Synopsis of Shivaram AC

Title:

Application of Mantras as a therapeutic tool for addressing Autism and similar speech and hearing related disorders in children

Abstract:

In this study, it is proposed to analyze audio samples of selected mantras using digital signal processing techniques; then propose an algorithm which can identify key markers encoded in these mantras and then correlate these key markers with physiological and psychological changes on a human body. Further it is proposed to use this understanding to formulate a therapy module to positively influence children suffering from Autism and similar speech and hearing related disorders.

Introduction:

It is believed that Yajnas can grant wishes of the performer. There have been many references in ancient literature where Yajnas / homas have been performed to heal the ecosystem, society, participants along with the performer. Yajna / homa therapy is an ancient tool which is emerging again as one of the healing techniques. Yajnas / homas have two components, Yantra a form based tool and Mantra a sound based tool which together provide an audio-visual stimulation to the mind-body complex. This stimulation is believed to improve efficiency of the brain and thus derive positive benefits like health, happiness and peace of mind. Music therapy is another sound based therapy technique in which the therapist composes and plays selected musical patterns to soothen the mind, activate the dormant brain centers and thus heal ailments of the recipient. Many research papers published recently provide enough evidence to prove the therapeutic benefits of music. The term music, itself is a subjective description, perception of which could depend on age, gender, location, culture, individual's upbringing etc. In a broader sense, mantras or music is made up of unique sound patterns which can influence physical as well as psychological existence of a human being. Though many have accepted this

fact, it would be of interest to generate more evidence by rediscovering the mechanism of how sound influences a human being, what are the key parameters in a particular sound pattern (ex: a mantra or a song) which evoke certain specific emotions, influence certain brain centers and bring about a change in the body metabolism of a person.

Literature survey:

Yajnas:

Though Yajnas are being practiced since time immemorial, very few publications are available which document the parameters and their effects. With renewed interest in this field and also with the improvement in measurement techniques, research papers are being published off late. Devi et al (Devi, Swamy, & Nagendra, 2004) reported significant increase in root length of rice seeds when exposed to Agnihotra. Agnihotra is one of the simplest homa which uses cow dung cakes to light the fire in a copper vessel, ghee coated rise grains as offering to the fire, done at sun rise and sun set times, along with a specific mantra. Institute of Vedic studies, Akkalkot, Maharashtra, India has taken up the task of popularizing this simple homa technique for better health of society and the performer. Sushrutha et al (Sushrutha, Madappa, & Nagendra, 2014) have documented the effects of Bhaishajya Maha Yajna on human energy field and environment using EPI (Electro Photonic Imaging) and Enviro-Tech pollution measurement equipment. Results show significant increase in energy field of the performers and about 43% reduction in SO_2 levels in the surrounding environment. In another study, Sushrutha et al (Sushrutha, Hegde, Nagendra, & Srinivasan, 2014) compared the increase in activation energy using EPI between a standard Yoga module and Saraswati Yajna. Results show an average increase in both interventions, however Yajna producing more increase than Yoga module. Increase in activation energy was interpreted as reduction in stress levels among the participants.

Mantras:

Yajna as a whole, involves many individual components which can be broadly categorized into two groups, Form based tools called as Yantras and sound based tools called as Mantras. There

are parallel efforts in literature to evaluate the effects of various Yantras on human mind; focus of this work will be on Mantras. Pradhan & Derle (Pradhan & Derle, 2012) have demonstrated significant increase in attention measured using Digit Letter Substitution Test among school children chanting Gayatri Mantra as against a Poem line. Kumar et al (Kumar, Nagendra, Manjunath, Naveen, & Telles, 2010) have analyzed the effects of OM chanting in experienced meditators and concluded that it increases physiological alertness and sensitivity to sensory transmission. Ghaligi et al (Ghaligi, Sripad, Nagendra, HR and Bhatt, 2006) have demonstrated improved memory and attention measured using delayed recall and cancellation tests among chanting group, which regularly practiced Vedic chanting. Jina Devi et al (Devi, 2004) have performed spectral analysis on A, U M and OM chanting and identified fundamental and sub-harmonics for both male and female voices. They proposed to use this technique to analyze Agnihotra mantra. A brief technical note has been published by Ramanujan (Ramanujan, 1996) describing the phonetic aspects of Sanskrit language with focus on Paniniya siksha. Paniniya siksha talks about six key parameters for proper pronunciation of mantras namely; Varna, Swara, Matra, Bala, Sama and Santhana. Further, it also describes an epitome of chanting method called as Varna sara bhuta karma which describes 26 parameters for each syllable. A few of them are Dhvani (quality of tone namely, nada, hakara, shvasa and arka), Sthana (place of origin of sound in the body), Karana, Prayatna (effort from within or from outside), Swara (Intonations like udatta, anudatta, swarita and dhirga swarita), Devata (associated deity for that particular syllable) and Jati (group to which the syllable belongs to). These parameters individually or in a group could become the key parameters describing the signature of a particular mantra. Similar studies have been done elsewhere in the world one such study is from group of Bernadi et al (Bernardi et al., 2001). This group has analyzed the effects of rosary prayer and yoga mantras on autonomic cardiovascular rhythms. This study showed that both prayer and mantra caused striking, powerful, and synchronous increases in existing cardiovascular rhythms when recited six times a minute. Any technique that involves breathing at six breaths per minute induces favorable psychological and possibly physiological effects. Similar study was done by Wolf (Wolf, 1999) wherein, the effects of chanting hare Krishna maha mantra on stress, depression and three gunas of the personality were analyzed. This

study proves the hypotheses that mantra chanting reduces stress, depression and increase the Sattvic guna.

Music:

Music being another sound based tool which has been widely used to influence human mind. Rao et al, (Rao, Kushwah, & Srinivasan, 2014) and (Rao & Nagendra, 2014) have reported positive effects of music intervention on students and Type 2 diabetes patients. Fancourt et al (Fancourt, Ockelford, & Belai, 2014) have systematically reviewed the literature published over the past 22 years on psycho-neuro-immunological effects of music and presented a new framework to further develop taxonomy of music and stress-related variables. One of the study in the above review done by Lai et al (Lai, Liao, Huang, Chen, & Peng, 2013) report absence of immuno-depressant stress markers among the group exposed to soothing music. In another study, Ellis & Israel (Ellis & Israel, 2013) demonstrate the influence of song structure on respiration rate and heart rate variability (HRV). They conclude saying "Singing produces slow regular and deep respiration which in turn triggers RSA" (Respiratory sinus arrhythmia, which is coupling of respiration with HRV). Choi et al (Choi, Lee, & Lee, 2010) report significant reduction in aggression and improvement of self-esteem among children with highly aggressive behavior. While there are many more papers attempting to evaluate the effects of music, very few papers address the need to identify the structure of music itself. Prashanth & Venugopalan (Prashanth & Venugopalan, 2011) and (Sridhar & Geetha, 2009) have demonstrated signal processing techniques which can identify Notes and thus the associated Raga in Carnatic music from a frequency spectrum. In another study, Sridhar and Geetha (Sridhar & Geetha, 2008) propose new set of features based on Carnatic music characteristics like just tempered, varying pitch varying interval of the octave etc to identify the singer.

Autism:

Autism is a chronic neuro-developmental disorder in which the brain is unable to process the sensory information properly. Sequeira & Ahmed (Sequeira & Ahmed, 2012) have published a review article summarizing the beneficial effects of meditation which includes mantra chanting for treatment of Autism. They further recommend mantra meditation to improve health

outcomes of children between 3 to 14 years based on their initial clinical studies. Shanta et al (Shantha, Nagarathna, & Nagendra, 2010) and (Shantha, 2010) have reported increased skills in eye contact, sitting tolerance, non-verbal communication, improvement in imitation skills, postural and oral facial movements, play pattern, peer and parental interactions among children suffering from Autism after administration of Yoga therapy. Yoga therapy involved simple warm-up and loosening practices, stretching and calming asanas, yogic breathing practices and A, U, M, OM and other short mantras chanting administered over a period of two years. Along with the overall positive effects of the yoga therapy, it was reported that children enjoyed chants because of its rhythm and coordination and displayed heightened awareness during chanting sessions. This observation is another encouraging sign to dwell more on the positive benefits of mantras chanting.

Aim and Objectives of Research:

Aim:

- To generate more evidence to prove effectiveness of Mantras as a healing tool

Objectives

- To analyze acoustic samples of mantras using digital signal processing techniques and develop algorithms to identify key markers based on parameters like Varna, Swara, Matra, Bala, Sama and Santhana described in Siksha vedanga
- Correlate existence and /or intensity of these key markers with various physiological and psychological changes in a human body
- Propose and demonstrate a methodology to positively influence children suffering from speech and hearing related disorders like Autism using Mantras and / or Yantras

Scope of Research:

- Record high quality audio samples of at-least 10 selected mantras recited by authentic resource persons and perform spectral analysis using Praat (A free scientific computer

software package for the analysis of speech in phonetics) to identify acoustic parameters like pitch, energy, tempo (rhythm) etc.

- Develop algorithms to digitally recognize and quantify Varna, Swara, Matra, Bala, Sama, Santhana, Chandas and similar parameters built into the audio sample and define key markers which could be used for the correlation study.
- Expose normal subjects to these mantra samples and measure all possible bio signals like breath rate, heart rate, heart rate variability, Galvanic skin resistance, ECG, EEG, GDV / EPI, Nadi pattern using Nadi tarangini etc before, during and after the exposure.
- Conduct a survey to evaluate memory, intelligence and emotional status after the exposure.
- Using this data, correlate the presence and / or intensity of key markers in mantras to physiological and psychological effects observed in healthy subjects.
- With this understanding of key markers in mantras and their physiological and psychological effects on human body, propose and demonstrate therapeutic methodology which can positively influence children suffering from Autism or similar speech and hearing related disorders.

Methods:

Subjects

- Resource persons from reputed Gurukulas, who can chant selected mantras to perfection would be chosen and requested to participate in this study.
- Normal healthy subjects would be screened from General class and YIC participants at Eknath Bhavan and would be requested to participate in this study.
- Children suffering from Autism or similar speech and hearing problems would be screened from special schools nearby Eknath Bhavan and requested to participate in this study with their parental consent.

Design

- **Correlational study:** To analyze audio samples of mantras, develop signal processing algorithms to identify key parameters in the audio sample and then correlate these key parameters with physiological and psychological effects on normal healthy subjects.

- **Pre-post study:** To administer the sound based intervention module on selected group of Autism subjects and gather pre and post intervention data. Fine tune the intervention module based on this pre-post study data.

- **Controlled group study:** To administer this fine-tuned module to an intervention group and monitor their progress against a control group.

Intervention

Sound based interventions using a few of the following audio samples will be used in this study

1. Monotones
2. Sounds from nature
    a. Leaves rustling
    b. Chirping of birds
        i. Morning
        ii. Evening
    c. Sea shore breeze
    d. Fire burning
    e. Water fall
3. Human created noise
    a. Clock ticking
    b. Whispering
    c. Crowded market place
    d. Vehicle horn
    e. Crowded traffic junction
    f. Civil aircraft takeoff
    g. Military jet takeoff

4. Western music
    a. Rock
5. Mozrat's Symphony
6. Sufi music
7. Carnatic music
    a. Vocal
    b. Instrumental
8. Hindustani music
    a. Vocal
    b. Instrumental
9. Samagana (Samaveda singing)
10. Vedic chanting
11. Mantras
    a. Gayatri mantra
    b. Maha Mrutyunjaya mantra
    c. Suryanamaskara mantra
    d. Pranayama mantra
    e. Shanti Mantra
    f. Om mani pindme om
    g. Om arihanta
    h. Allah ho akbar allah
    i. Beeja mantras
12. MSRT
13. Bhramari
14. A U M and Omkara chanting (Nadanusandhana)
15. Silence

Assessments

Sound samples from above list will be used to correlate key markers in them with the physiological and psychological effects observed in normal healthy subjects.

Data collection and analytics

All possible parameters from the following list would be considered for measurement before, during and after the intervention. Once data has been collected it would be used for correlation with key markers identified by the signal processing algorithms.

1. At Annamaya kosa level
    a. Standard hearing capability tests

8

i. Pure-tone testing and Audiogram mapping
        ii. Speech reception test (SRT) / Hearing in Noise Test (HINT)
        iii. Bone conduction hearing test
      a. Electrocardiogram (ECG)
      b. Pupillary dilation
      c. Galvanic skin response (GSR)
      d. Body temperature
      e. Heart rate & Heart rate variability (HRV)
      f. Plasma stress hormone
      g. Cortisol, stress hormone
   2. At Pranamaya kosa level
      a. GDV, before, during and after intervention
      b. Nadi pattern, before, during and after intervention
   3. At Manomaya kosa level
      a. Electroencephalogram (EEG) pre and post intervention
      b. Auditory brainstem response (ABR) or auditory evoked potential (AEP)
   4. At Vijnanamaya kosa level
      a. Standard Memory tests
      b. Standard Intelligence Quotient survey
   5. At Anandamaya kosa level
      a. Standard Emotional Quotient survey

Discussion

Summary

Conclusions

It is expected that this study will be able to identify key markers encoded in mantras and correlate it to physiological and psychological changes in a human body. Further, using this understanding, a therapy module would be formulated to positively influence the children suffering from Autism and similar speech and hearing related disorders.

Bibliography

Bernardi, L., Sleight, P., Bandinelli, G., Cencetti, S., Fattorini, L., Wdowczyc-Szulc, J., & Lagi, A. (2001). Effect of rosary prayer and yoga mantras on autonomic cardiovascular rhythms: comparative study. *BMJ : British Medical Journal, 323*(7327), 1446–1449.

Choi, A. N., Lee, M. S., & Lee, J. S. (2010). Group music intervention reduces aggression and improves self-esteem in children with highly aggressive behavior: A pilot controlled trial. *Evidence-Based Complementary and Alternative Medicine*, *7*(2), 213–217.

Devi, H. J. (2004). Spectal analysis of the vedic mantra Omkara. *Indian Journal of Traditional Knowledge*, *3*, 154–161.

Devi, H. J., Swamy, N. V. C., & Nagendra, H. R. (2004). Effect of Agnihotra on the germination of rice seeds. *Indian Journal of Traditional Knowledge*, *3*(July), 231–239.

Ellis, R. J., & Israel, B. (2013). Music structure determines heart rate variability of singers. *Frontiers in Psychology*, *4*(July), 1–16. http://doi.org/10.3389/fpsyg.2013.00334

Fancourt, D., Ockelford, A., & Belai, A. (2014). The psychoneuroimmunological effects of music: A systematic review and a new model. *Brain, Behavior, and Immunity*.

Ghaligi, Sripad, Nagendra, HR and Bhatt, R. (2006). Effect of Vedic chanting on memory and sustained attention. *Indian Journal of Traditional Knowledge*, *5*, 177–180.

Kumar, S., Nagendra, H., Manjunath, N., Naveen, K., & Telles, S. (2010). Meditation on OM: Relevance from ancient texts and contemporary science. *International Journal of Yoga*, *3*(1), 2–5.

Lai, H.-L., Liao, K.-W., Huang, C.-Y., Chen, P.-W., & Peng, T.-C. (2013). Effects of music on immunity and physiological responses in healthcare workers: a randomized controlled trial. *Stress and Health : Journal of the International Society for the Investigation of Stress*, *29*(2), 91–8. http://doi.org/10.1002/smi.2429

Pradhan, B., & Derle, S. G. (2012). Comparison of effect of Gayatri Mantra and Poem Chanting on Digit Letter Substitution Task. *Ancient Science of Life*, *32*(2), 89–92. http://doi.org/10.4103/0257-7941.118540

Prashanth, T. R., & Venugopalan, R. (2011). Note identification in Carnatic Music from Frequency Spectrum. In *ICCSP 2011 - 2011 International Conference on Communications and Signal Processing* (pp. 87–91).

Ramanujan, P. (1996). Siksha Shastra and Experimental phonetics. In *Seminar on Shiksha Shastra* (pp. 1–13). Melkote, Bangalore: Academy of Sanskrit Research, NIAS. Retrieved from http://cdac.in/index.aspx?id=mc_hc_tech_papers

Rao, T. I., Kushwah, K. K., & Srinivasan, T. M. (2014). Effect of Indian Devotional Music on Students and Performers Measured with Electron Photonic Imaging. *International Interdisciplinary Research Journal*, *iv*(Iv), 284–291.

Rao, T. I., & Nagendra, H. R. (2014). THE EFFECT OF ACTIVE AND SILENT MUSIC INTERVENTIONS ON PATIENTS WITH TYPE 2 DIABETES MEASURED WITH ELECTRON PHOTONIC IMAGING TECHNIQUE, *3*(5), 7–14.

Sequeira, S., & Ahmed, M. (2012). Meditation as a Potential Therapy for Autism: A Review. *Autism Research and Treatment*, *2012*, 1–11. http://doi.org/10.1155/2012/835847

Shantha, R. (2010). Application of integrated yoga therapy to increase imitation skills in children with autism spectrum disorder. *International Journal of Yoga*. http://doi.org/10.4103/0973-6131.66775

Shantha, R., Nagarathna, R., & Nagendra, H. R. (2010). Integrated approach to yoga therapy and autism spectrum disorders. *Journal of Ayurveda and Integrative Medicine*, *1*(2), 120–124.

Sridhar, R., & Geetha, T. (2009). Raga Identification of Carnatic music for music Information Retrieval. *International Journal of Recent Trends in Engineering*, *1*(1), 1–4. Retrieved from http://ijrte.academypublisher.com/vol01/no01/ijrte0101571574.pdf

Sridhar, R., & Geetha, T. V. (2008). Music information retrieval of Carnatic songs based on carnatic music singer identification. In *Proceedings of the 2008 International Conference on Computer and Electrical Engineering, ICCEE 2008* (pp. 407–411).

Sushrutha, S., Hegde, M., Nagendra, H. R., & Srinivasan, T. M. (2014). Comparative study of Influence of Yajña and Yogāsana on stress level as Measured by Electron Photonic Imaging (EPI) Technique. *International Journal of Science and Research*, *3*(8), 1402–1406.

Sushrutha, S., Madappa, K., & Nagendra, H. R. (2014). Effect of Bhaishajya Maha Yajna on Human Energy Field and Environment. *International Journal of Innovative Research in Science & Engineering*, *2347*(3207), 1–8.

Wolf, D. B. (1999). *Effects of the hare krsna maha mantra on stress, depression, and the three gunas. ProQuest Dissertations and Theses*. The Florida State University.