Bigu State: Can Meditation Trigger Alternate Metabolic Pathways Through Epigenetic Changes?*

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Abstract: Based on preliminary reports, case studies (Roy, 2000; Yan et al., 2002b) as well as an in vitro experiment conducted at University of California, San Diego (Yan et al, 2002a) we propose several new tests designed to confirm and further investigate the ability of human cell cultures treated with Yan Xin Qigong to survive for extended periods of time, in the absence of medium nutrients, when compared to controls. Specifically, our supplementary experimental protocol is intended to ask the following questions: 1. Are there changes in gene expression following the Yan Xin treatment when compared to controls, what physiological/metabolic processes are these genes associated with, and how does the gene expression profile evolve throughout the duration of the experiment under conditions of nutrient deprivation? 2. Is ambient light necessary for the extended survival of the treated cells? 3. Are there biophoton emission (BPE) changes noted at the test culture after the External Qi (EQ) treatment and how does that BPE profile evolve throughout the duration of the experiment, compared to controls? 4. Finally, is there any evidence of information or energy transmission between different cell cultures, that might support the hypothesis of a "remote metabolism" as described by Pitkanen (2013b)?

Background

One of the most rarely discussed and inadequately researched phenomena associated with the meditative practice of Qigong is "Bigu", or the ability to carry out a normal, active lifestyle on little or no caloric intake. During the First National Conference on the Bigu Manifestation, Health Effects and Scientific Research of Yan Xin Qigong (Pennsylvania State University, June 23-25, 2000), approximately 100 conference attendees claimed to have personally achieved this state, sustaining active, normal lives in corporate and academic research centers while eating no solid food (or the equivalent of 250-300 calories per day, vs. the recommended 2000) for weeks, months and sometimes years at a time. Of the 100 Bigu practitioners present at the 2000 conference, approximately a quarter were US physicians and university professors; some of these cases had been closely monitored and documented in US medical research centers (Roy 2002, Yan et al., 2002a), showing unusual metabolic profiles, clearly distinct from those

seen with starvation (Yan et al., 2002 b). In addition, an in vitro study conducted at University of California, San Diego was published in 2002 (Yan et al., 20002 b), showing that cells remotely treated by Yan Xin qigong were able to survive in a nutrient-deprived culture medium for over 8 weeks, compared to 3 days for controls cells.

Although such case reports stretch credibility from a Western theoretical perspective, the very high profile of the organizers and participants (including members of the US National Academy of Science, the past director of the Max Planck Institute of Theoretical Physics, professors at Harvard and University of California, etc) and the technical merit of the scientific presentations suggest that the phenomenon may warrant further investigation. According to Dr. Rustum Roy, conference chair and founding director of Penn State's Materials Research Laboratory, Bigu meditation techniques appear to make the body switch to a more balanced and efficient state, which requires far less energy intake. However, while decreased caloric intake has been consistently documented to reduce the oxidative stresses and cellular damage associated with the respiratory chain (Poljsak 2011, Holloszy and Fontana 2007, Sohal and Weindruch 1996), thus increasing longevity in numerous species, the Bigu protocol requires an extreme dietary modification that cannot be justified on the basis of currently understood metabolic pathways. Do the historic accounts of mystics "living on light" (Straubinger, 2010) have anything to teach us about the body's potential and the connection between meditation and physiology, or are we dealing with mere legends and frauds?

While we cannot endorse the adoption of such a lifestyle modification except under the strictest medical supervision (and noting that several fatalities have already been documented where individuals decided to proceed with such measures on their own), we nevertheless believe that the potential implications and applications of this phenomenon are too significant to ignore from a scientific perspective. Does the body have alternate metabolic pathways that can be switched on through meditation techniques? What could be the basis of such an alternate mechanism – could it involve the reactivation of silenced genes, or changes in molecular conformation and an increasingly coherent signaling/energy utilization system maximizing quantum biological effects? And in those cases of strict Bigu state where the caloric input is limited to zero, what source could possibly provide the minimal energy required to keep the body alive and active? The possibility that one day we might be able to tap into this hidden physiological potential through simple mental techniques, reducing our population nutritional needs and possibly increasing longevity, as current literature suggests, is, in these authors' opinion, sufficient justification for a more extensive research program into the validity and mechanisms of the Bigu phenomenon.

Preliminary Findings and Hypotheses

It has been recently proven that meditation can trigger genome-wide expression changes within as little as 2 hours, involving hundreds to over 1,000 genes which cover a wide range of metabolic functions and which vary, to some degree, with the type of meditation practice (Ravnik-Glavac et al., 2012; Qu et al., 2013; Li et al., 2005). These results corroborate previous controlled studies demonstrating that meditators exhibited significant and wide-spread transcriptional changes involving oxidative phosphorylation, ubiquitin-dependent protein catabolism, nuclear messenger RNA (mRNA) splicing, ribosomes, metabolic processes, NF-κB pathways, cysteine-type endo-peptidase activity, antigen processing and generation of reactive oxygen species (Dusek et al., 2008); regulation of cell cycle, antioxidant enzymes, DNA damage, cell cycle control, aging, and apoptosis (Sharma et al 2008); and

down-regulation of cellular metabolism, enhanced immunity, and alteration of apoptotic genes (Li et al, 2005) .

In addition, there is a vast literature demonstrating that gene expression can be significantly modulated by External Qi treatment (EQ) when applied to in vitro cell cultures: a 2012 controlled study on the SCLC cell line NCI-H82 showed powerful cytotoxic effects achieved by transcriptional modulation of 39 genes involved in cancer cell apoptosis, proliferation, metastasis, and glucose metabolism (Yan X. et al., 2012). Chien et al. (1991) looked at the bi-directional effects of external qi on FS-4 human fibroblasts and found that "facilitating" qi produced a 1.8% increase in cell growth rate in 24 hrs, 10-15% increase in DNA synthesis and 3-5% increase in cell protein synthesis in a 2 hr period. With "inhibiting" qi, cell growth decreased by 6% in 24 hours, while DNA and protein synthesis decreased respectively by 20-23%, 35-48%. Zhang et al. (1990) studied the effect of emitted qi on the nucleic acids of chick red blood cells and found a two-fold increase in DNA and 12-fold increase in RNA content.

The effects of meditation at the biomolecular level appear to vary to some degree with the type of meditation or visualization used: Rein and Laskow found that four different intentions by the same healer produced distinct magnetic signatures and corresponding biological effects on tumor cell cultures (Benor, 2001). Rein and McCraty (1994) reported a 250% change in DNA conformation, directly correlating with the intent of a healer from a distance. The directional winding/unwinding of DNA under specific intent has been repeatedly demonstrated by Rein and his team over a number of years and experimental set-ups, with some samples showing more denaturation than could be obtained via normal heating or mechanical means (Benor 2001). Finally, Achterberg and Rider showed that training patients in cell-specific visualization of either T lymphocytes or neutrophils resulted in statistical increase in cell blood levels correlating with the type of imagery employed (NIH 1992).

Of particular interest is Dusek's finding that meditation practice consistently resulted in significant enrichment of electron transfer gene sets, in addition to oxidative phosphorylation. Many studies have by now demonstrated that meditation reduces oxidative stresses as well as biophoton emissions (Mahagita 2011; van Wijk E. et al., 2008; van Wijk and Koch 2006; van Wijk and Ludtke, 2008; Kim et al, 2005; Schneider et al., 1998). Given the correlation between the concentration of reactive oxygen species (ROS) and the intensity of biophoton emission (van Wijk et al. 2006, 2008) this is not surprising and could be seen as supporting the hypothesis that alternate metabolic pathways triggered by meditation result in fewer products of oxidation. There is, however, an additional, perhaps complementary explanation that might account for the observed reduction in BPE – and that is the possibility that meditation induces conformational changes in biomolecules such as chromatin (shown to correlate with BPE fluctuations, per Popp et al 1984; Gericke, 2006) which enhance the underlying baseline biophysical coherence (Popp et al., 1984, Popp 2003, Bajpai 2003, Van Wijk E. et al, 2008; van Wijk and Ackerman 2005) and quantum biological effects (Sponer et al. 2012, Trevors and Masson 2011; Bajpai 2003; Sidorov and Chen, 2006), resulting in reduced dissipation, with more efficient energy utilization and cellular signaling (Sun et al., 2010; Rahnama et al., 2011). Dusek's finding that the transcription of electron transport genes was consistently affected by meditation suggests that perhaps we are dealing precisely with such an enhanced energy transfer mechanism. The interaction between reactive oxygen species (ROS), biophotons and cellular signaling controlling genetic expression needs to be investigated in more detail. In a 2006 paper published in Medical Hypotheses, Gericke discusses the impact of ROS on the conformation of DNA regulatory regions controlling synaptic plasticity (Gericke, 2006). Since reactions of certain radicals release sufficient energy to generate UV-photons and DNA conformational changes are also accompanied by changes in photon emission (Gericke, 2006; Popp et al., 1984), could the metabolic transcriptional changes induced by Yan Xin qigong and other Bigu-type meditation techniques allow the body to capture the energy of such endogenous photon emissions and feed it into novel electron transport chains?

Finally, the physical mechanism through which External Qigong acts on remote targets remains, together with hundreds of other DMILS studies (Benor 2001; Dossey and Schwartz; Sidorov and Chen 2006; Radin 1997; Qigong Institute Research Bibliography), a well documented but little understood phenomenon. We know that sender/receiver EEG synchronization has been amply documented between isolated subjects (for review see Radin 2006) and that biophotons can travel along single neurons as well as play a role in cell-to-cell signaling (Popp 2003, Sun et al, 2010; Rahnama et al., 2011). Rahnama et al.'s analysis showing that biophotons can modulate the degree of coherence in mitochondrial microtubules and that these microtubule fluctuations correlate with alpha-EEG diagrams, together with the findings discussed earlier in this paper, raises the possibility that biophotons act as an overarching signaling, control and energy transfer mechanism, allowing the coordinated expression of alternate metabolic pathways, as would be required by the Bigu state. Whether this hypothesis is true, and whether topological transformations as proposed by Pitkanen's recent TGD developments (Pitkanen 2013 a,b) are behind this nonlocal information transfer, are complex questions that we hope will be addressed by future experiments.

Experimental Proposal

In the 2002 experiment conducted at the University of California, San Diego, mouse hybridoma cells (S2B4C4 cell line) were grown in Dulbeco's modified Eagles medium without serum or in phosphate-buffered saline buffer without other nutrients. The test samples were treated with 30 minute sessions of external Qi from a distance by Dr. Yan Xin, while control samples were placed in a different building, but otherwise grown under identical conditions. While the control cells lasted 2 days in PBS medium and 3 days in DMEM, 33% of the PBS test cells were still alive at 14 days, and 65% of the DMEM test cells survived past 8 weeks (Yan Xin 2002 a)

Based on this preliminary study on "cellular Bigu", we suggest that a modification of the original protocol, looking closely at genetic and physiological markers, could not only shed light on the validity and magnitude of this effect, but provide important clues as to the mechanisms that might be involved.

The main questions we wish to address, and the corresponding experimental protocol modifications, are outlined below.

Question #1: Does the EQ treatment applied to the experimental cell sample induce changes in gene expression – and what processes are these genes associated with? How does the genetic profile compare to that of simple caloric restriction?

Since Bigu-type effects have been reported both in humans using specific mental techniques (Bigu meditation) and in vitro, in cell cultures treated by external qi, we postulate that such mental focus could induce alterations in the normal gene expression, allowing cells to switch to a novel (or silenced) metabolic pathway that somehow makes use of alternative energy sources.

Protocol #1: As per Ravnik-Glavac's protocol (2012) we suggest that mRNA be extracted from nutrient-deprived cell cultures and studied for transcriptional differences by micro-array analysis and Gene Set Enrichment Analysis (GESA) (Subramanian et al., 2005) to identify gene ontology (GO) categories that

were significantly enriched in the experimental vs. the control samples. We recommend that this be done shortly after application of the external qi treatment and then at regular intervals throughout the length of the experiment, to determine how genetic expression is influenced by the lack of nutrients and how EQ treatment might alter that response.

Question #2: Is ambient light necessary for the survival of the EQ-treated culture?

The obvious question behind any discussion of Bigu-type phenomena is "what provides the metabolic energy?" The general engine for the generation of cellular energy currency (ATP molecules) in humans is the oxidation of fuel molecules and the transport of electrons with high transfer potential along electron transport chains, which allows the capture and storage of this energy as ATP. The processes involved in this reaction are glycolysis, the citric acid cycle and oxidative phosphorylation – as opposed to photosynthesis, where light energy is used to pump protons across the chloroplast membrane, producing the proton-motive force responsible for ATP synthesis In the absence of fuel molecules, what could supply the high-energy electrons required for ATP production in the mitochondria?

The least esoteric solution would seem to point to ambient light/ sunlight as somehow producing a population of excited-state electrons – a hypothesis that finds some support in historical and anecdotal accounts (Straubinger, 2010). Could it be that specific mental intent is able to turn on alternate metabolic pathways capable of capturing the energy of these excited electrons? While the possible mechanisms remain unclear, a first step would be to confirm the necessity of light for the survival of the treated cell culture.

Protocol #2: we suggest dividing the nutrient-deprived, EQ-treated cell culture into two experimental samples, A (receiving daily sunlight exposure similar to human daily cycles) and B – grown in the same culture medium, under identical temperature and other ambient conditions, but without any light exposure. Do the [A] cells survive longer than [B]? And are different genes expressed in [A] vs. [B]?

A further refinement of this protocol could ask whether alternate metabolic genes are expressed at all under conditions of nutrient deprivation-sunlight exposure, in the absence of EQ, then compare those changes with EQ-treated cells. The finding that the mitochondria of caloric-restricted animals released fewer ROS per unit electron flow (Gredilla et al. 2001) suggests that such alternate metabolic pathways may be part of a natural mechanism, that meditation simply enhances. Finally, is there a difference in gene expression in non-deprived cells when grown with sunlight versus in the dark?

Question #3: If the necessity of light is confirmed (which would somehow suggest a photon-utilization mechanism), then the logical question to follow would be "what about non-surface tissues, such as gut or muscle, that do not receive any exposure to light? Is there an intercellular transfer of energy possible?

Protocol #3: We propose that, as I the previous step, the EQ-treated culture be divided into a fraction [A] that receives light exposure on a human-cycle basis and a fraction [B], grown in close proximity but in absolute darkness. Furthermore we recommend that sample [B] be enclosed in a biophoton measuring chamber (vanWijk & van Wijk, 2003), or be grown on a TSM sensor (Cheran 2012) which would allow real-time, non-invasive and highly sensitive detection of any changes associated with exposure of sample [A] to ambient light. Is there a change in baseline BPE or TSM resonant frequency/ motional resistance for sample [B] following light exposure of sample [A] – which would suggest some possible form of entanglement, as per Backster's findings (Backster, 2003)? What is the time lag to such an observable

change? And how does the BPE of samples [A] and [B] compare to non-EQ treated controls immediately following EQ treatment?

Finally, another way to test the possibility of information/energy exchange between cell cultures would be to look for biophoton emission fluctuations in [X] (EQ-treated, nutrient-deprived culture) and [Y] (a non-treated, non-deprived culture) both within and outside the EQ treatment periods. Do the biophoton emission intensities/ frequencies at [X] and [Y] correlate? If so, then further testing may be indicated to determine whether "entanglement bridges" are formed/strengthened by EQ between genetically related organisms.

FURTHER INVESTIGATIONS

Let's consider four different cultures, all originating from the same parent culture:

A: nutrient-deprived , no EQ treatment
B: nutrient-deprived with EQ treatment
C: no deprivation (normal growth medium) no EQ treatment
D: no deprivation (normal growth medium) with EQ treatment

Observables: survival time and gene expression.

Information/energy transfer: does it happen and where is it initiated? Inadvertent leakage versus active extraction

Backster's well known experiments demonstrating remote communication between plants hooked up to a polygraph detector and cell cultures under stress (Backster, 2003) suggests one other possibility: could nutrient-deprived cell cultures somehow communicate with non-deprived or EQ-treated sister cultures and thus extract necessary information or energy to help them survive longer? This type of "remote metabolism" and the biophysical mechanisms that might account for it are discussed in detail in [Pitkanen 2013 b]. The scope of our proposal is not to provide a definitive answer to these complex questions but simply to identify experimental protocols that might offer relevant data or further research leads.

We could also extend the above protocol to look into the possibility of information or energy "leakage" between the treated and the control cultures: could the healer's intent be inadvertently transmitted to the control cultures, as in Bengston and Moga's experiment (Bengston and Moga, 2007), resulting in a longer survival time when compared to deprived cultures in the *absence* of any concomitant EQ treatment? Would the survival of the controls be longer when run *at the same time* with the test sample than when run *separately*? This might give us a clue as to whether there is any degree of information/energy leakage either through experimenter/healer intent contamination or via energy transfer between the two cultures.

Scenario 1 Two type A cultures (nutrient-deprived, no EQ) are studied at separate times: in one protocol, A is studied alone and the survival time noted. In the second protocol, A is studied as a simultaneous control to B – where a healer treats the B sample with repeated EQ sessions. Does the average survival time of A in this latter protocol exceed the average A survival time in the former protocol, where no simultaneous injection of information or energy was attempted into a related culture?

Scenario 2 The culture is split into two, one half is EQ-treated [B] and the other is not [A]; the healer is blind to the fact that a second, control sample [A] exists - only the experimenter knows the exact set-up and test hypothesis. If [A] survives longer than the average time in the first protocol above, then one could conclude that information or energy was somehow leaked via the experimenter's expectation.

A similar question could be asked about the genetic expression in culture [A]: does the simultaneous treatment of another culture with EQ produce any changes in the genetic profile when compared with Scenario 1, first protocol? If the answer is positive, then the possibility of information leakage needs to be considered.

Effects on longevity

The studies discussed above show that meditation triggers ROS-protective genetic expression changes quite consistently in normal (non-nutrient deprived) individuals. It would be interesting to compare the genetic changes produced by yoga, TM and other self-administered meditation regimens with those produced by Bigu-specific EQ on cells extracted from the same individual. Also, labeling parent cells might allow us to see if non-deprived cells treated with EQ live longer than non-treated, non-deprived cells, while a genetic profile comparison could allow us to correlate the increased longevity associated with meditation (Epel et al., 2009; Jacobs et al. 2011) and caloric restriction (Ribaric, 2012) with the physiological mechanisms responsible for the Bigu EQ effect. Finally, it would be interesting to see what happens if an EQ-treated, nutrient-deprived culture is split in two after one week, and the normal growth nutrients are reintroduced to one of these daughter cultures: does the genetic expression switch back to the normal profile, or do some of the metabolic changes persist?

Discussion: Remote Metabolism and the Question of the Simplest Possible Metabolic Pathway

The TGD model of a "remote metabolism" (Pitkanen 2013 b) suggests an extremely simple manner to produce ATP without involving the standard metabolic machinery, and avoiding the production of free radicals. This mechanism could explain the reported ability to survive without nutrition (Roy 2000, Yan Xin 2002 b). For a detailed description of the model and its motivations coming mostly from anomalies associated with cell membrane and the work done by Tesla more than century ago see [Pitkanen 2013 b]. Here only the basic ideas are sketched.

1. Drop out all initial steps of the oxidative phosphorylation appearing in both photosynthesis and cell respiration (http://en.wikipedia.org/wiki/Oxidative_phosphorylation), and replace the last step involving formation of ATP using ATP synthase (pumping protons against membrane resting potential) with a much simpler process.

The final step in oxidative phosphorylation involves dropping of 4 protons through the mitochondrial membrane. The liberated electrostatic energy goes to ATP as it is formed. The electrostatic energy ZeVrest, E = eVrest ~ .06eV depends on the charge Z of the charged particle only. One can therefore imagine several basic units: two Cooper pairs of protons, two Cooper pairs of fermionic ions or two

doubly charged ions such as $Ca^{++,}$ and electron Cooper pairs moving in opposite direction through the membrane could liberate the same energy to be used to build ATP. One could even say that resting potential defines fundamental metabolic energy
quantum.

2. The loading of metabolic batteries could take place by remote metabolism in very simple manner: a charged particle with charge +/-2e sends negative energy Josephson photon energy E = -2 eVrest to some magnetic body and in this manner gains opposite energy as a recoil energy and is pumped to the other side of the membrane.

3. The fundamental energy quantum would be about .06 eV. Metabolic energy quantum assigned to ATP has a nominal value of .5 eV. This process would not utilize dark variants of visible photons (decaying to biophotons) but dark variants of infrared photons decay to IR counterparts of biophotons. A killer test for the proposal could be a check whether IR analogs of biophotons
with these energies exist.

Absorption of photons at Josephson frequency is obviously a very primitive manner to gather metabolic energy. What about photosynthesis? Could it rely on the absorption of visible photons at Josephson frequency kicking ions to the other side of the photo-receptor membrane, dropping back spontaneously and transferring their electrostatic energy to the electrons in the electron transport chain? This could eventually lead to the kicking of four protons (or two proton Cooper pairs) through the membrane and generation of ATP. Photosynthesis would transform solar photons as natural metabolic energy quanta associated with near vacuum extremals to the IR metabolic energy quanta. In [Pitkanen 2013 b] it is demonstrated that this kind of scenario can be indeed considered.

Conclusion

The above discussion and proposed experiments are just a tentative step toward unlocking the mechanisms behind the mind-body connection from a quantum biological perspective. Much of the existing scientific literature dealing with the effects of meditation has focused on neurophysiological and neuroendocrine responses. However, with the advent of quantum biology and epigenetics, we feel that the time has come to ask more incisive questions. The health benefits of meditation are wide-spread and amply documented – but Qigong and DMILS evidence suggests that we have only scratched the surface. If different types of meditation and targeted visualization can indeed achieve specific physiological effects, as documented above, then we have an obligation to understand the significance of these different protocols and customize them to patients' specific needs. Furthermore, the potential applications of Yan Xin/ Bigu mental techniques extend beyond the short-term adjunctive cancer interventions (He and Chen 2002; He 2001; He and Zhong 2001) or longevity-promoting lifestyle modifications advocated by current practitioners. Understanding the genetic and physiological mechanisms behind this phenomenon could unlock the door to better diabetes management interventions (Balaji 2012), reduce the overall health costs associated with ROS-related conditions and help undernourished populations supplement their metabolic needs through the application of specific meditation practices, at least on an emergency basis.

**WARNING: The above discussion is intended strictly for scientific research on cell cultures and should not be taken as an argument for the adoption of extreme caloric restriction in humans. The authors believe that the Bigu phenomenon still requires adequate scientific validation and is too poorly understood at the moment to permit the implementation of such a protocol in human subjects in the absence of expert training and full medical supervision – a warning that echoes Dr. Yan's recommendation in his 2002 paper.*

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