Ukhtomsky's Theory of Dominants

A. A. Ukhtomsky[1] was a Russian physiologist who investigated the mechanisms behind integrated actions in living organisms. As he clearly argued (and has since been demonstrated), simple action potentials measured outside the context of time and more general (higher order) integrative communications – cannot account for the extraordinarily efficient and responsive **unstable equilibrium** that is found in the brain and in all other homeostatic mechanisms at all scales. Whilst his work was primarily focussed on very small scale (control via action potentials in neurons), the patterns of communication-response that he identified appear to be universal from a molecular level up to whole-organism, and maybe beyond (into societal and ecosystem dynamics), and are not constrained to the nervous system and brain. Ukhtomsky deviates significantly from the fashion in western European science, because he specifically focusses on the time-variance required for organic life to function, and therefore focusses on the process (verbs). His investigative approach therefore points towards Goethe's holographic Multiplicity in Unity. On the other hand, Western neurology tends to still focus on location and attempts to locate the specific parts of the nervous system that perform certain tasks – and so is preoccupied with descriptive nouns and a reality constructed from building blocks – Unity in Multiplicity – leading to the very beautiful but static images of neural connectivity. It should be clear that a static model of connectivity, such as a "wiring diagram" of the brain, cannot possibly describe the dynamic process of Life. Just as a photograph of a bird in flight – no matter how beautiful - cannot capture its behaviour or place in the web of the ecosystem, or the sensory-motor integration of awareness and movement, or the exercise of wilful purpose as the bird flies. If there is no awareness of the

dynamics of time and response, it becomes possible to average out a rhythm and assume that this average is its reality, or to ignore the micro-variations that maintain equilibrium and consider them to be "only noise".

Ukhtomsky also pointed out that every organism attempts to anticipate the world in which it moves. **Anticipation** is a fundamental task that determines the sensory organisation of every organism (no matter how large or small) and every internal metabolic (homeostatic) process. A bacterium cannot move towards food unless it anticipates eating; a person cannot catch a ball (or a sparrowhawk catch a sparrow) unless they can anticipate its future position based on its past behaviour. And a homeostatic process cannot respond to any form of stress unless it anticipates how that stress will affect it – based, at least initially, on previous experiences.

Thus, *Meaning* is intimately tied into the question :

"That happened then ... so what happens next?"

In this sense, *anticipation* is not just a forward-looking gesture, but also constantly refers back to memory and previous experience. There are many reasons for this Janus-like position of staring at past and future from the present being central to metabolism, one of them being the fact that nothing has meaning unless it is already known (Chapter 5), and both the present and possible future are always related to the accumulated weight of experience. It does not matter that there is no direct experience in this life, because the Morphic Resonant response provides a fallback that (in its lack of physicality – being an "Idea") permeates every atom, molecule and organelle. The biological momentum behind this anticipation is so powerful that it takes a particular and extraordinary human capacity to step outside its constraints and imagine the apparently impossible. Since anticipation is an inbuilt reference to past and future, *one particular part* of the effort required to escape it and find a different response is to return wholeheartedly and with full conscious attention to the nexus of

Now[2].

Of particular interest to Ukhtomsky was the fact that – once a task has been started - any organism can and does prioritise that over other later distractions, even if their input is temporarily far greater than the communication that maintains the original task. This is *one of* the means by which actions are sustained over any length of time[3]. Homeostasis is not a fixed process, but rather, one in which there is a substantial flow of information in between different internal (almost always rhythmic) elements, and to and from the "external" environment[4]. Homeostasis itself, along with the biological structures that embody it, is not something that has arisen out of nothing. Rather, it has grown during the stages of embryological and post-natal development out of a continuously evolving dynamic homeostatic equilibrium that has also passed through several critical stages of re-working, in which old physical and temporal (rhythmic) interrelationships are replaced by new ones. Adolescence is becoming more recognised as a time when emotional regulation is difficult due to very substantial changes in organisation of the brain. And the many reorganisations necessary after birth – turning on lung function, increasing heart circulation, orienting to feeding through the mouth instead of the umbilicus (including a reversal of flow in major sections of the vascular system), recognising socialised eye contact, etc. etc. – precipitate a period of about two months in which the infant's whole organic impetus is focussed on adapting to these changes.

Although it is possible to think of homeostasis as being something relatively static, in fact it is an expression of holographic dynamic activity – rather than any simple transition from one homeostatic state to another. In exactly the same way that a stationary unicyclist is constantly adjusting by means of rapid micromovements to impossibly small changes in balance and orientation, but when s/he moves the first act is one of loss of control and literally falling in that direction. The fall – which appears to be more significant than stasis – requires less control and is less universally

adaptive, because the control to produce it was already initiated from stasis. So from a biological and homeostatic point of view, of all possible macro-activities *stillness* requires the greatest degree of internal self-regulatory micro-activity. And the balanced state of (apparent) stillness embodies the greatest potential (energy) for adaptation and response (**lability**). Technically speaking, all macro-states of change incur a penalty of inertia, and are therefore inevitably less adaptive. This seemingly topsy-turvy arrangement is a direct analogy to social immobilisation or the startle response, in which the immobilisation might appear externally calm and neutral, but in fact the homeostatic mechanisms underpinning it are more active and potentised and are open to a wider range of possibility than in any other state. Simply, a living organism that has temporarily stopped moving and entered any form of stillness is asking the question

"... What now...?"

with every atom of its being.

Immobilisation is so survival-critical for a mammal that *when healthy and awake* it cannot be a static disinterest – but rather is consists of constant high level of communication, both internally and between the socialising individuals via subtle tells in eye contact, body language etc. It is the micro-adjustments over millisecond intervals that embody meaning and maintain control through self-regulatory feedback loops. The sensitive feedback loops that maintain this homeostatic state (whether immobilisation, or constant body temperature, any other state) from a locus around which the entire organism's activity temporarily pivots, are fundamentally integrative in nature, and are always contingent ...

> *Normal physiological operation of any given organ or tissue is not a statically determined value but a reflection of the current functional condition...*[5]

The constant communication within a distributed holographic intelligent network that

is required for any kind of life (including a single cell!) to maintain homeostasis cannot be explained by centralised or linear or organ-centred model.

> *As Rusinov stressed – the various cortical elements in a polarizational dominant react as a unitary functionally organized ensemble or system with long-term effects after the current is switched off. This cannot be explained by shifted membrane potentials, which return to their initial levels almost immediately after the current is turned off, and which from the perspective of the polarizational model represent only the first and preliminary effect of forming a dominant physiological system. The dominant focus, according to Rusinov, entails widely integrated structural and biochemical changes occurring under electrotonic effects*[6].

In other words, the relatively high voltage action potentials are synchronised within a much lower voltage background level of activity that serves to coordinate and maintain coherence and persistence well beyond each specific discharge and beyond each specific neuron, synapse or target organ/muscle. It is possible to (appear to) account for this background Dominant by thinking of it as being *emergent* from the total action potential activity. However, the implication of the Dominant theory is that the higher order coordination egg precedes the chicken of total emergent individual action potentials. This arrangement is (amongst other things) reminiscent of Valerie Hunt's high frequency EMG measurements (see notes on Multiplexing, below). Bones are particularly effective semiconductors (though all connective tissue is to some degree semiconducting and provides a non-neural layer of communication[7]), and are particularly likely candidates as a source of this electronic and low frequency radio activity. It is not surprising that they have recently been identified as being central to the fight-flight response[8].

These inherent anticipatory responses (or more accurately *adaptive ranges of response-action*) are what Ukhtomsky called "Dominants". Each of them forms a

recognisable *pattern in time* – which on a higher organisational level might be observed as a pattern of reactive or automatic behaviour, or personality, or habit (or habituation). There are three fundamental characteristics whose change over time defines the three distinct phases of a Dominant response :

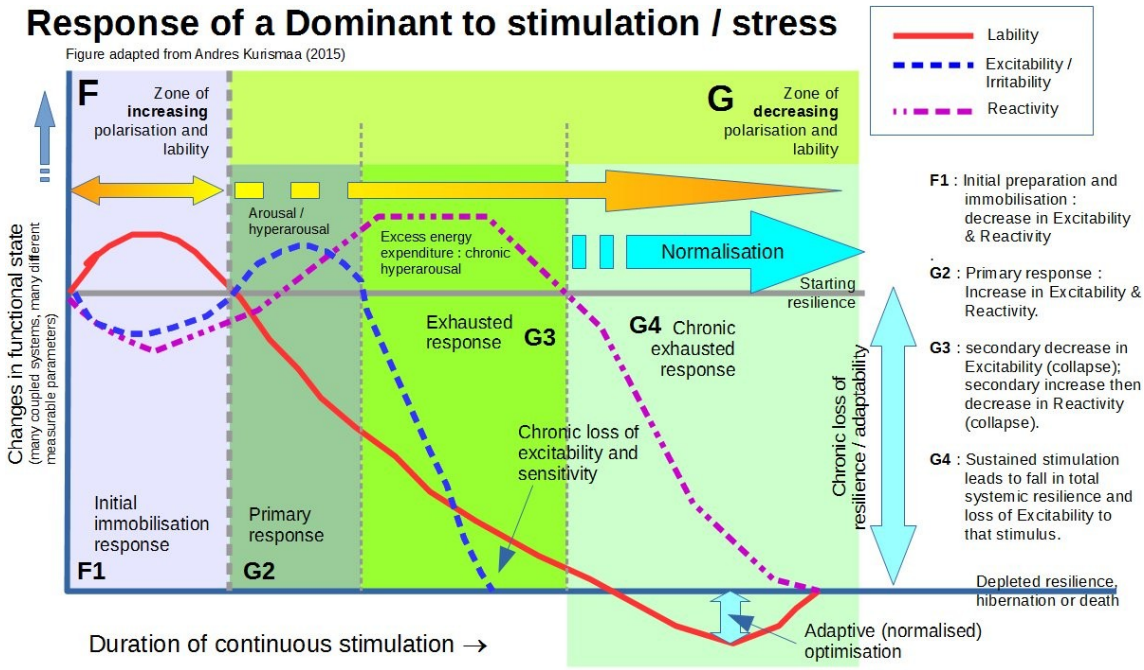
Lability is the capacity for constant change and ***adaptation***. When considering the Window of Tolerance of the ANS, Lability is at a maximum in the heart-centred range of ANS activation. In a heart-centred mental-emotional state, physiological efficiency and systemic coherence is optimised; and there is a maximised potential to adapt in any physiological, mental, emotional, sensory and behavioural direction. Lability with respect to action potentials is also associated with the generation of electrical charge. The body is electrical, and through the action of the whole-body electrical field, Lability is strongly associated with the capacity to maintain territory and defend body-space – and therefore to maintain psychological[9], physical and relational identity/integrity.

Excitability (or **Irritability**) is the capacity of a cell or tissue to generate or propogate (transfer) action potentials. On a more systemic or whole-body sense, it is the capacity to receive a stimulus (information) and then to respond through movement or other meaningful gestures. i.e. it is the ability to move within the ***sense-response cycle***. In contrast, Lability is a measure of what kind of responses are possible and how much choice and mobility there is in selecting those responses.

Whereas the previous two definitions are about *capacity* to respond, **Reactivity** is the *actual* response to stimulus. e.g. it describes the specific change in ANS balance that occurs when we meet a new situation.

The expression and creation of a Dominant

A basic Dominant response is shown in the figure below. As the graph moves to the right, it shows the changing effect if the same stimulus is applied constantly over an increasing period of time. The response of the two major zones and three sub-zones defined by Ukhtomsky can be understood simply with regard to the ANS, but *it should be remembered that the processes described are of the same generic form at all levels and modes of response by living systems, from sub-cellular up to societal.*



- **F1** : Initially there is a startle-immobilisation response. When we go still in order to create a space in which we can decide how to respond :

i. all sensory and physiological activity increases, but only focussed on the potential danger ... so *total* capacity to receive information (excitability) decreases

ii. the capacity for adaptation in creases because this Dominant – at least temporarily - takes highest priority, so there is no momentum from a currently active Dominant to be overcome. Note that a Dominant *always* suppresses all other activity within its sphere of influence - which in turn depends on its level of priority. If the priority level is high enough (such as a surival-critical event), all other potentially active Dominants are temporarily suppressed. This is sometimes described as "flooding".

iii. functionally, the stillness suppresses reactions so that (a) it is harder to be seen or heard, and (b) so our senses are more acute and therefore can more easily gather and assimilate information.

- **G2** : Now we have decided how we should best respond for optimum effect, and begin to express that as activity (which on a macro-scale always implies movement). This movement decreases our potential for adaptation (Lability), because a Dominant has been set up, which embodies a certain degree of momentum and tends to suppress response to other stimuli. For instance, if I focus on the road when driving (so driving is the Dominant), I am less aware of the passengers conversation. But if I focus on a conversation in the car (so that listening becomes a high priority Dominant), then the driving Dominant is given second place, and although I may still be driving, there is less capacity (Excitability/Irritability) for conscious awareness-response of driving, though that Dominant may still be processing on less conscious levels, with the necessary excitation being withdrawn to some degree from the capacity for conscious intervention. Once a course of action has begun it takes a big effort to change or redirect it or to engage with another Dominant. But the

movement/response also usually opens up a focussed ability to respond and to communicate and receive information (i.e. in the case of a social Dominant the Ventral Vagus nerve will be engaged in socialisation activity).

- **G3** : But as the same stimulation continues, it becomes harder and harder to maintain the same level of response. The party becomes more and more tiring, the loud music might be initially pleasant, and then just becomes a background noise that brings its own stress and exhaustion, the constant conversations and exchanges might be enjoyable for a few hours, but then a desire for something else – silence, solitude, sleep – begins to set in. As the duration of stimulus increases, if the reactive Dominant demands attention for good reason (i.e. it's not just a party – it might be a baby with colic that continues to scream unconsolably for several hours), it increasingly "dominates" the capacity to respond, excluding all other possible Dominants/responses. Information theory begins to take effect – in that a continuous noise becomes the norm and (almost) equal to no noise at all – except that it takes a lot of energy to filter it out so that we can be aware of anything else.

Meanwhile the "Excitability" (Irritability) increases for a while – so although the noise might become the norm, a hyperaroused response develops. Even though the level of noise (or pain) might not have gone up in reality, the sensory system ramps it up because of the feedback loop demanding our attention. One manifestation of Zone G3 is central sensitisation.

- **G4** : In the chronic state of stimulation, the sensory system disengages, becoming numb, and the entire mental-emotional-physical capacity to respond and adapt to anything (resilience) is decreased. This is stress-induced dissociation, which physiologically consists of an opiate-adrenal state. The bottom line of the graph is the chronic whole-body resting state with which the next stimulation is encountered and responded to. Note that in the final stages of normalisation the red line (Lability / capacity for adaptation / resilience) returns to a slightly higher level. This represents

the body shifting to a different homeostatic balance by changing the way in which everything interacts to make the best of the presence of the new adaptive Dominant. This shift increases total resilience (energy efficiency) at the expense of losses in efficiency and adaptive capacity at lower metabolic levels. This is essentially a reduction in Wellness (Chapter 3). If the cumulative effect of Dominants is sufficiently large, there is nowhere left for the total body adaptive capacity to go when a new stressor is encountered – and at that point a "last straw that broke the camel's back" effect can be seen. I regularly hear people coming to my clinic saying "*I just bent over to open a drawer and then my back gave way.*" The small normal everyday stress could not be accommodated by normal adaptive capacity because there was no adaptive capacity left.

The characteristic Dominant response shown in the above diagram is found in all biological, physiological, mental, emotional and societal responses regardless of their type; the difference being purely a matter of relative duration of each of the three zones, and the specific level of process one is observing. So this model applies equally well for whole-body ANS responses as it does for individual action potentials or for metabolic changes of any kind (whether immune or systemic or confined to an individual organ) to any kind of stressor. It applies to tranquilisation as much as excitation, as much as it also applies to inhibition, but each of these invoke a different proportion between the three/four zones.

The above graph should not be interpreted as having to be in any way traumatic or catastrophic (though, of course, it can be if the stressor is large enough). The magnitude of responses, of numbness, and loss of resilience that occur in response to a constant stimulus/stressor is determined by :

i. the magnitude and type of stressor

ii. the pre-existence of Dominants to deal with that stressor

iii. the inherent adaptive resilience at the onset of stress/stimulation

If the stimulation is a low level of traffic noise, then provided there is not a pre-existing noise-affected Dominant, the person will first feel a little stressed, then will become slightly hypersensitive to the noise and find it annoying. But then the traffic noise will become normal background, will (unless attention is deliberately directed at it) become unnoticeable. The penalty for this normalisation is that a new Dominant (lets call it the "I'm going to ignore traffic noise Dominant") is created, which

i. creates response inertia and so reduces total resilience and adaptive capacity on a mental-emotional-physiological level

ii. takes up metabolic room, and slightly displaces a series of sensory and metabolic processes, reducing their adaptive range

iii. induces an inbuilt level of environmental numbness, which is accompanied by a loss of capacity to respond to the environment

All these might be so small as to be imperceptible, but they are still present, perceptible or not – as is shown by the fact that even caterpillars are stressed by traffic noise and have a higher resting heart rate! The presence of this "traffic noise Dominant" specifically predisposes the person to a higher level of reactivity and reduced capacity to adapt gracefully to future noise-related stressors; but generally reduces the capacity to adapt to any kind of stressor. Many of these imperceptible Dominants (a chemical toxicity, a disruptive neighbour, a mobile phone signal, a piece of bad news, job insecurity, etc etc etc) may be stacked on top of each other, and the net effect of multiple small environmental stimulants or stressors is that there are cumulatively large losses in systemic resilience, and similarly large losses in sensory engagement. i.e. there is an increase in systemic dissociation.

In fact, any Dominant created as a result of a constant stimulation almost inevitably

leads to reduced resilience and an accompanying loss of sensory engagement – which most often manifests as a qualitative reduction in embodiment – i.e. dissociation. Having said that, life is a continuous adaptive compromise, and we are so universally adaptable that it is almost impossible to tell which particular environment humans are truly optimised for. And of course, Dominants may also be positive. Most people have strong dominants associated with activities that they enjoy, or which occupy all of their attention, and can often be heard to say "I was in pain, but when I got interested in X it seemed to go away". Which Ukhtomsky elegantly explains as one Dominant taking the highest priority and so reducing perception of stimulation that is not relevant to that particular Dominant. The need to pee or defacate similarly removes interest from other possible actions, and makes concentration on other things far more difficult – another example of the action of a Dominant that is familiar in everyday life. Survival-critical Dominants (such as the need to pee) tend to flood and take over far more easily, so even though it is possible to ficus through them to other layers of information, they still dominate the experience of that particular moment. Dominants are familiar in Trauma work as "alters" and "apparently normal parts" in Dissociative Identity Disorder – which are substantial and intense examples of Dominants that can be set up and retained in lesser traumas (such as traffic noise).

The interesting thing is that small to mid-range Dominants can be neutralised and re-normalised with a return to previous levels of adaptation, resilience, coherence, integration, and sensory engagement. So although a Dominant is an embodied response-pattern, it is a programmable one, and can equally be de-programmed. The rules for how a dominant is set up in the first place provide some understanding of the process by which a *redundant* Dominant (i.e. one no longer adaptive to current circumstances) can also be de-prioritised (as a temporary solution); and – most importantly - how it can be re-normalised.

Notes : AA Ukhtomsky

1 Zueva E.Y., Zuev K.B. (2015) The Concept of Dominance by A.A. Ukhtomsky and Anticipation. In: Nadin M. (eds) Anticipation: Learning from the Past. Cognitive Systems Monographs, vol 25. Springer, Cham. Pp 13-35

2 Eckhart Tolle (2016) The Power of Now: A Guide to Spiritual Enlightenment. Publ. Yellow Kite ISBN-13: 978-0340733509

3 Andres Kurismaa (2015) Perspectives on Time and Anticipation in the Theory of Dominance. In: Learning from the Past: The Russian/Soviet Contributions to the Science of Anticipation. Springer International Publishing, Editors: Mihai Nadin DOI: 10.1007/978-3-319-19446-2_3 ISSN: 1867-4925 Chapter 2, pp.37-57

4 Considering that to a homeostatic process, "external" can mean to and from internal processes that have a different primary function – that will also have to adapt to the overall change in systemic balance. So it is not only referring to the environment outside the physical and immunological bounds of the body.

5 Andres Kurismaa (2015) op. Cit.

6 Andres Kurismaa (2015) op. Cit. p. 53

7 Bordoni, B., Marelli, F., Morabito, B., & Sacconi, B. (2018). Emission of Biophotons and Adjustable Sounds by the Fascial System: Review and Reflections for Manual Therapy. Journal of Evidence-Based Integrative Medicine. https://doi.org/10.1177/2515690X17750750

8 Julian Meyer Berger, Parminder Singh, Lori Khrimian, Kamal Rahmouni, Xiao-Bing Gao & Gerard Karsenty (2019) Mediation of the Acute Stress Response by the Skeleton. Cell Metabolism 30, pp 1-13 https://doi.org/10.1016/j.cmet.2019.08.012 and https://scitechdaily.com/surprise-fight-or-flight-response-driven-by-bone-not-adrenaline/

9 Andres Kurismaa & Lucia Petrovna Pavlova (2016) The Dominant as a Model of Chronogenic Change: The Relevance of A. A. Ukhtomsky's and L. S. Vygotsky's Traditions for Systemic Cognitive Studies. In : Centrality of History for Theory Construction in Psychology, Chapter: 7. Springer International Publishing, Editors: Sven H. Klempe, Roger Smith, pp.125-149