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Future minds, mental organs and ways of knowing[1]

ABSTRACT

For hundreds of millions of years before the recent emergence of reason, evolution elaborated a multiplicity of ways of knowing through feelings, which remain valid today. Each way of knowing, including reason, is mediated by a 'mental organ' which is a population of neurons bearing a particular neurotransmitter receptor (e.g. serotonin-7, histamine-1, alpha-2C). Each mental organ adds spice to our lives. Reason coevolved with a pre-existing affective domain, and is designed to be informed by affective input. When reason reigns at the cost of losing touch with the other ways of knowing, we retain the ability to manipulate nature, but we do not understand its essence and cannot make wise judgements.

KEYWORDS

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mental organs
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affective
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FUTURE MINDS

The vision

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?' Students tend to view evolution as a progressive process, leading to improvements, making us better. While their views of evolution may not be realistic, their answers to these questions mostly represent their views of what a better and bright human

1. *Evolution Haute Couture: Art and Science in the Postbiological Age* (In Press), in D. Bulatov (ed.), Kaliningrad: NCCA.

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'.

In his article in this volume Steve M. Potter (2011) echoes these views, and acknowledges that it is not realistic to expect evolution to endow us with these changes. We do not know in what direction evolution may be taking us. Will it carry us towards Spock from *Star Trek*, or towards Clevon from *Idiocracy*? Wherever it may take us, its changes will be endowed upon our distant descendants. Therefore if we would like to change our minds within our lifetime, or those of our children, we will have to make those changes through deliberate actions.

Potter offers a panoply of technological means of achieving these changes that could make us better adapted to the modern world by helping us to remember things better, or become more quick and clever in a variety of contexts. He laments that we live in the modern world with the same brains that our savage ancestors had 30,000 years ago.

Caution

Those who would use technology to enhance or alter the human mind, emulate the human mind, create artificial intelligence or create artificial systems into which human minds could be downloaded, should advance with caution. If we are to engineer changes in our minds, we had better understand ourselves well before we begin. In his article in this volume, Andy Pickering (2011) argues that our understanding of ourselves is narrowly constrained and impoverished by modern culture and science.

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, 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 and science constrain us, as noted by Pickering, such that we have lost touch with, forgotten and no longer value these other ways of knowing. If we proceed in ignorance of our nature, we may engineer away our humanity.

MENTAL ORGANS

Here I will describe 'mental organs', a fundamental property of the organization of the human brain and the mind that emerges from it. (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. The methods by which I have arrived at these hypotheses are described elsewhere.) When we think of brain anatomy, we think of structures like the frontal lobe, cerebral cortex, cerebellum, thalamus, limbic system, pons or 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 human mind.

The human mind is populated by dozens of mental organs (perhaps more than 100), of which I have characterized a dozen. 'Mental organ' is defined as the population of neurons bearing a specific neurotransmitter receptor (in the family of G-protein coupled receptors, GPCR), such as serotonin-7, histamine-1 or alpha-2C. A little more than 300 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. Different mental organs mediate non-overlapping domains of human experience. The following list represents a set of hypotheses that I propose, concerning the mental functions mediated by a dozen mental organs:

Serotonin-7: cognitive (adult) consciousness, holds both cognitive and affective content; creates a theatre of consciousness; fantasy, imagination, theory. 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 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. At this point a mental big bang occurs. We exit the actual space and time and enter a space and time created by the mind, within which the mind creates an alternate reality. Consciousness is a generative system, capable of creating worlds, universes. This generative property may be the basis of free will.

Kappa: affective (childhood) consciousness, 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 filtering of access to consciousness, may focus attention. Activation of serotonin-2 closes the gates to consciousness, while inhibition of serotonin-2 opens the gates to consciousness.

Cannabinoid-1: long-term filtering, inhibition, protection. 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. The cannabinoid system probably coordinates with serotonin-2, to do on a long time-frame, what serotonin-2 does dynamically.

Sigma: our heart and soul, the core of our being, the core sense of self. Apparently a purely affective domain. Possibly the observer of the contents of the theatre of consciousness. 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, facades and masks that people wear, while putting on none of its own. Intimately connected to the body. Maybe 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, 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. Recall of emotionally significant biographical material (the affective essence of one's self). 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 non-family). ToM is not exclusively constructed on-the-fly. For each person, we build a model of their affective domain, which is stored and refined with each interaction. For close relations it accumulates a complete model, or representation, of their

affective domain. We hold their heart and soul within us, even after they have died. Extraordinary sexual sensibility. The sense of aesthetics.

Dopamine: meaning, significance, insight, deep emotions and moods (both positive and negative, thus heaven or hell); awe, certainty, religious sentiment; the sense of aesthetics. Associates feeling with thought.

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

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.

Yet 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 make 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 (GPCR) they bear on their surface.

The degree of development and expression of individual mental organs varies dramatically between individual persons. Thus each individual person has a unique pattern of expression, or proportioning, of the full set of perhaps a 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 and personality. Extreme modulatory personalities may produce exceptional individuals, but also may be pathological, and result in mental disorders.

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.

Flavour

I begin with flavour, because it is a non-rational way of knowing that we retain and value. Most of us know the odour of a rose, the flavour of cinnamon or vanilla or the rich flavour of a fine curry. It is through odour and taste that we know the flavour of foods and the smells of our world. Flavour is a way of knowing that is independent of reason. We generally do not attempt to reason about flavour, and we do not doubt the truths about the world that it reveals to us. We accept flavour for what it is, and leave it at that. Although people react differently to the same flavour, with likes or dislikes, we generally suppose that

different people's experience of the same odours or flavours are quite similar. While we have no way of knowing if this supposition about subjective experiences is true, to the extent that it is, it represents a kind of objective verification of the reality of what flavour reveals, in that it is independently confirmed by different observers. The flavours of a shared meal can be a shared experience.

While we do not generally intellectualize flavour, the 2004 Nobel Prize in Physiology or Medicine was awarded for unraveling the biological mechanisms of odour (Buck and Axel 1991). Odour and taste receptors are also GPCR. Although about a thousand different odour receptors are expressed in the mammalian genome, humans only express about three hundred, about the same number as neurotransmitter GPCR. Humans have less than a third the number of odour receptors as other mammals. The human genome is littered with hundreds of odour receptor pseudogenes (genes which have mutated such that they no longer function).

This suggests that the human experience of odour is relatively impoverished. Dogs are not just more sensitive to odour as a result of having a larger nose, but they have a qualitatively much richer and more subtle experience of odour than we do. Non-human mammals are able to know richer nuances of odour than can humans.

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 Bash (1644–1694). The book *One Hundred Frogs* (H. Sato, 1995) is a collection of nearly 150 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'.

There are 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 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 the most famous haiku.

There are, broadly speaking, two fundamental ways of knowing, the cognitive and the affective, the head and the heart, reason and feeling. 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 their own way. And each domain is able to construct a 'model' of the world, a rich, subtle and complex representation of the world, each within its own domain.

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 almost exclusively through language, logic and reason. We 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 of the world, based on feelings alone. The ineffability of many mystical experiences arises from this affective way of knowing.

While reason has emerged recently in evolution, the affective way of knowing has been elaborating through evolution for hundreds of millions of years. This archaic way of knowing has great evolutionary depth, and remains profoundly valid today. 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.

Traditions of knowing

It may be that each of our great teachers and spiritual leaders achieved their unique insights as the 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 was not 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 (Jaspers 1962), by a blooming, through meditative practices, of the mental organ of cognitive (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 a 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, 2007a, 2007b), which precisely describes the way of knowing mediated by alpha-2. Eckhart Tolle also alludes to this way of knowing:

> Once there is a certain degree of Presence, of still and alert attention in human beings' perceptions, they can sense the divine life essence, the one indwelling consciousness or spirit in every creature, every life-form, recognize it as one with their own essence and so love it as themselves. Until this happens, however, most humans see only the outer forms, unaware of the inner essence, just as they are unaware of their own essence and identify only with their own physical and psychological form.
>
> (2005: 4)

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 2010a). 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 2010b). While this may represent the entire effective domain, facets of Taoism clearly manifest alpha-2 and beta.

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 two mental organs. 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. This full bouquet of mental organs is what is great in us. This is our humanity, this is our evolutionary heritage. 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 or secular tradition.

This 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 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?

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 cognitive mental organs caused such a jump in Darwinian fitness (witness the population explosion), that fitness variation among affective mental organs is relatively negligible, as is their relative contribution to fitness. 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. The affective neurotransmitter receptors are in danger of becoming pseudogenes as have most of our odour receptors. Preservation of human neurotransmitter receptor diversity deserves a place alongside preservation of biological species diversity.

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 our selves? 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. 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 spices in a rich stew. Each mental organ adds spice to our lives. Reason coevolved with a pre-existing affective domain, and is designed to be informed by affective input. 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 do not understand its essence, and cannot make wise judgments.

FOR MENTAL ENGINEERS

What the mental organ hypothesis suggests about efforts to enhance the human mind, create artificial intelligence, emulate human minds or create a substrate into which human minds could be downloaded, falls into good news and bad news.

Bad news

Efforts at creating technologies of mind are usually conceived and executed around our purely cognitive functions (logic, reason, language) rather than our affective functions. Yet our cognitive functions are mediated by a small portion of our full complement of mental organs. Thus these methods leave out much of what makes us human. A. Damasio (2005) has suggested that the cognitive mind is built on top of, and remains fully dependent on the affective mind, and that without the underpinning of emotion, humans are not able to make judgements. We must acknowledge that reason is only one of many ways of knowing with which our ancient evolutionary heritage has endowed us.

Good news

The good news is that the mind, both cognitive and affective, has structure. The mind is not something that emerges out a general purpose computer, a wetware analogue of a universal Turing machine. Rather, the brain contains dedicated wetware for each mental function, including affective functions. Thus there exists the potential to gain insight into what kinds of circuits produce each kind of feeling, or domain of human experience, and the various ways of knowing, as well as consciousness itself.

The hard problem

This leaves aside the hard problem: how do joy, compassion, comfort, reason, logic and consciousness emerge from biology? The work described here provides no insight into this hard problem. Thus it provides no insight into what it takes for a mental plane to emerge from a physical plane, and thus provides no guidance to engineers as to how to induce a mental plane to emerge from an artificial system, although some clue might be found in the existence of organs of consciousness.

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