions: "What kinds of human mental properties might be favored by natural selection in the future? What kinds of minds might humans evolve in the future?" While it is not clear if evolution will move us toward Spock from Star Trek or toward Clevon from Idiocracy, their answers to these questions mostly represent their views of what a better and bright human future with an improved mind might look like. Here is a sample of their answers:

> "I see us becoming more intelligent."
>
> "I think natural selection will continue to push the human mind deeper into the realms of abstract thought and reasoning"
>
> "I believe that the minds in the future are going to be very complex and quick."
>
> "[the mind] still gets tired and worn out though, so hopefully our future minds can evolve to spend more time doing hard work and thought."
>
> "In the future, I think humans will need minds for multitasking. That property of our minds will expand as humans become busier and live in a more technology-driven world… Unfortunately, I also think that the artistic parts of our minds will shrink because artistic talents have been less valued and less nurtured in society recently."
>
> "The brain will become more specialized to comprehend higher levels of intelligence, such as advanced math or science understanding. This may be due to rewiring of the brain to re-engineer parts of the brain that may not be of much use anymore, which had developed millennia ago for use of basic survival… humans may artificially invoke this by our own means through advanced science. This may possibly happen with the aid of computers to make advanced levels of reasoning for specific purposes."

The speculations of my students (deeper into abstract thought and reasoning, spend more time doing hard work and thought, multitasking, quick, busier) do not strike me as attractive visions of the future. None of my students envisioned our future minds as more joyful, humorous, compassionate, kind, relaxed, or wise.

My own studies of the human mind have led me to see intelligence in the form of logic, reason, and language, as only one of many ways of knowing that evolution has endowed us with. Modern culture, science, and technology constrain us, such that we have lost touch with, forgotten, and no longer value these other ways of knowing.

Mental Organs

> There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.
> Mark Twain – *Life on the Mississippi*

The human heart, mind, spirit, and soul emerged through the same process that created all of life: evolution by natural selection. In order to understand how the mind evolved, we must understand how it is structured, and how its structure is tied to genes. Here, I propose that "mental organs" (defined as the population of neurons that bear a specific receptor on their surface, such as serotonin-7, histamine-1, alpha-2C) provide the structure and genetic mechanisms that allow evolution to sculpt the *mind*. It should be noted that mental organs currently hold the status of a hypothesis that I am proposing. Their existence remains to be confirmed by rigorous experimental methods. This new hypothesis about a fundamental organizational principle of the mind emerges from my studies of the effects in humans, of drugs that selectively activate neurotransmitter receptors.

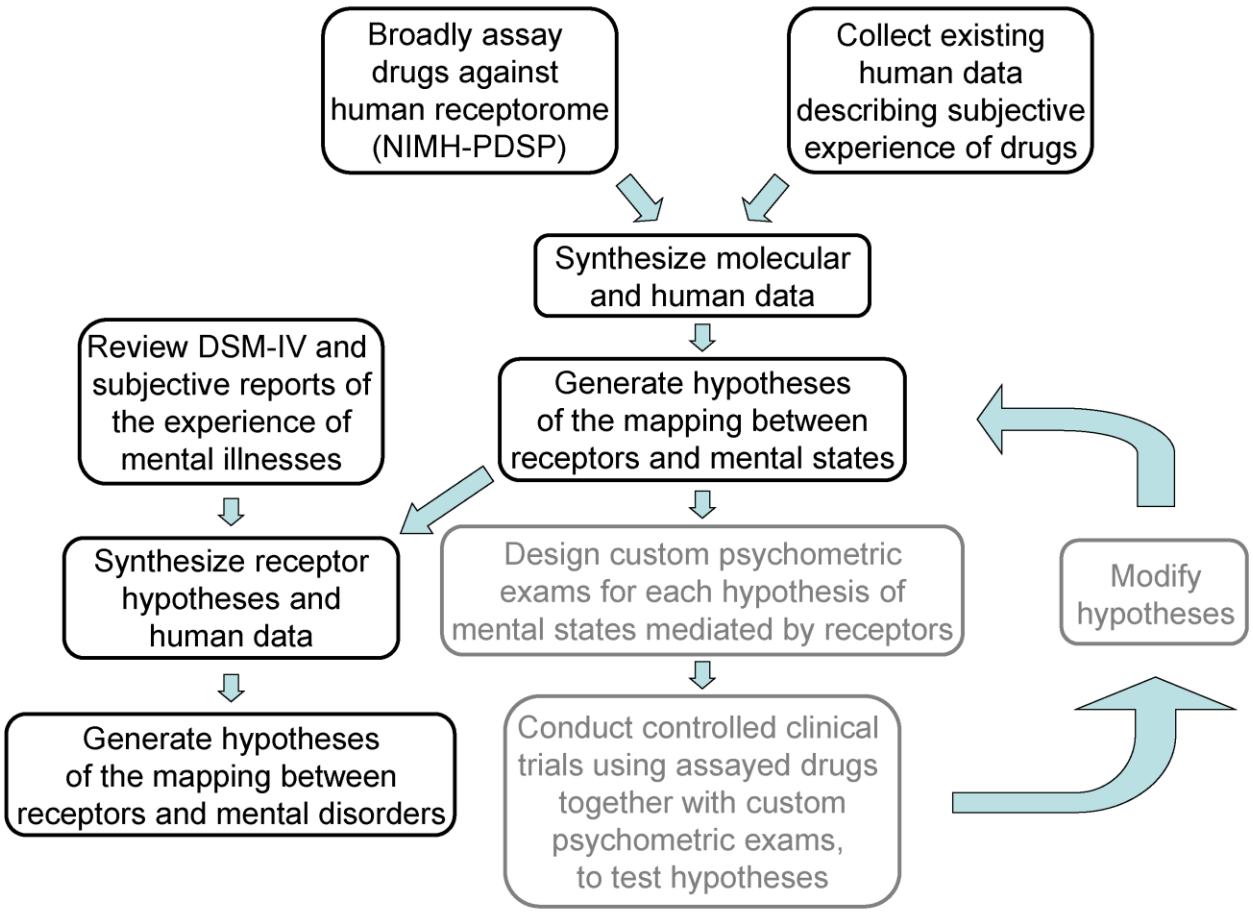

Figure 1: The overall flow of the research method for discovering, characterizing, and utilizing human mental organs. NIMH-PDSP refers to the National Institute of Mental Health – Psychoactive Drug Screening Program. The three steps in gray in the lower right have not been attempted yet. These three steps are needed to test and refine the hypotheses of the mapping between receptors and mental states.

The diverse set of psychoactive drugs collectively represents a rich set of tools for probing the chemical architecture of the human mind. These tools can be used to explore components of the psyche whose discreteness is normally obscured by their being embedded in the complete tapestry of the mind. By activating specific components of the mind, they are made to stand out against the background of the remainder of the psyche. Thus both their discreteness and their specific contribution to the psychic whole can be better appreciated. That the revealed mental elements can be pharmaceutically manipulated suggests that they may be naturally modulated through chemical systems. These receptor mediated mental components are the distinct elements from which the mind has been fashioned through evolution.

In this nontechnical chapter I will present my findings on the nature of mental organs and the implications of their existence, without doing the heavy lifting of providing the supporting evidence. That technical work will be published elsewhere. Although I will name a dozen receptors, you do not need to know anything about them to follow my arguments. If you have some knowledge of psychopharmacology, then I must ask you to set that knowledge aside, to

avoid confusion. The view of psychopharmacology that I present here is new and is not consistent with current paradigms (set aside what you may have heard about serotonin-2 and dopamine).

> It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so. – Mark Twain

I ask the reader to suspend disbelief and allow me to present a new view of the mind that has tremendous coherence and explanatory and predictive power. The human mind is populated by mental organs, which play diverse roles within the mind. Some mental organs provide consciousness (in separate adult and childhood forms); others function as gatekeepers to consciousness (in long and short time scales); others give salience, meaning or significance to the contents of consciousness, while others provide content to consciousness. Some mental organs support the facilities of language, logic and reason, which appear to have arisen in the last hundred thousand years in humans. I will refer to language, logic and reason simply as cognition. The facilities of cognition appear to be fully developed only in adult humans. The children we develop from and the animals we evolved from lack those facilities, and yet have fully functional minds and are capable of making their way in the world. Other mental organs provide affective ways of knowing the world, through feeling alone, which provide the complete archaic mind in our developmental and evolutionary antecedents. Most mental organs have not yet been characterized.

Some definitions from Encarta Dictionary:

heart
3. basis of emotional life: the source and center of emotional life, where the deepest and sincerest feelings are located and a person is most vulnerable to pain

mind
1. seat of thought and memory: the center of consciousness that generates thoughts, feelings, ideas, and perceptions, and stores knowledge and memories

spirit
1. life force of person: the vital force that characterizes a human being as being alive
2. will: will or sense of self
3. enthusiasm: enthusiasm and energy
4. disposition: somebody's personality or temperament

soul
1. nonphysical aspect of person: the complex of human attributes that manifests as consciousness, thought, feeling, and will, regarded as distinct from the physical body
2. feelings: a person's emotional and moral nature, where the most private thoughts and feelings are hidden

Additional definitions from http://www.merriam-webster.com/dictionary/:

cognitive
1 **:** of, relating to, being, or involving conscious intellectual activity (as thinking, reasoning, or remembering) <*cognitive* impairment>

affective
1 **:** relating to, arising from, or influencing feelings or emotions **:** emotional <cognitive and *affective* symptoms>

I propose the following list of hypotheses concerning the mental functions mediated by different receptors:

- Serotonin-7: adult consciousness and creativity, holds both cognitive (language, logic, reason) and affective (feeling, emotion) content. What we are aware of: the present scene, fantasy, imagination, idea, theory, memory. The spark of creativity. Rather than creating a central theater of consciousness, may bestow the property of consciousness on other mental organs. When strengthened, can create a sense of sumptuousness, sparkle, grandeur, majesty, transcendence, something greater, cosmic, divine, god. As consciousness is strengthened, the contents of consciousness are rendered at higher resolution, become more tangible, and begin to be perceived as if through the five senses. At a critical point, we pass through a mental event horizon, as the contents of consciousness become more salient than actual reality. We mentally exit the actual space and time and enter a space and time created by the mind, within which the mind can create an alternate reality. At this point a mental big bang may occur. Consciousness is a generative system, capable of creating worlds, universes. This creative property may be the basis of free will.

- Kappa: childhood consciousness and creativity, holds only affective content. Pretty much everything said of serotonin-7 applies here, except that kappa is a purely affective system, so the contents of consciousness have a very different quality. Kappa consciousness creates a complex, subtle, and richly detailed representation of the world constructed exclusively from feelings.

- Serotonin-1: pure cognition: logic, reason, concepts, thought, language. Produces no feeling, can only be detected by engaging in cognitive tasks.

- Serotonin-2: dynamic filtering, inhibition, protection. Provides dynamic moment-to-moment selective filtering of access to consciousness, may focus attention. Activation of serotonin-2 closes the gates to consciousness, while relaxation or inhibition of serotonin-2 opens the gates to consciousness. May be involved in integration.

- Cannabinoid-1: long-term filtering, inhibition, protection. The cannabinoid system probably coordinates with serotonin-2, to do on a long time frame, what serotonin-2 does dynamically. The cannabinoid system may operate through long-term potentiation of the filtering function of the serotonin-2 system. A mental immune system, one of whose functions is to provide selective long-term protection against the recurrence of intense mental states, whatever their etiology (spontaneous or drug induced), by selectively blocking access to consciousness. Another function of the mental immune system is to produce an evenly proportioned set of

mental organs at maturity, by attenuating access to consciousness of over-expressed mental organs. As we mature, the cannabinoid system gradually, progressively, and permanently (at least for years) blocks access to consciousness of many systems, particularly the affective mental organs.

- Sigma: our heart and soul, the core of our being, the core sense of self. Apparently a purely affective domain. The seat of the basic emotions (anger/rage, fear, happiness, sadness, surprise, and disgust). The seat of biographical affective memory. Very sensitive to pleasure and pain. Needs the protection of the serotonin-2 and cannabinoid systems. A strong sense of self. Completely genuine, sees the affectations, façades, and masks that people wear, while putting on none of its own. Manifests innocence, honesty, integrity, and is uncorrupted but also is uncivilized, selfish, hedonistic, and emotional. Intimately connected to the body. May be capable of causing psychosomatic problems such as chronic pain.

- Mu: sense of comfort, security, protection; dissipation of pain, hunger, tension, anxiety, frustration, fear, anger, and aggression. A primary role may be the pacification of the fetus and early infant.

- Beta: a sense of home, family, community, society, humanity, and human nature that shows as wisdom and may provide a moral compass in human affairs; the sense of happiness, joy, elegance, luxury; the feeling of a fine brandy; the feeling of the season when all the fruits ripen; the feeling of the bustle in the street; the feeling of the smoke from the chimney when dinner is cooking; the joy of cooking. The sense of aesthetics.

- Imidazoline: compassion, forgiveness (of others or of one's self; not the concept or gesture of forgiveness, but true letting go in one's heart of anger, grudge, guilt, or shame), healing (letting go of psychological burdens may heal psychosomatic illness), open-hearted tenderness, altruism, empathy, platonic love.

- Alpha-1: the sense of place, scene, context. The sense of the unfolding, coherence, continuity, liveliness, and vitality of a scene. The sense that the scene and the entities that populate it extend in space and time, beyond what we directly perceive (it continues behind walls, around corners, and tomorrow). Likely fundamental to the emergence of our sense of reality.

- Alpha-2: the sense of the essence or soul of *things* (material objects). Rasa (Sanskrit): "Capturing the very essence, the very spirit of something, in order to evoke a specific mood or emotion in the viewer's brain" (Ramachandran 2007a). Activation of alpha-2 may provoke recall of (predominantly childhood) memories stored in alpha-2 format. The sense of aesthetics.

- Histamine: affective theory of mind (ToM), constructs a persistent representation of the affective domain (heart and soul) of close relations, such as close family members (but also works for nonfamily). ToM is not exclusively constructed on the fly. For each person, we build a model of his or her affective domain, which is stored and refined with each interaction. For close relations, it accumulates a complete detailed model, or representation,

of their affective domain. We hold their heart and soul within ours, even after they have died. The more we interact with them, the more completely we hold them. Extraordinary sexual sensibility. The sense of aesthetics.

- Dopamine: salience, meaning, significance, insight, integration, deep emotions, and moods (both positive and negative); awe, certainty, religious sentiment; the sense of aesthetics. Establishes the significance of mentation and in this way may modulate the influence of mentation on behavior. Able to associate feeling with thought, making us passionate about ideas.

Each mental organ mediates a domain of human experience with great depth and breadth. I have described each one with a few words, which fall within the domain, but which do not begin to convey the richness, depth or breadth of the mental domain mediated by each organ.

Mental organs are a fundamental organizational property of the human brain and the mind that emerges from it. When we think of brain anatomy, we think of structures like the frontal lobes, cerebral cortex, cerebellum, thalamus, limbic system, pons, and Broca's area. Mental organs are another form of brain anatomy that is less visible to the naked eye but which underlies a no less fundamental relationship to the organization of the mind.

Individual mental organs are real physical entities, just like hearts and lungs, but they have distinctive topological properties because they are composed of populations of neurons woven into networks. The population of cells that make up a mental organ would probably be compatible with definitions of "tissue" based on patterns of gene expression, in that they express the gene for the corresponding receptor. All mental organs identified so far are associated with receptors in a single gene family, the G-protein coupled receptors (GPCR).

Mental organs do not necessarily have the physical cohesiveness that we associate with conventional organs, such as the liver or kidneys. It is theoretically possible for one neuron to be a component of more than one mental organ or for a mental organ to consist of a dispersed population of neurons, none of which makes any contact with the other neurons of the organ.

On the other hand, the population of neurons composing a mental organ could have all their cell bodies clustered together as is found in the raphe nuclei, a cluster of neurons that release serotonin. However, mental organs are not defined by what neurotransmitter they release, but rather by what kind of neurotransmitter receptor they bear on their surface. We can imagine a different mental organ associated with each of the hundreds of different kinds of modulatory receptors (GPCR). The mental organs associated with different receptors may be anatomically separated or interwoven.

Consciousness

Theater and Gates – Collectively, the mental organs form the apparatus of consciousness. Consciousness renders that which we are aware of. It is a kind of mental space where a representation is created. This might be a representation of the present scene, or it might be a body sensation, a fantasy, a memory, a vision of the future, a feeling, an idea, etc.

Consciousness is a complex phenomenon, and the participating mental organs play a variety of roles. Bernard Baars describes consciousness as a theater, with a stage of working memory, a spotlight of attention, context operators (director, spotlight controller, local contexts), players (outer senses, inner senses, ideas), and an unconscious audience (memory systems, motivational systems, interpreting conscious contents, automatisms) (Baars 2001).

Serotonin-7 (or kappa) may provide the stage upon which other mental organs can perform. Serotonin-2 and cannabinoid can be seen as the director. Dopamine can be a spotlight controller. The ways of knowing (serotonin-1, histamine, beta, alpha-1, alpha-2) can be the players. Sigma can be a part of the unconscious audience.

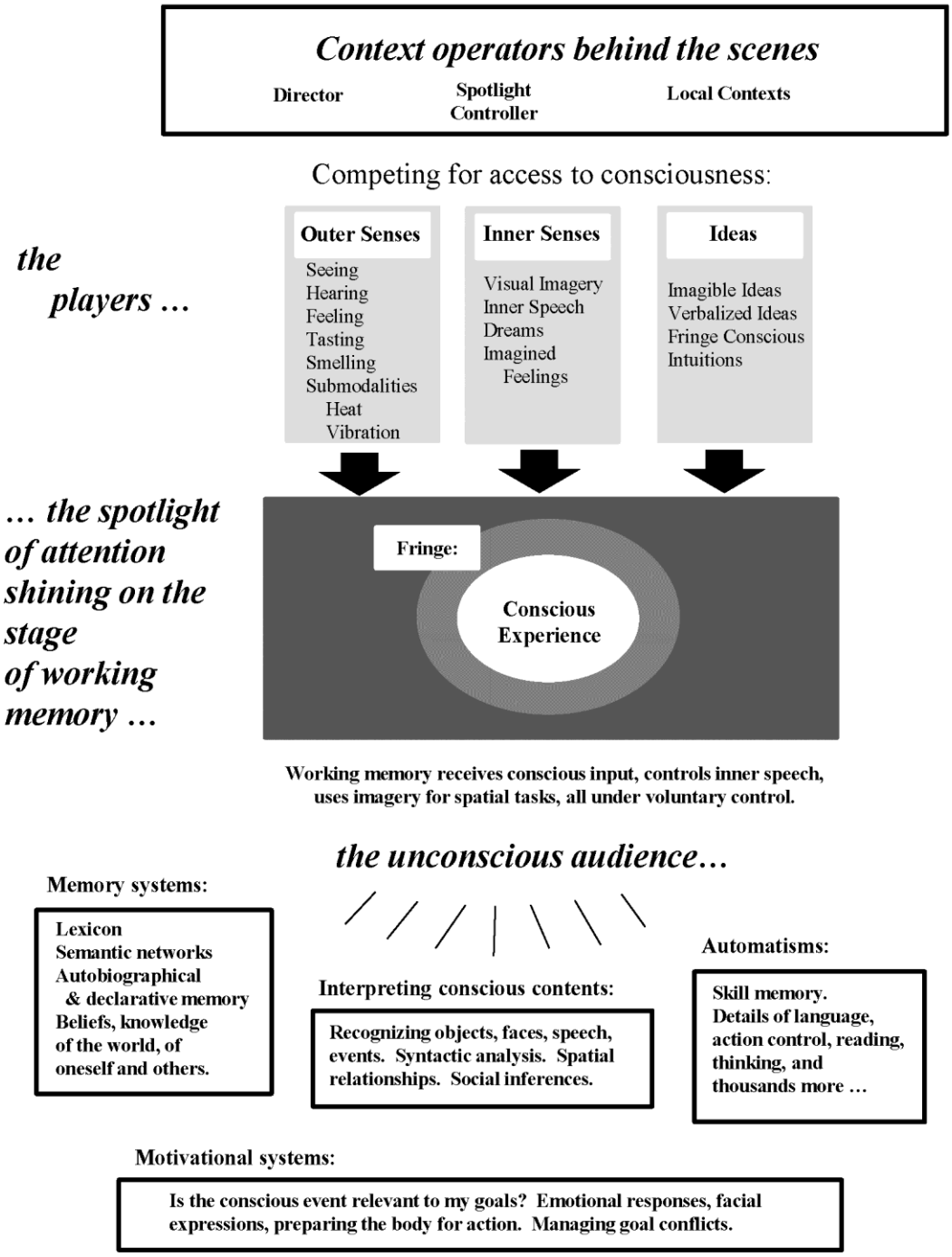

Figure 2: Figure 2-1 from Bernard Baars "In the Theater of Consciousness". His caption: "*A theater metaphor for conscious experience*. All unified theories of cognition today involve theater metaphors. In this version, conscious contents are limited to a brightly lit spot of attention onstage, while the rest of the stage corresponds to immediate working memory. Behind the scenes are executive processes, including a director, and a great variety of contextual operators that shape conscious experience without themselves becoming conscious. In the audience are a vast array of intelligent unconscious mechanisms. Some audience members are automatic routines, such as the brain mechanisms that guide eye movements, speaking, or hand and finger movements. Others involve autobiographical memory, semantic networks representing our knowledge of the world, declarative memory for

beliefs and facts, and the implicit memories that maintain attitudes, skills, and social interaction. Elements of working memory – on stage, but not in the spotlight of attention – are unconscious. Notice that different inputs to the stage can work together to place an actor in the conscious bright spot, a process of *convergence*; but once on stage, conscious information *diverges*, as it is widely disseminated to members of the audience. By far the most detailed functions are carried on outside of awareness.

The theater metaphor suggests that the mentation produced by various mental organs enters into a mental space produced by the organs of consciousness. Let's examine this for the specific example of beta and serotonin-7. Beta produces the sense of home, family, community, and the joy of life. However, activation of beta does not cause a subject to experience these feelings unless they enter consciousness. In order to enter consciousness, the feelings produced by beta must pass through the gates mediated by serotonin-2 and cannabinoid.

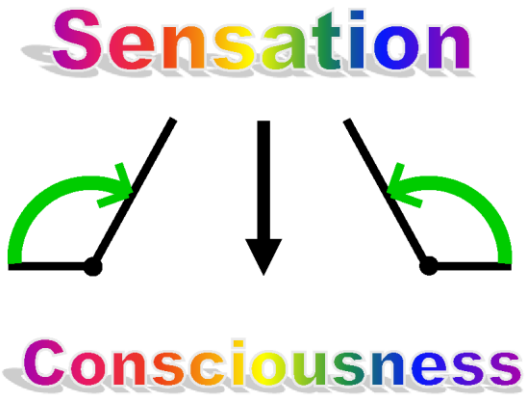

Figure 3: In order to enter consciousness (mediated by serotonin-7), sensation (mediated by a variety of receptors) must pass through the gates (mediated by serotonin-2). Serotonin-2 manipulates the gate in a dynamic moment-to-moment fashion. When serotonin-2 is activated the gates close, when serotonin-2 is relaxed the gates open. The strength of serotonin-2 activation is indicated by the length of the curved green arrows.

For some subjects, activation of beta alone will not produce a conscious experience of the joy of life, because the gates to consciousness are permanently blocked closed by the cannabinoid receptors. For these subjects, the experience of beta can only occur if at the same time that beta is activated, the cannabinoid blocks are also removed. Then the effects of beta can get past the gates and enter consciousness.

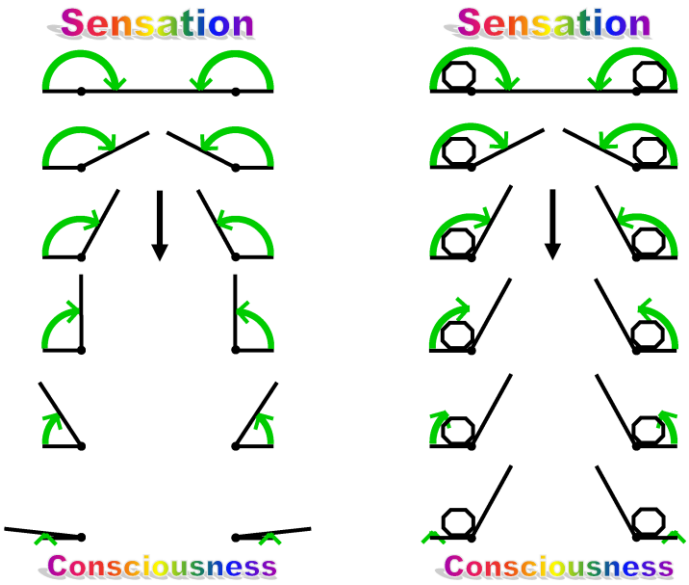

Figure 4: Left: Illustrates that serotonin-2 operates the gates along a spectrum from relaxed/open (bottom) to activated/closed (top). Right: Illustrates the interaction of the serotonin-2 gates with the cannabinoid blocks. Note that the green arrows are the same length at each level of the spectrum in the diagrams on the right and left. On the left, the positions of the gates are determined by the strength of serotonin-2 (length of the green arrows). However, on the right the ability of the gates to open is limited by the blocks imposed by the cannabinoid receptors. In the figure on the right, the cannabinoid blocks are all at the same position, allowing the gates to open partially. However, cannabinoid also operates on a spectrum so that the blocks may allow the gates to open most of the way, partially, barely, or not at all.

Central vs. Distributed – Now we need to consider an interesting observation: the expansion of consciousness itself can be permanently blocked by the cannabinoid receptors. For subjects that have such blocks, consciousness can only expand if the cannabinoid blocks are removed. A possible implication of this is that the gates of consciousness do not mediate the access of the mental organ (e.g., beta) to the organ of consciousness (serotonin-7); rather, the gates mediate the access of the organ of consciousness to the other mental organ(s) (e.g., beta).

This possibility suggests a fairly different view than that suggested by the theater metaphor. In the theater metaphor, the mental organs that act as players (e.g., beta) enter onto the central stage of consciousness (e.g., serotonin-7). This presents some practical and conceptual difficulties. If a specialized mental organ is required to produce a specific domain of feeling (e.g., the sense of home, family, community, and the joy of life), then could there be a general purpose organ of consciousness capable of rendering the experience generated by each of the many different kinds of mental organs? And how is the feeling communicated from the source mental organ (e.g., beta) in all of its richness and detail, to the organ of consciousness?

In the alternate view, the organ of consciousness does not provide a mental space into which other mental organs enter; rather, the organ of consciousness performs the function of making other mental organs conscious. In this view the mental space is distributed across mental organs, not centralized in one, and the above mentioned conceptual and practical issues evaporate.

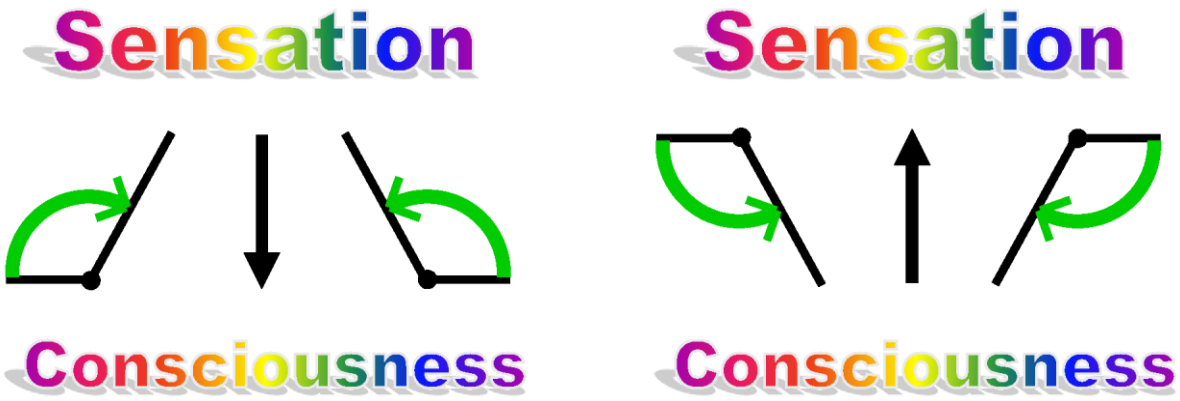

Figure 5: Two alternate hypotheses of the relationship between sensation, consciousness, and the gates. Left: The conventional view is consistent with the theater metaphor, in which sensation must pass through the gates in order to play in the spotlight on the stage of the theater. This view implies that the organ of consciousness (serotonin-7 or kappa) is a central theater where consciousness manifests. Right: An alternate view suggests that consciousness is distributed among the sources of sensation (various mental organs). Rather than the other mental organs having to send their sensation through the gates into the theater of consciousness, the organ of consciousness must pass through the gates in order to bestow the property of consciousness on the organs that generate sensation. In this alternate view, consciousness is not centralized in any one organ, and the theater is not an appropriate metaphor.

Sense of Self – When serotonin-7 is strongly activated without simultaneously activating serotonin-2, the subject is very likely to experience a loss of the sense of self, ego-loss, the fully non-dual state. This is a curious observation, because it occurs without any actual inhibition of the serotonin-2 system, but with only a strong activation of serotonin-7. It appears that if serotonin-7 is strongly activated while serotonin-2 is not altered, the serotonin-2 system is overwhelmed, and consciousness floods through the gates, with the gate-keeping function of serotonin-2 effectively completely disabled. The loss of the sense of self in this situation suggests that an important component of the egoic sense of self is the *act* of the serotonin-2 system manipulating the gates of consciousness. The ability of serotonin-2 to manipulate the gates of consciousness appears to depend on the relative strengths (level of expression) of serotonin-2 and serotonin-7. Balance matters.

Generative – In the description of serotonin-7 above, I discussed how when sufficiently activated: "At a critical point, we pass through a mental event horizon, as the contents of consciousness become more salient than actual reality. We mentally exit the actual space and time and enter a space and time created by the mind, within which the mind can create an alternate reality. At this point a mental big bang may occur. Consciousness is a generative system, capable of creating worlds, universes. This creative property may be the basis of free will."

Figure 6: When consciousness is expanded by activating serotonin-7, the contents of the mind become more tangible, and may be experienced as if perceived through the five senses. The mind becomes increasingly creative as consciousness expands. Photo by: LSD-photos Marco Casale – Paolo Dall'Ara (http://lsd.eu/, http://lsd.eu/index.php?gallery/show/adv1).

It has been suggested that the naturalistic view challenges free will, the idea that human beings are first causes. I would like to suggest that while human beings may not be first causes in the sense of the big bang, and while they operate within the fully causal flow of the laws of nature, they none-the-less contain generative mental centers (serotonin-7, kappa), that contribute novel input into this flow. Human creativity (art, music, and literature) illustrates this generative property.

Consciousness is a generative system capable of creating worlds in the mental plane, and capable of influencing the body in the physical plane. The generative system of consciousness introduces original causal input, while completely obeying the laws of nature. Thus the causal creativity of the human mind coexists peacefully with the causality of the laws of nature.

However, this generative property does not occur when serotonin-7 is activated alone. When activated almost alone (together with serotonin-1), it produces an empty state of non-duality. It is only when affective mental organs are simultaneously activated that the generative property becomes apparent. Thus the generative process is not a property of serotonin-7 alone, but of affective mental organs when they are brought very strongly into consciousness by serotonin-7.

They are transformed by serotonin-7, a process I call "serotonin-7ization." There seem to be common themes to its effects: Adds a creative exuberance; takes it to a higher level; makes connections; comprehends the bigger picture; creates sumptuousness, sparkle, grandeur, majesty, transcendence; intangible becomes tangible; thoughts, feelings, motivations originating from within may be perceived to originate from without. In her novel "Jane Eyre," Charlotte Brontë describes the natural process in ordinary life:

> "Won in youth to religion, she has cultivated my original qualities thus:—From the minute germ, natural affection, she has developed the overshadowing tree, philanthropy. From the wild stringy root of human uprightness, she has reared a due sense of the Divine justice. Of the ambition to win power and renown for my wretched self, she has formed the ambition to spread my Master's kingdom; to achieve victories for the standard of the cross. So much has religion done for me; turning the original materials to the best account; pruning and training nature." (Bronte 2009)

This creative process is not limited to religion. Simple curiosity could be cultivated, developed, reared, formed, and turned into a Nobel Prize winning insight. Serotonin-7ization is a fundamentally creative process that may form the basis of free will.

Balance – With serotonin-7 strongly activated, the contents of consciousness are more richly rendered. The ratio of expression of consciousness (serotonin-7) and the other mental organ will influence the quality of the expression of the mentation. If the ratio leans toward the other mental organ, the expression of the mental organ (joy, compassion, comfort), will be more grounded in actual reality. If the ratio leans more toward consciousness (serotonin-7), the expression will be more invented, more generative, more creative, and able to go beyond actual reality. The organs of consciousness are organs of creation. Balance matters. Outside of a certain range of balance, mental difficulties are likely.

Ways of Knowing

As adult humans, we largely know and understand the world through reason, and many of us have lost touch with, forgotten, and no longer value other ways of knowing. Here I will attempt to remind us of what we have lost.

> "What Mrs. Coulter was saying seemed to be accompanied by a scent of grownupness, something disturbing but enticing at the same time: it was the smell of glamour." Philip Pullman, "The Golden Compass" p. 66.

Flavor – I begin with flavor (odor and taste), because it is a non-rational way of knowing that we retain and value. Most of us know the odor of a rose, the flavor of cinnamon or vanilla, or the rich flavor of a fine curry. It is through odor and taste that we know the flavor of foods and the smells of our world. Flavor is a feeling, and a way of knowing that is independent of reason. We generally do not attempt to reason about flavor, and we do not doubt the truths about the world that it reveals to us. We accept flavor for what it is, and leave it at that.

While we do not generally intellectualize flavor, the 2004 Nobel Prize in Physiology or Medicine was awarded for unraveling the biological mechanisms of odor (Buck and Axel 1991). Odor and taste receptors are also GPCR. Although about 800-1200 different functional odor receptors are expressed in the mammalian genome, humans express fewer than four hundred (Niimura and Nei 2007). Humans have about a third the number of functional odor receptors as other mammals. The human genome is littered with hundreds of odor receptor pseudogenes (genes that have mutated such that they no longer function).

This suggests that the human experience of odor is relatively impoverished. Dogs are not just more sensitive to odor as a result of having a larger nose; they also have a qualitatively much richer and more subtle and nuanced experience of odor than we do.

When flavor is conveyed from person to person, the language we use takes the form of words like "floral," "minty," "musky," "citrusy," etc. This implies several things. We assume that if we have both experienced a flavor (e.g., vanilla, mint), then we have had a shared experience of the feeling that is that flavor, and by naming a shared tasteant or odorant, we can convey the feeling of the flavor. And it may be largely true (except due to variation in expression of the relevant odor or taste receptors). If we had not shared the experience, there would be no language to describe the feeling. Flavor is ineffable.

The same principles apply to feelings in general. There is no language for feelings, other than reference to a shared experience. It could be the odor of a rose, the taste of cinnamon, the feeling of falling in love, the sense of family and humanity mediated by beta, or the sense of the essence or spirit of things mediated by alpha-2. The same applies to any class of feeling, mediated by any mental organ.

If we had never smelled a rose, no one could communicate that sensation to us in any meaningful sense. Similarly, if we had never experienced smell, we could never understand what it feels like. And this is also true for the affective ways of knowing. Those who experience an affective way of knowing cannot communicate the feeling to those who have not. The only way to know feeling is to experience it.

In the description of a dozen mental organs above, I have attempted to identify the feelings associated with them, in ordinary language. But I cannot convey the feelings themselves. What

I have attempted to do is to allow us to understand the feelings intellectually, to the extent that is possible.

Emotion – When we think of feelings, most of us think of emotions, such as anger/rage, fear, happiness, sadness, surprise and disgust. Emotions play a role in determining motivational states. When strong, emotions can take control of us and dramatically affect our behavior. Many people rightfully feel that emotions are something that needs to be controlled and dominated, lest they take over and cause us to do things we regret, or cause us to suffer. While emotions and ways of knowing are both in the affective domain, ways of knowing are not as tightly linked to motivation. Feelings that fall into the category of ways of knowing play the role of painting the world for us, just as flavors do. Affective ways of knowing are a way of truthfully representing the world in our minds, and do not have the troublesome motivational properties of emotions. As adults we are barely aware of and have largely forgotten these ways of knowing through feelings.

Cognitive and Affective – At the Tofukuji Buddhist temple in Kyoto Japan, there is a large rock, which is ten to fifteen feet tall, three to four feet wide, and about a foot thick. On this rock is carved, in beautiful flowing vertical Japanese script, a haiku. The haiku reads: "Furuike ya kawazu tobikomu mizu no oto." This translates into English as "old pond, frog jump, sound of water." This is perhaps the most famous haiku, written by Matsuo Bashō (1644-1694). The book "One Hundred Frogs" (Sato 1995) is a collection of nearly a hundred and fifty different translations into English of this simple haiku. There is a joke about a haiku vendor with a sign that reads "Haiku 100 yen. With frog, 25 extra."

Figure 7: Rock at the Tofukuji Buddhist temple in Kyoto Japan, with a carving of the famous haiku by Matsuo Bashō (1644-1694). The haiku reads: "Furuike ya kawazu tobikomu mizu no oto." This translates into English as "old pond, frog jump, sound of water." Photo by: Tom Ray.

There are fundamentally two ways of knowing this haiku. We can know the haiku with our rational mind. In this case, well, if a frog jumps into water, it will make a splash, and that will cause vibrations in the air, so of course there will be a sound, which we can hear. If we know the haiku this way, it is kind of silly and pointless. Or we may rationally interpret it as a metaphor, in which case we may be able to find symbolic meaning in it.

The other way to know the haiku is with our heart. If we know it this way, it paints a moment, a beautiful and timeless scene of an ancient pond, with a frog jumping in and splashing, as frogs have jumped in for millions of years. While we may not have a visual image of the scene, we can feel it. We paint the scene with feelings. It may even be better not to visualize it, because then its representation is purely affective. When we know the haiku in this way, we can understand why it is so famous.

There are, broadly speaking, two fundamental ways of knowing, the cognitive and the affective, the head and the heart, reason and feeling, modern and archaic. The cognitive domain understands the world in terms of language, reason, ideas, symbols, and concepts, while the affective domain understands the world in terms of feelings. Both domains, cognitive and affective, are capable of "knowing" and "understanding" the world, each in its own way. And each domain is able to construct a "model" of the world in consciousness, a rich, subtle, and complex representation of the world.

It appears that children are dominated by the affective domain, while adults are largely dominated by the cognitive mind, at the expense of emotions, feelings, and intuition. When we mature into adults, we find ourselves knowing the world largely through language, logic, and reason. We tend to lose touch with the way we knew the world as children, the archaic way of knowing, through feelings, through our heart.

Reason as a way of knowing and understanding is evolutionarily new, and appears to be fully developed only in adult humans. However, before the emergence of reason, we still knew and understood our world and ourselves through feelings, and adult humans retain this capacity (even if it is not exercised). Our developmental and evolutionary antecedents (children and non-human higher animals) have a fully developed affective mind and still know the world exclusively in this way. The affective mind of humans predates the cognitive mind (developmentally and evolutionarily), and is ancient, complex, subtle, rich, and capable of knowing and understanding the world, based on feelings alone. The ineffability of many kinds of mystical experiences arises from this affective way of knowing.

While reason has emerged in the last hundred thousand years of our evolution, the affective ways of knowing have been elaborating through evolution for hundreds of millions of years. This archaic way of knowing has great evolutionary depth, and like flavor, remains profoundly valid today, revealing truths about the world. Perceiving truth can be a matter of life or death (i.e., natural selection). Multiply this by many millions of generations (iterations). If truth can be found, evolution can find it.

While the faculties of language, logic and reason seem to be mediated by one or a few mental organs based on serotonin receptors, the affective mental organs are numerous and diverse, mediated by a wide variety of receptors (among the dozen mental organs that I have characterized: alpha-1, alpha-2, beta, histamine, imidazoline, dopamine, sigma, mu, kappa). Thus the affective systems do not represent a single, alternate, way of knowing, but rather a multiplicity of ways of knowing.

We might suppose then that the cognitive way of knowing is relatively monolithic in part due to being evolutionarily young. Perhaps over evolutionary time, the cognitive way of knowing will mature, diversifying and differentiating across widely varying mental organs, as have the affective ways of knowing.

Ontological Categories – The ways of knowing collectively represent a set of natural ontological categories which evolution has settled upon for representing the world in the mind:

- Laws and patterns of nature – serotonin-1
- Things – alpha-2
- Place, scene – alpha-1
- Home, family, community – beta
- Beings – histamine

Traditions of Knowing – It may be that each of our great teachers and spiritual leaders achieved their unique insights as a result of the exceptional blooming of a particular mental organ. In each case, this was a great achievement, and often religions or major philosophical or secular traditions formed around them. It should be possible to identify the mental organ(s) associated with each tradition.

Socrates taught how to think rationally, at a time when it wasn't done, and is credited with the origin of the "concept" (Jaspers 1962). From Socrates and others, ultimately flowed the age of reason and the age of enlightenment. Socrates experienced an exceptional bloom of the mental organ of reason, built from the five serotonin-1 receptors.

Siddhartha Gautama (Buddha) experienced an expansion of consciousness by a blooming, through meditative practices, of the mental organ of adult consciousness, defined by serotonin-7.

Confucius displayed the deep understanding of humanity and human nature that shows as wisdom (Jaspers 1962), which likely resulted from an exceptional bloom of the mental organ defined by beta.

Jesus Christ had absolute faith in God, and absolute faith in the immanent end of the world and coming of the kingdom of heaven (Jaspers 1962). This suggests an exceptional bloom of dopamine. Also, his reputation for open hearted tenderness, compassion, forgiveness, healing, and love, suggest an exceptional bloom of imidazoline.

Among the affective ways of knowing that I have characterized, alpha-2 may be the most ineffable. Ramachandran discusses a word from Sanskrit, "rasa": "Capturing the very essence, the very spirit of something, in order to evoke a specific mood or emotion in the viewer's brain"(Ramachandran and Hirstein 1999; Ramachandran 2004; Ramachandran 2007a; Ramachandran 2007b), which precisely describes the way of knowing mediated by alpha-2.

Alpha-2 appears to provide the basis for several philosophical and religious traditions. The Shinto religion "teaches that everything contains a kami (*"spiritual essence"*, commonly translated as god or spirit)." "There are natural places considered to have an unusually sacred

spirit about them, and are objects of worship. They are frequently mountains, trees, unusual rocks, rivers, waterfalls, and other natural edifices" (Wikipedia 2010b). This is also characteristic of animistic religions in general, and of alpha-2.

In Taoism, attributed to Laozi, the goal is to attain a mental state in which is revealed "the soft and invisible power within all things". It is a state in which "everything is seen as it is, without preconceptions or illusion." "It is believed to be the true nature of the mind, unburdened by knowledge or experiences" (Wikipedia 2010a). While this may represent the entire affective domain, facets of Taoism clearly manifest alpha-2 and beta.

The Full Bouquet – The paradigmatic individuals that I described above, each of which achieved a unique insight through the exceptional blooming of a particular mental organ, would have also had an exceptionally well developed consciousness (serotonin-7) to render the key mental organ in rich resolution, and an exceptionally well developed cognitive organ (serotonin-1) to be able to articulate their insights. Thus their unique insight and teaching requires a triple bloom of consciousness and cognition with another mental organ(s).

But this picture is not whole, because each of our teachers or spiritual leaders, while endowed with the full bouquet of mental organs, experienced the exceptional bloom of only one, or perhaps a few mental organs (other than serotonin-1 and serotonin-7). Each of these traditions celebrates only a narrow domain of human potential. The discovery and characterization of a significant set of mental organs opens the possibility of a new tradition of knowing. We now have the potential to experience the blooming of the full bouquet of mental organs, resulting in the realization of our full human potential (Ajaya 2009). This full bouquet of mental organs is what is great in us. This is our humanity, this is our evolutionary heritage. This is what makes us rich. It should be cultivated in its wholeness, not only narrowly selected parts of it, chosen by the historical accident of our birth into a particular religious, philosophical, secular, or ethnic tradition.

Recognizing and valuing the full bouquet has the potential, at least theoretically, to unify the competing traditions, by showing the contribution of each one to the richness of the human spirit. We see how taken together, they form the beautiful bouquet of the human heart, mind, soul, and spirit. Each mental organ is like a unique flower, contributing to the floral arrangement that evolution has left us, here a rose, there an iris, and there a daisy… Only when all are taken together are we *fully* human.

Can scientists, naturalists, materialists, and rationalists of various sorts, acknowledge that their way of knowing, reason, is only one of many ways of knowing with which our ancient evolutionary heritage has endowed us? Are not all of these ways of knowing equally valid? Can the followers of any tradition, religious or secular, acknowledge that their particular tradition is not exclusive and above all others?

Loss of Affective Ways of Knowing – An existential risk that my work identifies is loss of neurotransmitter receptor (mental organ) diversity as a result of the aggressive spread of a cognitive monoculture. The mind is populated with mental organs. To persist, each mental organ must contribute to fitness. The cognitive mental organs caused such a jump in Darwinian fitness (witness the population explosion and the elaboration of war technology), that fitness variation among affective mental organs is *relatively* negligible, as is their contribution to fitness *relative* to the cognitive organs.

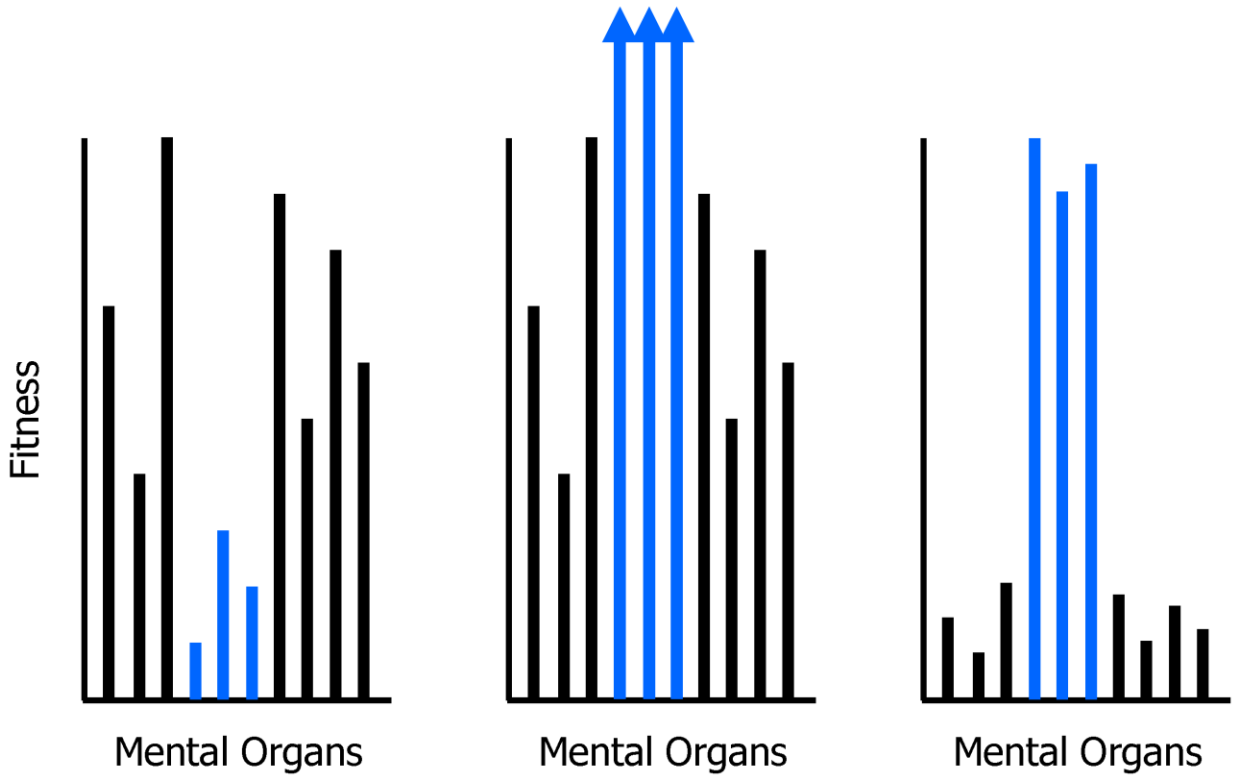

Figure 8: Patterns of fitness of the mental organs that populate the mind. Left: To persist, each mental organ must contribute to fitness. Let the fourth, fifth, and sixth bars (in blue) represent the cognitive mental organs, and the other bars (in black) represent the affective mental organs. Center: By providing logic and reason, cognition gave us science and technology that produced the human population explosion, an extraordinary payoff in Darwinian fitness that dwarfs the fitness contribution of the affective mental organs. The fitness of the cognitive mental organs is off the chart. Right: Adjusting the vertical fitness axis, we see that the fitness contribution of the affective mental organs is slight *relative* to the fitness contribution of the cognitive mental organs.

At present, the affective mental organs appear to be fully active in childhood, but by adulthood, the mental immune system has largely converted them into vestigial organs. For now they may be preserved by their critical roles in childhood; and their unconscious activity in adulthood may still influence our judgment. However, the affective neurotransmitter receptors may be in danger of becoming pseudogenes as have most of our odor receptors. Preservation of human neurotransmitter receptor diversity deserves a place along-side preservation of biological species diversity. The worlds of feeling and reason need to recognize one another, reconcile, learn mutual respect, and merge, because only then can we truly be whole.

> "we have lost the way… Our knowledge has made us cynical, our cleverness hard and unkind. We think too much and feel too little: More than machinery we need humanity; More than cleverness we need kindness and gentleness." – Charlie Chaplin, 1940, "The Dictator" (Chaplin 2011)

There is another side of this issue. What kind of mind can be comfortable with, or ignore, or willingly participate in the destruction of our planet, each other, or ourselves? The shutting off of the affective domain in adults can be a contributing factor to such a mentality. Our history of warfare may have selected for the shutting off of the affective domain more completely in adult males (through more aggressive serotonin-2 and cannabinoid systems). The degree to which this shutting off occurs is highly variable within the population, and varies between individuals, ages, genders, cultures, and mental organs.

The various ways of knowing do not compete. They blend together to form a perceptual whole, like the flavors in a rich stew. Each mental organ adds spice to our lives. Reason coevolved with a preexisting affective domain, and is designed to be informed by affective input. Various authors have suggested that the cognitive mind is built on top of, and remains fully dependent on the affective mind, and that without the underpinning of affect, humans are not able to make sound judgments (Damasio 2005; Pham *et al.* 2012). The cognitive domain alone can produce reason, intelligence, and knowledge, but wisdom requires a healthy unity of both the cognitive and affective domains (Hall 2010). When reason reigns at the cost of losing touch with the other ways of knowing, we retain the ability to manipulate nature, but we don't understand its essence, and cannot make wise judgments. The accumulation of material goods and power over nature cannot make us wealthy if we lack feelings. It is the rich experience of the flavors and feelings of life that makes us wealthy.

The affective ways of knowing are the means by which children grow into adults who understand the world. Alison Gopnik describes the way that children explore the world through fantasy, imagining scenarios, in order to translate an understanding of chains of causality into an understanding of the nature of the world and how to flourish in it (Gopnik 2009). But how do children obtain such understanding before the emergence or maturation of cognition? It is in large part through the affective ways of knowing, which are more obviously active and dominant during childhood.

Definitions

At the beginning of this document I provided dictionary definitions of several mental terms which are not commonly used in science. Now I would like to restate those definitions in terms of mental organs:

- Head – the cognitive systems, language, logic, and reason, mediated by serotonin-1
- Heart – the numerous affective (non-serotonin) mental organs
- Spirit – consciousness, as mediated by serotonin-7 (perhaps kappa as well, although kappa is closer to soul), the spark of creativity, the primary source of mental energy
- Soul – the core of our being, the seat of the biographic-self and memory, and the basic emotions, as mediated by the sigma mental organ

- Mind – heart, spirit, and soul taken together
- Open the Heart – bring fully into consciousness, an affective mental organ that does not normally rise to consciousness
- Lift the Spirit – increasing a person's vitality, energy, and enthusiasm

Mind of the Dog

My interpretation of human mental organs is based on the synthesis of molecular data with reports of subjective experience. Unfortunately the same methodology cannot be applied to non-human animals, because they cannot tell us about their experience. However, there is one animal with which humans have an intimate enough relationship that humans have generated detailed descriptions of the animal's mind: dogs.

Dogs are the first animal that humans domesticated, from wolves, about 15,000 years ago. The ancestral dog has evolved through artificial selection into hundreds of different breeds. Wolves were pre-adapted to evolve into our best friend, by virtue of their social nature. The American Kennel Club provides temperament data for 161 breeds of dog (AKC 2012). Here are a few examples:

Sloughi – The Sloughi is a dog with class and grace. The attitude is noble and somewhat aloof.

Bichon Frise – Gentle mannered, sensitive, playful and affectionate. A cheerful attitude is the hallmark of the breed and one should settle for nothing less.

Briard – A dog of heart, with spirit and initiative, wise and fearless, no trace of timidity. Intelligent, easily trained, faithful, gentle, and obedient, excellent memory, ardent desire to please his master

Irish Water Spaniel – Very alert, inquisitive and active. Stable in temperament with an endearing sense of humor. May be reserved with strangers but never aggressive or shy.

Pekingese – A combination of regal dignity, intelligence and self-importance make for a good natured, opinionated and affectionate companion to those who have earned its respect.

Pomeranian – The Pomeranian is an extrovert, exhibiting great intelligence and a vivacious spirit

Toy Fox Terrier – Intelligent, alert and friendly, and loyal to its owners. He learns new tasks quickly, is eager to please, and adapts to almost any situation. Self-possessed, spirited, determined and not easily intimidated. He is a highly animated toy dog that is comical, entertaining and playful all of his life.

Newfoundland – Sweetness of temperament is the hallmark of the Newfoundland; this is the most important single characteristic of the breed.

The mental properties of dogs are characteristic of their breed, and vary between breeds. These mental properties of dogs are clearly genetically based and heritable. I believe that dog and human personalities are constructed from the same kinds of elements: mental organs. Not the same two sets of elements, but the same kinds of elements. However, I also believe that the individual properties that are shared by the two (e.g., sense of humor) are examples of convergence, not homology. Neither the wolf, nor the common ancestor of the dog and human had a sense of humor. The ability of such a great diversity of distinct mental properties to emerge rapidly through selective breeding is indicative of the speed with which mental organs are able to evolve.

It appears that fully developed cognition is unique to humans. Thus the minds of dogs and other non-human animals are purely affective minds. In order to understand the animal mind, we need to understand the affective mind.

Modulatory Personality

Just as individuals vary in the size and proportioning of features such as ears, nose, breasts, and hands, the degree of development and expression of individual mental organs varies dramatically between individual persons (Borg *et al.* 2003). Thus each individual person has a unique pattern of expression, or proportioning, of the full set of perhaps one hundred or more mental organs. I call this individual pattern the "modulatory personality". Modulatory personalities are as unique and variable as human faces, perhaps more so, and probably underlie much of what we refer to as character, temperament, and personality. Extreme modulatory personalities may produce exceptional individuals, but also may be pathological.

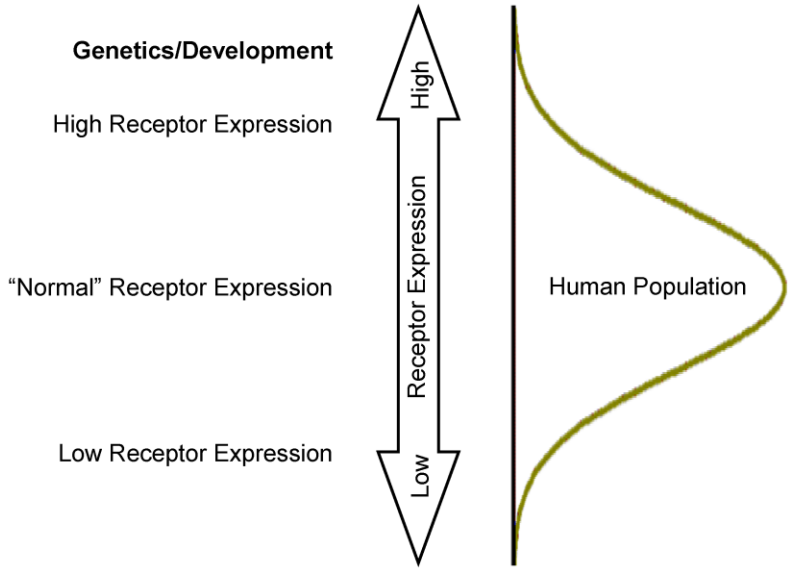

Figure 9: Each mental organ expresses itself along a spectrum. Each individual human will at any point in time be at some position on the spectrum of each mental organ. The human population will be distributed along the spectrum, perhaps in a normal distribution.

Each mental organ plays its role in the mind along a spectrum of degree of expression from low to high (figure above right). We would generally expect that the mean of the distribution would correspond to the normal and healthy condition, while the two extremes of the distribution may correspond to exceptional individuals, or pathological conditions. Thus each human mind represents a configuration in a space of hundreds of dimensions, in which each axis represents the level of expression of a single receptor or mental organ (see figure below right), and each point in the space represents the modulatory configuration of all receptors in an individual human.

We would expect a cloud of points representing the human population, with the highest density centered around the point representing the median values of all the hundreds of receptor distributions, and the density of the cloud decreasing as we move away from this global mean, in any direction in the receptor space.

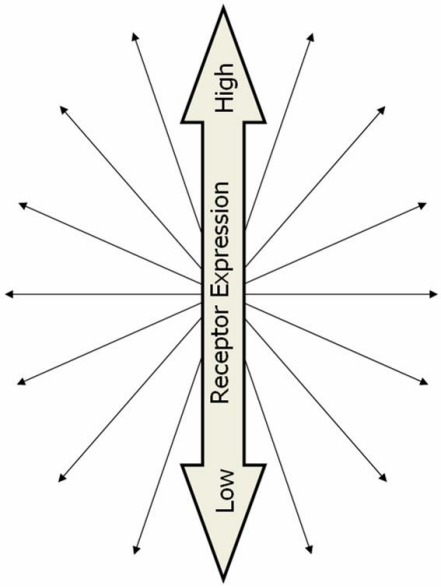

Figure 10: One spectrum will exist for each mental organ, of which there are likely hundreds. Collectively, the population of mental organs could be represented by a high dimensional space, with one axis per mental organ or receptor.

In evolutionary terms we would expect selection to shape the population variation in receptor expression such that the mean of the distribution would maximize fitness, while the extremes would tend to be less fit. When selection is strong, it would likely maintain a narrow distribution, when weak a broader distribution. The overall configuration of the relative levels of expression of the many mental organs is the "modulatory personality," and is highly variable within the human population.

Spectrums of Expression – The figures below illustrate hypotheses of the spectra relating mental states and the level of expression of two mental organs, serotonin-2 on the left, and serotonin-7 on the right. The figures illustrate the variations in mental properties found along the spectrum, including the central healthy range, as well as pathologies that might be found at the extremes of expression of these two mental organs.

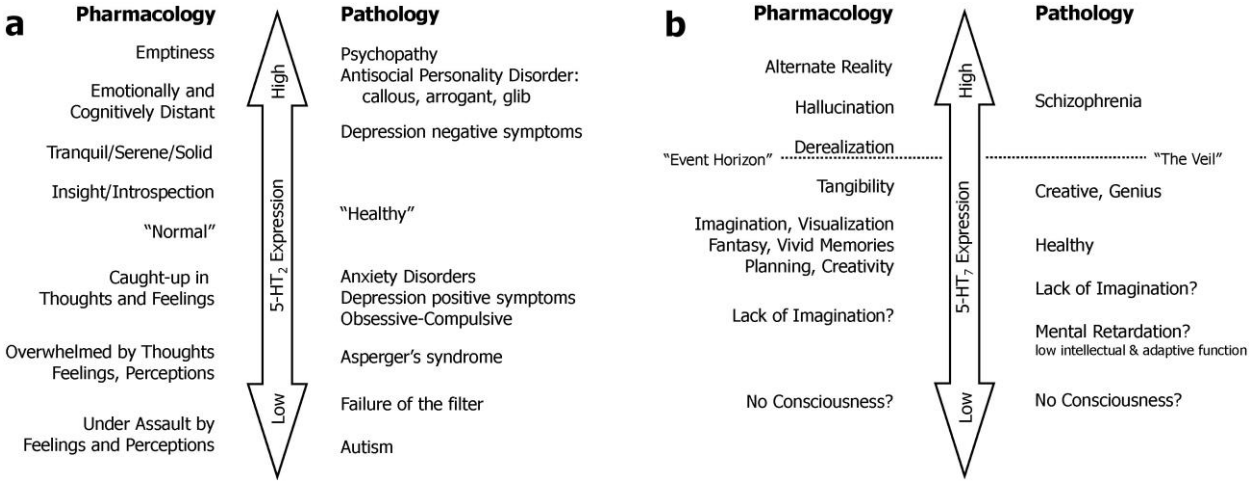

Figure 11: A spectrum representing a hypothesis of the mental continuum associated with the range of expression (from low to high) of the mental organ defined by the serotonin-2 receptors (left) and serotonin-7 receptors (right).

Evolution of the Mind

Mental organs are all tied to a single gene family, the G-protein coupled receptors (GPCR), and thus evolve through duplication and divergence of the underlying genes and regulatory elements. The GPCR include receptors for serotonin, dopamine, histamine, and many other neurotransmitters. GPCR genes provide a genetic and regulatory system to richly specify the structure of the *mind*, not just the brain, and thereby make the *mind* highly evolvable. A little more than three hundred different GPCR are expressed in the human brain. However, individual mental organs are often made up of groups of closely related receptors. There may be half as many, or fewer, mental organs than receptors.

Shaping Mental Organs – If modulatory receptors implement components of the mind, then new components can be created through the process of duplication and divergence of receptor genes. Each individual GPCR corresponds to a single protein encoding gene, whose expression is influenced by many genetic regulatory factors (which largely remain unknown). The GPCR are one of the largest gene families in the human genome, and have diversified through the process of duplication and divergence. The figure at right shows the relationships among a small sample of GPCR (those examined in this study).

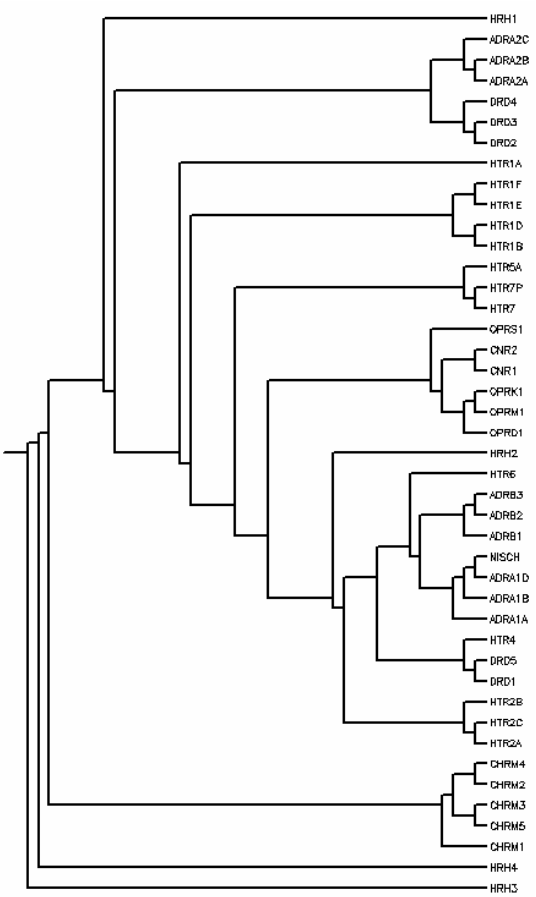

Figure 12: A tree showing the relationships between forty-three G-protein coupled receptors (out of over three hundred expressed in the human brain), based on sequence similarities.

On a long time-scale, evolution shapes and fine tunes the qualitative properties of individual modulatory components (i.e., do they modulate joy, empathy, consciousness, or reason). This evolutionary process likely involves alteration of both the genes coding receptor proteins, and the regulatory components; and in addition likely involves alteration of the second messenger systems (G-proteins) coupled to the receptors.

On a shorter time-scale, evolution shapes the proportioning of the modulatory personality (the relative levels of expression of all the receptors). This proportioning likely can be done entirely through alteration of the regulatory elements, without affecting the genes encoding proteins. To understand the importance of the proportioning of the modulatory personality, consider that psychoactive drugs only (transiently) alter the proportioning of the mind, yet they result in radically different mental states.

There are a variety of means of evolutionary shaping of the proportioning of the modulatory personality. Evolution can influence the abundance and distribution of the modulatory receptors,

the pattern of activation of these receptors, and the degree to which the mental property mediated by the receptor gains access to consciousness (as mediated by the inhibitory systems, serotonin-2 and cannabinoid).

Coevolution With Religion – It has been argued that religion provides adaptive benefits and so has been favored by natural selection (Wilson 2003). If so, it would be expected that our innate psychology would have evolved to facilitate religion. Several mental organs appear to facilitate religion. Alpha-2 mediates a sense of soul which some have argued is the ultimate basis of all religions (Tylor 1958). Imidazoline mediates compassion and forgiveness which are central to some religious traditions. Dopamine mediates awe which has been called the distinctive religious emotion, as well as certainty (Smith 2001), meaning, and the sense of spiritual significance (Griffiths *et al.* 2006). Dopamine appears to be the most quintessentially religious mental organ. Beta may form the basis of Confucianism, which some consider to be a kind of religion. When beta is activated together with serotonin-7 it can produce ecstatic joy which can have a religious quality. Serotonin-7 can produce a sense of transcendence of the body, the cosmic, the infinite, a greater power, and even god.

Exploration of Mental Space – If a mental organ is relatively well expressed in a population, on average, it will play a prominent role in mental life. Under these circumstances, it will experience more selection than a mental organ that is on average, poorly expressed. As evolutionary time goes by, the highly expressed mental organ will become more richly shaped than the poorly expressed mental organ. At this level of selection, we are not talking about the proportioning of mental organs in the mind, but the qualitative properties of individual organs. A mental organ that is well expressed in a population, and thus experiencing strong selection, can more elaborately evolve the regulatory elements that shape the connection patterns and distribution of the population of neurons that make up the organ. As an element of the mind, this mental organ can become richer, deeper, more subtle, more detailed, more clearly defined, more complex.

If a mental organ decreases in its relative strength of expression in a population, then with weakened selection, the receptor gene may become vulnerable to being converted into a pseudogene; but in addition, the myriad properties of the mental organ may begin to wander, and more randomly explore more distant realms of mental space. Under weaker selection, the mental properties can wander through regions of low fitness and may eventually settle on a new function or a new variation of an existing function, and a new mental organ will have been born. But these periods of weak selection correspond to exploration, not refinement. Refinement requires stronger selection than does exploration.

Origin of Mind – In order for evolution to sculpt exquisitely complex, large, multi-celled organisms, it needed an evolvable genetic and regulatory mechanism that could specify a developmental program to give rise to such form: the homeotic genes. The evolutionary discovery and elaboration of that genetic and regulatory system was likely one of the key facilitators of the Cambrian explosion and the origin of complex life.

The true evolutionary elaboration of the mind requires a genetic system analogous to the homeotic genes, for shaping *mental* life. In order for the mind to be shaped by evolution, there

has to be a genetic and regulatory system that allows heritable genetic variation in coherent mental features. It appears that mental organs, modulatory receptors (GPCR), and the genetic systems that regulate them provide the evolvable genetic keys for the origin and evolution of the mind. I suspect that the association of mental organs with receptors is a matter of evolutionary convenience, related to evolvability.

This is a possible answer to one of the fundamental questions in neurobiology: why are there so many different kinds of modulatory receptors (with over three hundred expressed in the mammalian brain)? The mental organ hypothesis suggests a possible answer to this evolutionary question: modulatory receptor diversity is a mechanism to structure and modularize the *mind*, allowing it to be shaped, fine-tuned, and elaborated by evolution. The emergence of mental organs with the genetic systems to regulate and evolve them facilitated the origin of complex minds.

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