ABSTRACT

All vocal sounds are inextricably linked to respiratory patterns. Sounds that express anguish or joy are equally tied to respiratory function. Hence, one may modify cognitive-emotional states in individuals through breathing therapy by restructuring the breathing patterns that accompany maladaptive emotional states to more closely resemble breathing patterns that accompany positive emotional states. Can specific vocal music literature with phrase structure requiring breath patterns that correlate with breathing therapy interventions mitigate the negative emotional states of those identified with Obsessive Compulsive Disorder? A literature review describes how respiratory training can be used as an alternate intervention and how the breathing exercises found in the Indian philosophical tradition of Kundalini Yoga correlate to these researched interventions. A proof of concept case study with human volunteers uses an original composition modeling these breath techniques to gauge the efficacy of using musical performance as a modified way of executing the breath exercises versus doing the breath exercises as prescribed by the tradition.

Keywords: breathing, Kundalini Yoga, Obsessive Compulsive Disorder, Pranayama, respiratory psychophysiology, singing
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CHAPTER I: INTRODUCTION

Background Information

The secret to mind control is breath control. The diaphragm muscle is the only muscle that is made up of both involuntary and voluntary muscle tissue. The field of respiratory psychophysiology makes use of this overlap between involuntary/voluntary as a metaphor for unconscious and conscious in order to alter maladaptive behaviors through breathing exercise therapies (Ley, 1999). What the field of respiratory psychophysiology has done a good job of helping us to understand is the ancient yogic technique of *pranayam* (breathing technique). Therapeutic *pranayam* rests upon the principle that each action, thought pattern and vocalization has a certain “breath signature” accompanying it (Bhajan, 2007 p.91). Where maladaptive thought patterns manifest, so does the corresponding breath signature. To alter the breath pattern is to alter the maladaptive thought (Ley, 2001).

This music education thesis research is focused on understanding how breath-work therapies may be of benefit to those affected by the symptoms of Obsessive Compulsive Disorder. However, from the researcher’s personal respiratory training experience, some of these breathing techniques (*pranayams*) can be especially uncomfortable. It would be of great benefit if some modification or preparatory experience were devised in order to make the benefits more widely accessible. Here enters *singing*.

Singing requires some form of breath control (Edwards, 2008). In order to hold a note, make a phrase or vocalize a syllable, directed, intentional and conscious application of the breath is required. We investigate here the possibility of using specific choral repertoire that has phrasing and musical parameters that would require the use of certain breath patterns that align with the *pranayams* found in the Kundalini Yoga tradition.
Structure

After a literature review, this thesis will begin with an exploration of understanding the breath first from the Indian philosophical tradition of Yoga. It will then examine the understanding of the breath from the field of respiratory psychophysiology and then explain the significance of the breath in vocal performance and how the two previous sections are essential to an informed view of the breath in singing.

Following will be a brief description of Obsessive Compulsive Disorder and an explanation of its various attributes as related to breathing patterns.

Next comes a section about vocal repertoire in which we examine specific vocal repertoire that seems to resemble yogic breathing patterns. Following is a description of a case study in which an original composition was created by the author to model these breathing patterns in a musical composition. The piece is to be performed by a group of individuals who fill out a pre and post performance Perceived Stress Test and Yale Brown Obsessive Compulsive Scale questionnaire in an attempt to quantify the effects of the singing. The singing is juxtaposed with a control group filling out the same pre and post surveys, but performing a specific yogic breathing exercise taught by a certified Kundalini Yoga instructor.

The conclusion will discuss findings of each research question, offer an explanation of the potential applications of the completed research and recommend further investigations.

Philosophical Stance and Methodology

This research is philosophically situated somewhere between traditional positivist interpretations and interpretivist approaches. The scope of background research contains such material, especially from yogic philosophy, that predisposes the research to an interpretivist/constructivist bias. The researcher assumes a position that the realities individuals experience are
created out of their individual interpretations of their experiences. However, a seminal work by author Aldous Huxley entitled *The Perennial Philosophy* also informs this bias by situating all of those created realities on top of a background. A metaphor would be that these realities are all paint upon a canvas. That unitive ground, the canvas, unities all of the action of top of it (Huxley, 1945). In this regard, one might call the uniting ground the thread of positivist bias through this research. Perhaps then what this research is looking for is some sort of positivist statement to find beneath the constructivist claims. It is essential to understand that any caricatures a reader may have of someone interested in yoga and non-traditional worldviews are very much at play as a bias in this research.

With all of this in mind, the proof of concept case study presented is more of a positivist scientific method based project. One might call the study performance ethnography. We are involving a group of individuals in the performance of a piece of music and then collecting information about their experiences through surveys. The performance ethnography is typically a more organic situation in which the researcher in including themselves in a performance of performer elected material and becoming familiar with their practices and attitudes through participation (O’Toole, 2013). However, this performance ethnography is more limited in its scope because the study participants are not directly involved in the creation of the piece or parameters of its performance, but detail their experiences afterwards in an attempt to reach some sort of positivist claim about the effect that the singing of this piece has on their physical and cognitive states.

**Previous Research**

Some clinical research has been conducted in regards to the efficacy of specific *pranayams* used to treat and mitigate the effects of Obsessive Compulsive Disorder (OCD).
David Shannahoff-Khalsa published a study entitled, “Kundalini Yoga meditation techniques for the treatment of Obsessive-Compulsive Disorder” in 2008 in which a randomized control trial was conducted that compared the effects of a breathing techniques called “one minute breath” with traditional forms of “Mindfulness Meditation” as published by Dr. John Kabat-Zinn. The Yale Brown Obsessive Compulsive Scale, Symptom Checklist 90 Obsessive Compulsive Scale, Profile of Mood States, Perceived Stress Scale and Purpose in Life Test were used to quantify the results. The trial found that the group receiving the yoga *pranayam* had statistically significant improvements on all the scales except the Perceived Stress Test and Purpose in Life Test (though the improvements on those two tests were notable).

Another clinical study under the authorship of G.K. Pal in 2004 entitled, “Effects of short-term practice of breathing exercises on autonomic functions in normal human volunteers” found that a specific *pranayam* involving breathing through the left nostril only at a slow pace produced statistically significant changes in parasympathetic nervous system activity in relation to the control group that performed the exercise at a fast breathing pace through both nostrils. This study helps to illuminate the relationship between activating the relaxing and calming part of the nervous system through intentionally slowing the breath in order to produce behavioral changes. This principle will be absolutely essential in our investigation of using singing to replicate these results.

More research on using breath therapies to modify behavior was conducted by Richard Ley and published in the 1999 article, “The modification of breathing behavior”. The author describes how ventilatory changes accompany emotions and that the changes in ventilatory patterns are amendable by the effects of Pavlovian conditioning. His research corroborates with the research of Shannahoff-Khalsa and Pal in describing in more psychological terms what a
“breath signature” may be and how breaking these breath signatures can be understood as Pavlovian conditioning.

**The Field of Respiratory Psychophysiology**

Respiratory psychophysiology is a branch of psychological research that investigates the physical factors of psychological processes that relate to breathing. Much of the research in this field relates to breathing patterns and panic attack disorders. The field developed as an offshoot of the Society for Psychophysiological Research, a professional group that promotes scientific research into the connection between psychological processes and bodily functions (About SPR, 2015). There were three seminal articles authored by Ronald Ley that outlined the basic tenants of respiratory psychophysiology. The most recent was “Respiratory psychophysiology and the modification of breathing behavior” published in 2003. Since that time, there have not been any peer-reviewed articles with the words respiratory psychophysiology published as listed keyword descriptors. There exists the International Society for the Advancement of Respiratory Psychophysiology which according to their website, is to hold a conference in October 2015 (isarp.org, Meeting 2015). However, literature published by this society seems to not be available in the major online academic journal databases. There does however exist an International Journal of Psychophysiology that contains work of a similar theme.

**The Purpose Of This Research**

The techniques outlined in the Yoga tradition have gained much attention in the Western countries but their qualitative reports by individuals of their physical and psychological benefits vary. The field of respiratory psychophysiology offers us an exciting insight as to why some of these techniques might work in terms that we can understand ie. psychological or physiological terms versus philosophical/ metaphysical terms.
With this important bridge in place between the philosophical traditions of Yoga and the psychological and scientific terminology with which we are familiar, we can begin to address questions of practical application. This thesis is a music education master’s thesis, and up to this point, the emphasis on music has been little outside of the fact that we are attempting to set up how we will show singing to be of the same physical/psychological benefit as Yoga. Understanding this possibility can give a whole new understanding and meaning to making music. Countless scores of people from as far back as we can imagine refer to the intoxicating, healing, powerful, spiritual and transcendent nature of music. Plato’s dialogue *The Symposium* contains powerful imagery on how the power of music is the power of Love. In Eryximachus’ speech, Plato writes that “Here, music inserts agreement in all the sings… as it instills mutual love and unanimity; and music, in turn, is expert knowledge of the erotics of harmony and rhythm (Plato, 1951 p.248). This Platonic dialogue is illuminating in the strong metaphor music as love creates in the healing vision of music. In the realm of scientific writing, justifications for these philosophies are not well understood and few seem to wish to make an attempt to fuse the two.

In this project, we have an opportunity to look at perhaps one of many of the mechanisms that might produce these healing effects or offer some explanation as to why so many find musical activities so pleasurable or meaningful. There are many hundreds of contributing factors to the meaning and values of making music. Some of these include using music as ritual, as praise, as celebration or as mourning. Other factors that make music valuable to us might include psychological and emotional stimulus. Does the value of making music hide within any particular element of music making? This research offers an inroad or at least a directional signal to one of those factors that gives music making meaning and value: the breath. The breath is both
a highly spiritual and philosophical underpinning in the tradition of Yoga and a scientific and psychological mechanism in the field of respiratory psychophysiology. This research is necessary to open up a field of inquiry that will help us address questions about which music we should teach in schools and offer some insight into how we should teach it. According to the Anxiety and Depression Association of America, Obsessive Compulsive Disorder affects 2.2 million American adults over 18. It is equally common among men and women and. The median onset is age 19 with a significant portion- 25%- of cases occurring by age 14. One third of the adults afflicted with Obsessive Compulsive Disorder experienced the symptoms in childhood (Anxiety and Depression Association of America, 2015). The insights gained from this research may assist in creating a mindset that encourages music educators to teacher with more than just a musical performance in mind- our work can have deeply significant implications for the wellbeing of our students. The insights also propose ways that we may provide assistance in mitigating the effects of Obsessive Compulsive Disorder more effectively and holistically. It may also offer some more grounding for the highly spiritual and esoteric meanings of music making for those that wish to broach the ground.

**Research Questions**

We address a number of questions in this research in order to prepare a field for understanding the healing power of music. We focus on one specific object that one may wish to heal- Obsessive Compulsive disorder. As such, these questions are aimed at one central question:  

*can breathing patterns in vocal repertoire be used to modify Obsessive Compulsive behavior?*

In order to address the question, we must understand: *can breathing patterns create physiological state changes? Why do restricted repetitive patterns of behavior interests or activities manifest? How does the breathing exercise work to modulate behavioral response?*
How can music educators use vocal and instrumental repertoire to achieve these goals? What vocal repertoire can inherently replicate these breathing exercises as a constructive intervention?

Scope Of This Research

This research will look at why breathing exercises work to mitigate the effects of Obsessive Compulsive Disorder and then attempt to point out specific places in the vocal music repertoire where these breathing exercises seem to be replicated. This research will not attempt to prove the efficacy of these yogic breathing exercises in a clinical setting nor attempt to prove the efficacy of replacing therapeutic breathing exercises with the signing of musical pieces resembling their breath structure. The research will include a proof of concept case study with human volunteers to demonstrate the possibility that such applications of breathing techniques in musical compositions need further research.

Some readers may ask why this research focuses on vocal music and not on instrumental music. Because there is a metaphorical wall between the breathing and the music in instrumental music, we have elected to focus first on vocal music. The literature available on the breath in singing is more easily accessible than the breath in instrumental music (though there is of course a substantial body of literature). This investigation is a preliminary step, and the author speculates that instrumental music might well be used for the same purposes we are investigating here.

Terms and Definitions

Autonomic Nervous System: The Autonomic Nervous System is the part of the central nervous system that regulates bodily functions without conscious control. It is split up into two branches, the sympathetic and parasympathetic (Low, 2013).
*Sympathetic nervous system:* The sympathetic nervous system controls the “fight or flight” reflexes and responses such as increasing blood flow to the extremities, producing the stress hormones needed to signal the release of glycogen from the liver to provide the elevated blood sugar levels needed for physical exertion, increases respiratory rate and release the stress hormone Cortisol. (Low, 2013).

*Parasympathetic Nervous System:* regulates all of the “relaxing” characteristics of the autonomic nervous system- it slows the heart rate after a period of effort, returns blood flow to the digestive tract and slows respiratory rate (Low, 2013).

*Biofeedback:* Biofeedback is information about psychological and physiological processes relayed through biological indicators. It is closely associated with the field of respiratory psychophysiology in that biofeedback markers- such as respiration rate, heart rate and blood pressure provide indications of changes in cognitive behavior on a physical level (Biofeedback, 2013).

*Musical phrase:* A musical phrase is a small portion of a musical composition that contains a complete musical idea, or if not a complete musical idea, contains musical ideas or material that comes to an appropriate pause at the completion of the phrase (Glossary of musical terms, 2015).

*Obsessive Compulsive Disorder:* Obsessive Compulsive Disorder (OCD) is a psychological phenomena in which a person experiences unwanted and alarming thoughts that are sufficient cause for actions taken (compulsions) to remedy the anxiety produced by the thoughts or to ensure safety from the content or specific threat perceived (Phillips, 2014).

*Prana:* Prana is a yogic philosophy term that refers to a subtle life force animating the cosmos. It is particularly important in relation to pranayam, which uses as its root the word prana- it relates
to the control, placement and transformation of the subtle life force animating our corporeal and non-corporeal form (Lord, 2012).

Pranayam: Pranayam (sometimes written pranayama) is yogic breathing. It is any of the activities taken up to intentionally control the various phases of the breath (inhalation, expiration and holding) for a specified length of time with or without some other combination of bodily posture or particular way of producing the inhalation or exhalation (Lord, 2012).

Respiratory psychophysiology: The term respiratory psychophysiology refers to a field of study that examines the psychological responses to breathing behaviors; respiratory= related to breathing processes and mechanisms. Psychophysiology = a branch of psychology examining the physical basis for mental processes. In short, it is the study of body and mind (Dupler, 2005). For the purposes of this report, one could interchange the terms respiratory psychophysiology with breathing science. In order to retain consistency and correct associations to bodies of literature, we will refer to the more Western notions in the field as respiratory psychophysiology and a more Eastern conception of similar topics as yogic breathing.

Yoga: The word Yoga is a Sanskrit word that means “union with the Divine.” Yoga is also a specific set of practices that include physical exercises, mental exercises such as meditation and spiritual exercises that are aimed at uniting individual consciousness with Divine consciousness (Desikachar, 1999). Throughout this thesis, Yoga appears in capital letters because when used as a noun, it is a proper noun denotes a specific system of practices.

Yogic Breathing: Yogic breathing is pranayam, as previously defined. It appears in this thesis in lower case because yogic is being used only to connote a certain kind of breathing, not a specific set of practices, only the connotation that the practitioner is doing something specific with the control of the breath.
**Yogic Philosophy:** Refers to a world-view and system of thought that is derived from a canon of ancient Indian texts called the Vedas. Most important of these is Patanjali’s *Yoga Sutra* which describes the entire system of Yoga- how it is practiced, what it aims to do and what occurs when it is practiced correctly (Desikachar, 1999). Throughout this paper, “yogic philosophy” appears in lowercase letters because yogic is being used as an adjective to describe a certain kind of philosophy. It does not necessarily refer to a specific set of published beliefs and is more of an umbrella term.

**CHAPTER II: LITERATURE REVIEW**

**Breathing Science**


This article includes an historical review of studies regarding breathing and emotion and cognition. The author highlights the findings from these studies that evidence the fact that changes in breathing lead to changes in emotion and cognition. These changes in breathing are observed at the onset of Type 1 Panic attacks and in other stress inducing environments such as in individuals with test taking anxiety. The mechanism behind panic attacks and test taking anxiety is a maladaptive conditioned response. The author reviews how training in breathing developed in the field of respiratory psychophysiology uses Pavlovian conditioning to reverse the effects of the maladaptive conditioned responses to create new, positive effects on emotion and cognition that do not precipitate a panic attack.

The findings of this research study explain that differences in breathing behavior occur when singing takes place with an emotional stimulus versus when it takes place without an emotional stimulus. A key finding was that non emotional-stimulus singing was characterized by "belly-out" breathing while singing with an emotional stimulus was characterized by "belly-in" singing. In explaining the mechanisms of the Kundalini Yoga breathing techniques, understanding that the specific mechanisms of the movement of the diaphragm focused on "belly-out" movement is characteristic of non-emotional stimulus singing. It helps to develop the idea that the breathing techniques of Kundalini Yoga are taking practitioners out of the simulated emotional state. In the scope of the thesis, we want to examine vocal repertoire that does exactly that and understanding that the way in which a singer is breathing indicates the presence of an emotional stimulus or not is key in identifying that repertoire.


This research article demonstrates the importance of breathing in phonation during singing by examining the patterns of breathing across numerous takes of one musical example from 5 professional opera singers. The results find that the patterns in inhalatory actions are extremely consistent across the numerous takes of the same example. The authors indicate that it is because the musical context is the same each time that the given inhalatory action is the same. This will help to illustrate that specific breathing patterns can be achieved through the musical composition.

This clinical trial studies the effects of long deep breathing exercises on parasympathetic nervous system function. It was found that regular practice of long deep breathing exercises for a minimum of three months at 30 minutes a day improved autonomic function in the parasympathetic system. The authors cite research that has proven that the yogic work of pranayam improves autonomic function by changing sympathetic and parasympathetic activity. This article provides direct evidence as to the efficacy of breathing exercises to reduce the biological markers of stress—namely sympathetic activity that can be measured by heart rate or breath rate. In relation to Ley, 1999, this article provides both a practical method for training conditioned responses in the autonomic nervous system as well as provides evidence as to the efficacy of those methods in regards to quantifiable markers that indicate parasympathetic function.

Singing


This book describes the voice culture of classical Indian music. It is pertinent in the scope it presents regarding the theoretical metaphysics of breath control in singing described in the Indian classical music singing tradition as well as contemporary research in the science of voice culture including care of the voice and the mechanisms of breathing in singing. Discussion is included on the notion in Indian music that the singing voice is the first tool in balancing the mind. The book provides descriptions of how this functions from a philosophical and from a
mechanistic perspective. The book provides working definitions of vocabulary necessary to understand the breathing exercises described in Yoga traditions that will be examined in this thesis.


This research is extremely important in confirming the physiological changes that take place as a result of singing. The authors describe how Immunoglobulin A is observed to increase in previous relaxation response studies, indicating a positive effect on the immune system as a result of purposely employed relaxation techniques. In this study, the authors found a significant increase in the same Immunoglobulin A marker of relaxation response after singing exercises.

Additionally, the authors examined the changes in Cortisol levels during singing activities. Cortisol is a well-studied hormone produced during times of stress. It is particularly important in understanding the activation of the sympathetic nervous system (Lowe, 2013). Its increase indicates an increase in sympathetic nervous system (stress branch) function. The authors here were able to determine that a statistically significant decrease in Cortisol levels took place during choral rehearsals, but that the Cortisol levels increased after a performance. Particular attention to the decrease during rehearsal helps to underpin and quantify the relaxing effects of singing. It is absolutely essential in recognizing the connection between the physiological processes needed for singing and their reduction of Cortisol and the same reduction of Cortisol observed after yoga breathing exercises.

Sanal’s work examined psychological and physiological markers of well being as an effect of singing in a choir. His work was able to determine that singing has statistically significant positive impact on affect and anxiety. The study looked only at the excretion of salivary amylase as a physiological marker of positive effect, but could not determine from this marker alone if singing produced physiologically positive results. However, when looked at in conjunction with the work of Beck, 2000, the demonstrated combination of positive benefits both psychologically and physiological help to inform the parallels between yoga breathing exercises and singing.

**Obsessive Compulsive Disorder**


_American Journal of Psychiatry, 165*(12), 1532-1542.


This article describes the distinctive factors of Obsessive Compulsive Disorder by performing a meta-critique of studies involving classifying OCD behaviors. The study finds that a 4 dimensional structure of OCD factors is accurate. These four factors are symmetry, forbidden thoughts, cleaning and hoarding. Each factor is associated with various obsessions and leading to various behaviors. From Block et al. (2008) we are able to understand how certain thought patterns become associated with certain actions. It is essential in understanding how Ley, 1999 underpins Obsessive Compulsive actions as the result of Pavlovian conditioning.

Repetitive behaviors or stereotypy and repetitive behaviors that classify as Obsessive Compulsive (OC) behaviors in non-verbal children with Autism may be marked by rapid changes in heart rate and negative affect in those with more OC like symptoms. Identifying whether or not a non-verbal child has OCD or just has repetitive behaviors is difficult to discern, but the measurements and changes in heart rate that occur only in OC like behaviors may help to identify what exactly a child is dealing with. The decrease in heart rate spike associated with exposure and response prevention therapy suggests that this type of therapy is an effective treatment for OC like repetitive behaviors in non-verbal children with Autism. It is this exact type of physiological indicator that we use as evidence to suggest when breathing exercises are activating parasympathetic function. Pal et al. (2004) corroborates this evidence in the measurement of parasympathetic function as a result of specific Yoga pranayams.


Included is a discussion of two studies in which groups of adults and adolescents with Obsessive Compulsive Disorder (OCD) went through a treatment regimen of Kundalini Yoga meditations for one year. Study number one is an uncontrolled pilot study consisting of 8 patients and study number two a randomized controlled matched trial. Group one received the Kundalini Yoga treatment protocol for OCD while the other received training in mindfulness meditation and relaxation response. Results were measured using 6 psychological test including the Yale Brown Obsessive Compulsive Scale. The Kundalini Yoga protocol group made statistically significant improvements on 4/6 scales, whereas the mindfulness meditation/relaxation response did not make statistically significant improvements. Included in the article are exact instructions
on what was included in the Kundalini Yoga protocol. Follow up of participants demonstrated that those who completed the treatment were no longer taking medications for OCD one year after completion of the study. The article provides a published account of which exact breathing exercises have been shown to work in treating patients with OCD. This study differs from Shannahoff-Khalsa, 2003 in that we are not investigating the efficacy of the specific breathing exercises from this study. We are looking to replicate some of the contributing factors that are beneficial in the performance of these exercises through singing.

**Music as Intervention**


This article gives an historical review of music in medicine and some examples of the current research in neuroscience that is helping to reveal the mechanisms behind music as a healing modality. In the scope of this thesis, this article provides some specific citations of brain regions activated by certain musical components. The evidence based research reviewed here will be important in drawing connections between the brain areas activated by breathing practices and those activated in musical practices.


This article describes the Indian music theory of the *rasas-* or the emotions in music. It is pertinent in the scope it presents on the uses of music to identify and release certain blocked emotions. When discussing the mechanisms of breathing therapies, understanding the relationship between emotions and breath patterns is essential to creating an understanding of how the breath therapies work to release the negative effects of certain emotive qualities. As we
discuss accessing breath patterns through music, parallel conversations about the nature of emotion in music and its relationship to breathing will be essential to understand. This established tradition and philosophy of understanding emotion in music will provide evidence and support of descriptions regarding the utility of breath exercises encoded in music to achieve certain behavioral changes.


Donna Williams investigates the numerous possible causes of Autism Spectrum Disorders conditions and possible treatments. The most relevant piece of this book to this thesis is her discussion about the use of music in therapy. She describes how music can be less confrontational than speech and how the "realization of exposure may be less on guard." As it pertains to treating OCD, the Exposure Response Prevention therapy requires direct confrontation of the obsession triggering stimuli. This exposure to obsession triggering stimuli produces the physiological changes that manifest as anxiety and or panic as described in Ley, 1999. If involvement in music is a way to lessen the realization of direct exposure, than creating treatments for OCD through music may be more effective for those who cannot handle direct exposure as in Exposure Response Prevention Therapy.

**CHAPTER III: THE BREATH**

**Introduction**

A fascinating place to begin the discussion about the breath is looking to the root of the word and words associated with it. First, the Latin word for Spirit, *spiritus* means “breath” and the Greek root of the word *psychology* means breath, spirit/ soul (Online Etymology Dictionary,
The traditional roots of the word for our modern branch of scientific inquiry into behavior and cognition, the field of psychology, is perhaps rooted in a longstanding connection to the spirit and soul, the liquid moving life force within. The imagery of the moving breath is rich in everything from the first Breath of Life in the book of Genesis, to these fantastical time lapse images from outer space of the seasons changing on planet Earth that look eerily like a person breathing (https://www.youtube.com/watch?v=kSNbLYHRrU8). These illustrations beg us to investigate the link between breath, body and mind.

**Respiratory Psychophysiology**

A prominent researcher in the field of respiratory psychophysiology Richard Ley points out to us that breathing is the only vital function under voluntary and involuntary control. He also points out that shrieks, grunts, laughter and all of the emotional parts of communication are rooted in breathing gesture and motions (Ley, 1999). Imagine what crying looks like- huge heaving breaths at a rapid pace, irregular, erratic etc. and imagine the accompanying emotions. Imagine what whispering into a lover’s ear looks like- quiet, soft, gentle, and the breathing, slow, soft, gentle and regular. With these examples, someone without hearing or sight may be able to identify someone’s emotional state just by feeling their breathing patterns.

Which came first, the emotion and a biological necessity of a certain kind of breath pattern or a breath pattern and a resultant emotional state? An illustration of the former is a “fight or flight” situation. Here, a threat is perceived and the breathing becomes quick and rapid in order to provide the oxygen necessary to perform the survival act. Accompanying communications to warn others of the threat- shouting and yelling- require certain types of breathing to provide the air needed to make the vocalizations. Ley writes that it is a combination of both processes in which vocalizations (ie. communications) are dependent on their breathing
maneuvers and the breathing maneuvers are conditioned by the effects of the communications (Ley, 1999). We learn that a certain physiological state is what is needed to produce a certain communication and prepare the body for certain types of action.

The example is illustrated by some early research in the field cited by Ley. There was quite an interest in this type of psychology in the 1940’s and 1950’s, and two researchers Finesinger and Mazick, 1940 found that subjects recalling a painful stimulus exhibit a change in breathing while recalling it. This example and Ley’s research illustrate that breathing patterns are acquired as a result of classical Pavlovian conditioning. By repeatedly pairing a cognitive-emotional state with a physiological response, both become mutually dependent. For example, a state of fear is linked to rapid breathing patterns. Presumably, a threat is perceived and soon the body will require additional oxygen for either fighting or running away from the threat, and prepares itself accordingly. Ley’s research helps us to understand that the opposite may be true—an increased breathing pattern may create a psychological state of fear. As a result, breaking apart these associations could be used to dissociate negative cognitive-emotional states from their corresponding breathing patterns.

Ley develops a “fear theory of panic attacks” in which a fear of panic attack leads to an increase in respiratory resistance, and that respiratory resistance is indicative of a panicked state and so further precipitates an actual panic attack. He notes that the changes in breathing that accompany these negative cognitive-emotional states are the work of the sympathetic nervous system. This is the branch of the autonomic nervous system that controls the “fight or flight” responses by creating increased respiration, increased circulation to the limbs, dilation of the pupils etc. It’s opposite is the sympathetic nervous system- the relaxation of muscles, the return of circulation to the digestive tract, slower respiration, and reduction in Cortisol production
Pal, 2004 found that the slower breathing produced statistically significant changes in parasympathetic nervous system and showed a statistically significant decrease in the sympathetic nervous system output (Pal et al., 2004). This research helps to understand that the changes in breathing patterns which are a product of fear responses may be the actual catalyst for a panic attack. Understanding the significant role that slow breathing exercises have in increasing parasympathetic (relaxing) nervous system activity and decreasing sympathetic activity is the key component to understanding the function of both yogic breathing techniques and respiratory psychophysiology therapies.

**The Breath in Yogic Philosophy**

The breath in yogic philosophy is the direct bridge from the physical to the non-physical psychological and spiritual world. As discussed above, breathing is the only vital function that is under both voluntary and involuntary control (Ley, 1999). It is significant as an image of a bridge between those things under our conscious control and those not. In the yogic philosophy, the breath is not really something that belongs to one organism or one individual, in fact, there is really only one giant macrocosmic breath. This macrocosmic breath moves in waves and patterns the same way that the winds blow through the atmosphere. These winds are created by convection currents - currents of movement of kinetic energy that moves the air particles along with them as the kinetic energy flows from areas of high concentration to low.

When we talk about the macrocosmic breath, Stephen D. Edwards (2008) author of the article “Breath psychology: Fundamentals and applications”, helps us to understand that the breath is not really an individual’s but a shared flow of energy when he states that, “Quantum theory illuminated the sub-atomic reality of this fourth dimensional universe as a dynamic interrelated web of inseparable wave–particle energy patterns of tendencies called quanta, which
continually appear and dissolve” (Edwards, 2008). Edwards helps us to expand the analogous relationship from wind and kinetic energy versus breath and *prana* to an invisible, more subtle level. The sub-atmospheric reality is Einstein’s relativity, and helps to open up an understanding of modulating energy flow beyond the gross to a more subtle level.

In yogic philosophy, breath is considered the conveyor of the life force that sustains. When there are imbalances in the flow of life force, psychological and spiritual problems manifest. Edwards (2008) describes that the task of spiritual healing is to balance and harmonize the various patterns of breath energy flow. This kind of healing can be thought of in esoteric terms, but it can also be looked at in familiar terms to readers in the West. Edwards (2008) describes that every inhalation is energizing to the sympathetic division of the autonomic nervous system and that every out breath is relaxing and stimulates the parasympathetic nervous system and activates the pneumogastric nerves along the spinal column. These pneumogastric nerves are the central nervous system interfaces with the parasympathetic nervous system, the digestive tract and heart (Edwards, 2008). Adjustments in breathing pattern will correspondingly affect the various parts of the nervous system and the host of bodily functions controlled and connected.

Here is an example of its application. If someone has an anxiety problem, this is an over activation of the sympathetic nervous system. In this individual, the heart rate is elevated, and among other things, digestion is slowed as the blood circulation is diverted to the extremities needed for fight/flight actions. In order to return circulation to the digestive tract and slow the heart rate, the parasympathetic nervous system must be activated- a necessity that can be achieved by increasing the duration of exhalation and slowing the breathing cycle (Edwards, 2008; Pal et al., 2004). We might say that the anxiety has been “cured” but truly, what has taken
place is a readjustment of prana or life force energy into the right places, spoken about in Western terms.

The word for breathing exercises in yogic philosophy is pranayam. ‘Prana’ is the word that describes the link between energy and matter, and pranayam refers to an extension of the life force that is prana (Lord, 2012). Hewitt (1977) explains that “Prana exists on all the planes of manifestation, as the connecting link between matter and energy on the one hand, and consciousness and mind on the other. Consciousness expressing itself through the mind, cannot come into touch with matter and function through it without the intermediate presence of prana” (Hewitt, 1977 p. 421). Yogic breathing pranayams are certain sequences of inhalations and exhalations performed in particular ways with the effect of strengthening and redirecting the amount of prana for an individual. Keep in mind that the analogous relationship from prana to energy is the parasympathetic nervous system to relaxation and ease. Consider the example of someone who is stressed about a test taking a deep breath and then not feeling so stressed about it anymore. The yogic philosophy might state that the long deep breathing increases the amount of prana and the Western terms may state that the parasympathetic nervous system as been activated. Not one way of describing the phenomena is absolute, but instead, both are metaphors.

**The Breath and Singing**

Dr. Maumita Banerjie (2014) in “A New Approach to Hindustani Classical Music” states that the classical Hindu music tradition views the singing voice as the first instrument which can influence and rebalance the mind (Banjerie, 2014 p.8). The premise of this research is the idea that perhaps what might make singing such an effective tool for “rebalancing the mind” may take its root in the physiological effects produced by certain kinds of breathing patterns.
Chitravina Ravikiran (2009) in an article about the Indian philosophical notion of music reminds us that “art begins where science ends” (Ravikiran, 2009). This serves as a special link between the artistic qualities of music making and the scientific applications in psychology for the benefit of others. As we look into the breath in singing, a theme develops that perhaps there is something inherently beautiful or wonderful about a specific musical product. As a caveat, the very notions of beauty, what music is and why we make music are all vast conversations. The only intent in this investigation is to notice a link between certain kinds of music and the psychological and physiological state changes that may occur as a result of the way one must breathe in order to perform these pieces. With a reminder that the philosophy of Indian music sees certain melodies and tempos as being able to elicit certain rasas (moods) (Ravikiran, 2009), we can examine the idea that a certain song if performed correctly might have a repeatable effect time after time on the performers.

Thomasson and Sundberg (2009) published a study entitled, “Consistency of inhalatory breathing patterns in professional operatic singers” that helps us to understand how breath patterns are specific to a piece of music. The study found a strong link between respiratory breathing behavior and phonation and that the duration of the inhalation varied greatly depending on the musical context (Thomasson et al., 2001). For the purposes of the proof of concept case study as a part of this thesis, we can understand that the way the musical phrasing lays should have a similar effect for the various performers given that what we know about breathing and its effect on the parasympathetic nervous system has already been proven. In Thomasson et al. (2009) the investigators found that there was a high degree of consistency between the numerous takes performed by participants of the same musical context (Thomasson et al., 2001). We can
use this information to inform the utility of creating breathing patterns that resemble *pranayams* for participants.

As we address using breathing techniques as an intervention for OCD, we must keep in mind that we are dealing with a cognitive-emotional distress. In our connection to music, it is quite common for people to refer to music as “helping the emotions” or “using music to rebalance the mind” (Ravikiran, 2009). Sometimes these kinds of associations are tenuous and non-specific. However, a paper by Pettersen and Bjørkøy (2009) entitled “Consequences from emotional stimulus on breathing for singing” helps us to understand that there is a special link between how music is performed when cognitive-emotional distress is involved. The study found that singing with emotions was associated with using a greater amount of air (Pettersen, 2009). This greater amount of air leads to the hyperventilation that Ley (1999) says creates the false biofeedback that leads to panic attacks and other states of emotional distress (Ley, 1999). It seems that an elevated involvement in the emotional background of a musical performance has the opposite calming effect of which we are searching here.

However, Pettersen (2009) found that non-emotional singing was associated with “belly-out” breathing, and that emotional singing was associated with “belly-in” breathing (Pettersen, 2009). This is significant because all *pranayam* exercises are properly performed when the belly expands from the diaphragm out (Bhajan, 2007). A properly inhaled breath does not cause the shoulders to rise immediately, but instead creates muscular movement around the navel (Bhajan, 2007). It is the goal of the *pranayam* and the breathing exercises to control cognitive-emotional states (Edwards, 2008). What Pettersen (2009) observes presents us with an idea that music properly performed has a sense of being transcendent of emotional stimulus. What is “emotion” and a philosophical debate on emotion in music should be saved for another venue- the point
here is to illustrate that there seems to be a substantial link between breath control/ cognitive-emotional control and the ability to gain that control through singing.

The final important topic concerning using singing as a means of bringing about some benefit to mitigating Obsessive-Compulsive behaviors is the idea of music as medicine. It is certainly a popular notion, and often dismissed as ancillary or downright made up when it comes to research on music, but the idea is particularly strong in the Western philosophical tradition as well as in the Eastern philosophical tradition. An article by Babikian, Zeltzer, Tachdjian, Henry, Javanfard, Tucci and Tachdjian, (2013) “Music as medicine- A review and historical perspective” gives us a good idea of the shape of music as medicine throughout time, reminding us that the Platonic notion (from The Symposium) of music as aligning the soul with the vibration of the cosmos and as the healing force of Love to purify the emotions has underpinned much of the thinking about music since that time (Babikan et al., 2013). It is important to note that making music does not seem to have any direct biological necessity in humans (Elliott & Silverman, 2015). This seeming lack of biological necessity points to the idea that musical activities possess a transcendent nature corroborated by the idea that music has been used throughout the course of human history in ritual, spiritual practice, ceremony and healing (Bakikian et al., 2013). It appears as though music is not used for mere survival, but towards a fuller flourishing. In our investigation, we wonder if what we find significant in the transcendental nature of spiritual practices like Yoga is what we find significant in music. Our specific example of treating OCD is a possible door into understanding.

CHAPTER IV: OBSESSIVE COMPULSIVE DISORDER
Obsessive Compulsive Disorder (OCD) is a psychological condition in which unwanted and unreasonable thoughts occur repeatedly for an individual causing large amounts of anxiety that lead the individual to carry out various routines or compulsive actions to mitigate the anxiety caused by the distressing thoughts (Phillips, 2014). These obsessive thoughts could include a broad range of themes and topics with associated actions. For example, someone may have a deep fear of hurting someone by accident. While driving, this person feels a bump and believes that they have run over a person and so turn around to check and make sure they have not. Upon driving away, the individual feels a growing fear that maybe they missed it and in fact did hit someone and so returns to check. This process could repeat multiple times. Another example may be that someone has a deep fear of contracting an illness through germs. In order to mitigate their anxiety that arises from the thoughts of contracting a disease, they repeatedly wash their hands.

These obsessions are manifested by some form of anxiety about everyday occurrences that may range from distress about unwanted sexual thoughts playing in the mind, fear of being contaminated by touching others’ hands depending on the various sources of the obsessions (Phillips, 2014).

The compulsive part of the disorder is the behaviors one feels driven to perform in order to mitigate the anxiety produced by the thoughts. These may include associated actions with similar themes to the distressing thoughts such as continual checking, cleaning, or counting or praying. These compulsive actions typically offer only quick temporary relief from the anxiety but then are felt they must be repeated because the anxiety producing thoughts surface again.

This is a vicious cycle of alarming thought, an effort to rid oneself of the anxiety, and then a reinforcement of the cycle through the relief brought on by the compulsive action (Chok et
al., 2014). When we talk about why OCD cycles become so hard to break, it is because Pavlovian conditioning reinforces the efficacy of the various compulsive actions and so makes it seem to the individual that their actions are necessary even though they may recognize logically that they are not.

We explore OCD typically through the level of the mind, but research by Chok et al. (2014) begs us to look at OCD more holistically, with an emphasis on the physiological effects of the disorder. In their recent study they found that the wanting to perform a compulsive action is accompanied by an increase in heart rate and followed by a decrease in heart rate once the action is performed (Chock et al., 2014). Looking back to the research by Pal et al. (2004), we know that specific breathing exercises have the effect of fluctuating the heart rate based on whether or not the breathing exercise is activating the parasympathetic or sympathetic nervous systems. This link may signal to us that the anxiety produced by the obsessive thoughts and the need to perform the compulsive action is an activation of the sympathetic nervous system and an intervention that decreases sympathetic nervous system activity while activating parasympathetic nervous system activity may help to mitigate the symptoms. This is the idea behind pranayam and the method we seek to explore.

**Specific Pranayam for Obsessive Compulsive Disorder (OCD)**

The system of Kundalini Yoga as taught by Yogi Bhajan was brought to the United States by Yogi Bhajan, (HarBhajan Singh Khalsa) in 1969. This system of Yoga includes the various branches of Yoga including asanas (poses), pranayam (breathing exercises) and meditations. There is one specific pranayam designed to treat OCD that if performed correctly for the full length of the exercise as outlined, is purported to completely cure OCD (Khalsa, 2008). One researcher at the University of California San Diego, David Shanahoff-Khalsa
performed a randomized control trial to test the effectiveness of this pranayam versus the published “mindfulness based stress reduction” published by John Kabat-Zinn. As mentioned in the literature review, this pranayam specific to the treatment of OCD was found to be more effective on many of the quantitative measurements versus the control.

As a note, any practitioner may perform any pranayam. Many pranayams have specific benefits relating to specific conditions, but can still be beneficial to an individual not necessarily debilitated from a clinical case or condition. A pranayam may say it is helpful for depression, but no ill results will be found for a practitioner without depression performing the exercise.

This pranayam for Obsessive Compulsive Disorder is performed in the following way. The practitioner sits comfortably on a cushion or in a chair. The eyes are closed and focused at the area between the two eyebrows. First the practitioner rubs their hands together and places them one palm against the other with the thumbs pressing into the sternum (“prayer pose”). The practitioner chants the phrase “Ong namo guru dev namo” three times, which means “I bow to my highest consciousness” (Tuning in with ong namo guru dev namo, 2015). A correct pronunciation can be found here: https://www.youtube.com/watch?v=BiIAa92lWQI beginning at time-stamp 2:01. Following this short introduction, the right hand thumb blocks the right nostril and the practitioner inhales through the left nostril for 15 seconds. Maintaining the position, the breath is held for 15 seconds. Then the breath is exhaled out of the left nostril in the same position for 15 seconds and then finally the breath is held completely out for another 15 seconds. This pattern continues continuously for 31 minutes.

While the practitioner is performing this specific breath pattern, they mentally repeat again and again (chant) the words Ek Ong Kar, Sat Gur Prasad, Sat Gur Prasad, Ek Ong Kar. The words together constitute what is called a mantra. This particular mantra is referred to by
Kundalini Yoga as Taught by Yogi Bhajan as the “magic mantra.” In this yoga tradition, it is used to remove deeply seeded mental blocks and thinking errors. Bhajan (2007) writes that, “It can stop anything negative. It is so strong that it elevates the self beyond duality and establishes the flow of spirit (Bhajan, 2007 p. 84). The theoretical framework of what a mantra is and how chanting is designed to work on a philosophical and physiological level, and whether there is any sort of Western grounding or explanation is a topic for another paper.

Mantra and pranayam in the tradition of Kundalini Yoga as Taught by Yogi Bhajan works like a sword used to cut through maladaptive thoughts and habits that manifest themselves in thoughts and in the breath (Bhajan, 2007 p.78). During this pranayam, as the practitioner is confronted with the obsessive thoughts that lead to compulsive actions typical to their symptoms are intersected by the strict breath pattern. As discussed, every thought as a breath signature associated with it (Edwards, 2008). Instead of activating the downward spiral as described by Ley (1999) in which the thought associated with the physiological response can create further triggers of alarm in the sympathetic nervous system, this breath exercise stops the cycle in its place. It is the kind of Pavlovian conditioning to which Ley (2001) refers. The practitioner is conditioning themselves not to respond to the alarming thought in the typical way.

This author speculates that the portion of the exercise in which the breath is held out is incredibly important in reconditioning the fear response. As the practitioner holds the breath out, the sympathetic nervous system is highly activated- there is a direct perceived threat of impending death if there is no inhalation. It would be a reflex at this point to take a breath- that is how drowning occurs. But because the diaphragm muscle is both under voluntary and involuntary control, the practitioner holds the position. When the fifteen seconds is over, the practitioner then inhales. This inhale is then in accordance with a voluntarily controlled action
instead of a reflex response to fear. The attendant anxiety experienced by someone affected by OCD is the driving force to perform the compulsions in order to alleviate that anxiety (Bloch, 2008). Over repeated action, that suffocation fear of holding the breath out is replaced by the knowledge that that particular feeling or impending sense of doom is does not have to be a direct signal of an actual threat. This particular pranayam is multifaceted and much remains to be studied about it. The addition of the chanting component and the various effects of the specific phases of the breathing pattern remain to be further studied.

CHAPTER V: VOCAL REPERTOIRE

This investigation set out to give a number of examples of repertoire from the Western tradition in which the phrase structure mimicked some of the pranayams and other breathing exercises found in the literature.

Carmina Burana (Carl Orff, 1935)

The first movement O, Fortuna of Carl Orff’s famous choral work, Carmina Burana is an example in which the phrase structure necessitates a breathing pattern that may activate the parasympathetic nervous system. Bernardi (1998) found that a 6 second breath cycle has the maximum effect on activation of the parasympathetic nervous system. This first movement is constructed of regularly occurring phrases that take 6 seconds each to perform. According to Bernardi (1998), a 6 second breath cycle was the optimum time for maximizing oxygen saturation- a marker of parasympathetic nervous system activation. Included here is the opening of Carl Orff’s famous choral work. Notice that the time signature is marked 3/half note with a tempo marking of half note= 120- 132 beats per minute. This means each measure is about 1.5
seconds long. The first breath mark occurs after approximately 6 seconds (6 measures of music). It is marked “end phrase A” in the score below. The second phrase ending after 8 measures marked “end phrase B” lasts a very similar length. The first movement of the work continues with almost identical phrasing to the end. This is an excellent example of a piece requiring the singers to sing with regularly occurring long breath cycles. A larger print version of the images below is found in Appendix B.

Figure V.1
*Score reproduced under U.S. Code Title 17, Chapter 1 section 107: doctrine of “fair use”*

*O Vos Omnes* (Ralph Vaughan Williams, 1922)
The very beginning of *O Vos Omnes* by Ralph Vaughn Williams is a perfect example of phrasing that seems to fit into a roughly 6 second phrase structure being used as a rough metric by which we might use to identify pieces suited to mimicking beneficial yoga *pranayams*. The first two phrases marked “end phrase A” and “end phrase B” are of a sufficient length to last about 6 seconds. Breath marks are indicated by a red oval in the annotated score below. The piece is marked free rhythm and the marking “andantino” indicates a freely moving comfortable pace. A performance that is smooth and flowing is indicative of the kinds of breathing patterns we find in *pranayams*. The pattern of this phrase length continues into letter B on page two of the score. This piece is used as an example because not all music continues in identical phrasing patterns for the same length of time that a yoga *pranayam* might. The expressive gestures implied by the andantino marking help us to create an image of what this smooth breathing patterns might look like in music. A larger print version of the images below is found in appendix B.
Figure V.2

Score reproduced under U.S. Code Title 17, Chapter 1 section 107: doctrine of “fair use”

**Go, Song of Mine (Edward Elgar, 1909)**

This piece is slow and even- the first category we might want to examine when searching for repertoire that might have the relaxing effect sought from evenly and regularly controlled breathing in *pranayam*. Even in pieces with fast tempos, but long even phrasing, the effect might be found. However, Elgar’s piece is performed at slow tempos at about 60 beats per minute, which makes it especially easy for a preliminary identification as a piece that may serve the purpose investigated in this thesis. Below, “end phrase A” is an 8 beat phrase, performed at 60 beats per minute give us an 8 second phrase. “End phrase B” is longer at 12 beats. The last system of music displayed in the image below continues these long flowing phrases. This piece was selected as a possible work to suit the purpose explored in the thesis much the same reason
that *O, Vos Omnes* was chosen - the information presented in the score allows for a preliminary examination of phrasing. Realizations of the score help to illustrate the nature of the slow breathing required of the yogic *pranayams*. A larger print version of the images below is found in Appendix B.

![Figure V.3](image)

*Figure V.3  
Score reproduced under U.S. Code Title 17, Chapter 1 section 107: doctrine of “fair use”*

**CHAPTER VI: CASE STUDY**

**Purpose**

This study is being used as a proof of concept to determine whether or not the singing of musical phrases produces the same relaxing effects as breathing exercises specifically designed to mitigate the effects of Obsessive Compulsive Disorder.

**Hypothesis**
Musical phrases requiring a breath cycle of six seconds will produce the same relaxing effects specifically designed to mitigate the effects of Obsessive Compulsive Disorder.

**Study Design**

Adult volunteers 18 and over will be split into two groups, one performing a specific yoga breathing exercise called “left nostril breathing” and the other performing a three minute vocal piece composed by the researcher. The vocal composition is intended to require breathing that will mimic the breath patterns required by the yoga breathing techniques. The participants do not need to have any previous singing experience and do not need to be diagnosed with obsessive compulsive disorder.

Participants of both groups complete a pre-exercise survey and a post-exercise survey that is designed to construct an understanding of the participant’s emotional state before and after the exercises. The surveys are included in the appendix of this paper.

The first part of the survey is the Perceived Stress Scale (Cohen, 1983). This scale is designed to measure the degree to which situations in an individual’s life are perceived as stressful, and has been evaluated as an adequate measurement tool (Cohen, 1983). The questions are phrased to be general and elicit overall responses. For the post survey questions, the phrasing has been altered to exactly resemble the initial questions, but ask the participant to evaluate their condition at the exact moment in which the survey is taken in order to uncover whether or not the experimental activity has had an effect.

The second part of the survey is the Yale Brown Obsessive Compulsive Scale which is designed to measure the severity of obsessive-compulsive symptoms without reference to the specific type of obsession experienced (Goodman, 1989). Goodman, 1989 found that this scale is a reliable instrument for measuring the severity of obsessive-compulsive symptoms (Goodman,
Normally, this scale is a clinician rated scale, but for the purposes of this proof of concept study we have selected only four of the questions to be used and to be completed by the study participant. Because the participants of the study do not need to have Obsessive Compulsive Disorder in order to participate, the questions selected are intended to target the likeness of obsessive qualities. The pre-survey questions are left exactly as published by Goodman, 1989, but are modified for the post survey to ask participants to evaluate the content of the question at the time the survey is being taken.

Each item of the pre and post survey questions will be measured in its improvement towards the less severe states of anxiety or less severe level of obsessive symptoms, and analyzed to see if there is any statistically significant change before and after the experimental exercises are performed. Additionally, results will be analyzed to determine if there is a statistically significant larger difference (or lack thereof) between the singing group and the breathing group.

**Original Musical Composition**

A specific *pranayam* for the treatment of OCD is mentioned in chapter 3. This exercise requires that the practitioner suspend the breath in the held in position as well as the held out position, and deliberately control the inhalation. These types of control are not possible in a musical composition. Instead, the original composition is designed to require phrases that take 6 seconds. Bernardi 1998 describes how maximum oxygen saturation occurs with breath cycles that take 6 seconds, and Pal 2004 describes how oxygen saturation and other biofeedback markers indicate the activation of the parasympathetic nervous system. The intent of the original composition used for this study is to activate the parasympathetic nervous system through the
requirement of repeated, long phrases while at the same time engaging some of the methods described in chapter three of the specific pranayam for OCD.

The text used for the composition is a mantra used in Kundalini Yoga as taught by Yogi Bhajan. The text is: **Sa Ta Na Ma** (pronounced Sah, Tah, Nah, Mah). This mantra is used in a meditation exercise called Kirtan Kriya. The text is used as a visualization of the chain between Sun, Earth, Moon and Stars and Cosmos. This text was chosen because it is always performed during a Kundalini Yoga as taught by Yogi Bhajan on the musical pattern mi-re-do-mi and easily lends itself to creating phrases of six seconds each. The musical pattern of mi-re-do-mi is not always preserved in the composition. The purpose of this study is not to examine the use of this mantra in the composition, but the breathing patterns. The text could have been chosen arbitrarily, but this text was selected to retain some relevancy to the focus on the techniques of Kundalini Yoga described in this thesis. A score of the composition can be found in the Appendix B.

**Breathing Exercise**

The breathing exercise used is “alternate nostril breathing” in the Aquarian Teacher Yoga Manual (Bhajan, 2007). This breathing exercise is extremely similar if not identical to the exercise described in Pal 2004. Participants sit comfortably in a chair or on the floor with a straight spine and eyes closed focusing on the point between the eyebrows. They use their right thumb to block off the right nostril and inhale deeply and fully through the left nostril. No specific amount of time for the inhalation is required by the published directions. Using the right pinky, the left nostril is blocked and the air exhaled through the right nostril. The process is repeated over and over for a total of three minutes. Pal 2004 examined the efficacy of this exercise in 30 minute intervals for 90 consecutive days, but the minimum required time
published in Bhajan, 2007 is 3 minutes. For the cases of the participants, we have elected to use the minimum required time in the experimental activity. The specific pranayam for OCD described in chapter 3 is not used here because it requires 31 minutes of practice for the complete desired effect. We feel that we can examine some of the component parts of the mechanisms of this pranayam with the exercise outlined by Pal, 2004.

Results

Data from the surveys indicated that there was a positive effect in reducing anxiety and Obsessive Compulsive spectrum symptoms in both the group performing the singing and the group performing the breathing. More research will need to be conducted to conclude whether or not the singing was more effective than the breathing exercise. However, it was clear that the singing exercise had the desired outcome. Below are graphical representations of the average scores collected from the survey data.

![Questions where decrease indicates positive outcome-singing group](image)

VI.1 Questions where decrease indicates positive outcome-singing group
VI.2 Questions where decrease indicates positive outcome - breathing group

VI.3 Questions where no change indicates positive outcome - singing group
VI.4 Questions where no change indicates positive outcome- breathing group

VI.5 Questions where increase indicates positive outcome- singing group
VI.6 Questions where increase indicates positive outcome - breathing group

Question 3 yielded dramatic results. The question in the pre-survey asked “in the last month, how often have you felt nervous or stressed?” and the post asked “Do you feel nervous or stressed right now?” In figure VI.1, the dramatic decrease from average score of 3.16 to .16 is highly suggestive that the singing exercise helped to reduce the participant’s level of anxiety. It was equally as effective at reducing the anxiety of the breathing group, who went from an average score of 3.62 in the pre-survey to a .62 in the post. We know from Pat et al. (2004) that the left nostril breathing exercise performed by the breathing group here is going to be effective in reducing anxiety, but we are able to see from the data that the singing is equally as effective in this regard.

The singing group outperformed the breathing group on question 2. Question 2 in the pre-survey asked “In the last month, how often have you felt that you were unable to control the
important things in your life?” and the post survey asked “Do you feel that you have control over the important things in your life?” In this question, no change between the answers would indicate the most positive result- if the pre survey was answered “4- control all of the time” and the post survey answered “4-complete control right now” this would indicate that the singing exercise was effective in reinforcing feelings of control. A decrease would indicate the opposite, while an increase would indicate an improvement, though in the scope of the data would work at bringing those individuals answering that they felt less in control after the exercise closer to the no change data, and so have equal and opposite effects on the data. This question is problematic in some ways because its phrasing does not exactly evaluate direct improvement from the singing exercise.

Despite this, the change from the singing group’s pre and post survey results was only .16 while the breathing groups change was .25. The smaller change indicated that those singing were more likely to feel in control after the exercise.

The singing group also outperformed the breathing group on their improvements in the Yale-Brown Obsessive Compulsive Scale number 3. This question in the pre-survey asked “How much distress do your obsessive thoughts cause you?” and the post survey asked, “How distressed do you feel right now if you were to have obsessive thoughts?” The singing group went from an average score of 1.66 to a post survey average score of .67 while the breathing group went from an average score of 1.5 to a post survey average score of 1. The singing group showed a larger improvement in this marker of symptoms of Obsessive Compulsive Disorder.

Discussion

Some of the data was particularly encouraging in demonstrating that the singing is effective in mitigating some of the markers of Obsessive Compulsive spectrum behaviors.
However, n=6 in the singing group and n=4 in the breathing group. The number of participants is too small to be able to create accurate statistical models of the data. However, the purpose of this experiment was only to prove that the subject is worth studying under closer scrutiny.

It is important to note that the data collection tools are imprecise. While the Perceived Stress Scale (Cohen et al., 1983) and Yale-Brown Obsessive Compulsive Scale (Goodman et al., 1989) are both scales that have been evaluated as accurate data collection tools, this exercise altered them beyond their original state and so the data collection tools used in this activity cannot be thought to have the same accuracy as Cohen et al. (1983) and Goodman et al. (1989).

However, despite the lack of rigor in the data collection tools, the results to give an encouraging picture that examining singing as a mode of mitigating Obsessive Compulsive Disorder symptoms is worth exploring in the future. Figure VI.1 presents very clear visual data that the singing had a positive outcome on all of the questions represented in that chart.

**Recommendations for Further Research**

This study needs to be expanded to examine more vigorously participants actually diagnosed with Obsessive Compulsive Disorder. Longer compositions need to be directly compared with the practice of the specific pranayam for OCD in Chapter 3. Additionally, the research needs to be conducted by a clinician that can accurately use the complete Yale Brown Obsessive Compulsive scale. Further research needs to examine the possibility of using singing to modify Obsessive-Compulsive behavior over a longer period of treatment.
CHAPTER VII: Conclusion

Research Questions

1) *Can breathing patterns in vocal repertoire be used to modify obsessive compulsive behavior?*

This primary research question after the completion of this research points optimistically towards yes. The parallels between *pranayam* are an apt metaphor for any familiar vocabulary that respiratory psychophysiology would offer us readers familiar with a Western tradition. The proof of concept case study provided here demonstrates the efficacy of a musical composition that is explicitly designed to induce the same types of physiological effects as yogic breathing exercises to lessen the attendant anxiety produced by obsessive thoughts. When we consider Babikian et al. (2013) and his historical perspective of music as medicine in conjunction with the insights into Yoga practice described by Pal et al. (2004) and Shannahof- Khalsa (2003), the possibility of using singing as a direct treatment for Obsessive Compulsive Disorder is strong.

2) *Why do restricted repetitive patterns of behavior, interests or activities manifest?* Shannahoff-Khalsa (2003), Ley (1999; 2001), Bloch et al. (2008) and Edwards (2008) all help us to understand that these restrictive patterns of behavior associated with Obsessive Compulsive Disorder occur as an attempt to rid oneself of the feelings of anxiety, (psychological and physical) that are produced by the worrisome thoughts. Attending to this anxiety at the psychological and physical levels is the basis for Obsessive-Compulsive behaviors.

3) *How does the breathing exercise work to modulate behavioral response?* We have come to understand from Ley (1999) that Pavlovian conditioning is at the root of the efficacy of breathing exercises. It is a psychophysiological- a term up until this point that has not been used to explicitly connote mind-body connection- that forms reinforcing habits. Just like Pavlov’s dogs,
where the bell rings and the dog is given a treat, but when the bell rings and there is no treat, the
dog still salivates, so do individuals learn to associate physiological states with certain apparent
dangers, even when they do not exist. If the physiological response to the bell (the perceived
danger) can be altered, the behavioral response is changed.

4) How can music educators use vocal and instrumental repertoire to achieve these goals?
Music educators are responsible for a litany of objectives, but the author believes that their
primary responsibility is one of maintaining an ethic of care (Elliott et al., 2015). Whether or not
a student is suffering from Obsessive Compulsive Disorder, general anxiety disorder or is not
suffering from any sort of extenuating circumstance, music educators have a responsibility to
educate their students about the real uses of music through music. As we come to understand just
how music can be applied as medicine in a typically defined disorder (OCD), we can also
understand how music as medicine may be applied more broadly. In the classroom, music
educators apply an ethic of care by selecting (or composing) repertoire that is engaging students
in the real uses of music making. Healing might well be argued as the primary reason for music
making (Babikan, 2013; Banerjie, 2014). Understanding how singing can work to remove
Obsessive Compulsive Disorder symptoms can help music educators understand that all of what
they do in the classroom might be viewed as both teaching students how to self-heal through
music and engaging students in actual opportunities to interact with self-healing. A sensitivity to
this fact and intention thus applied in relation to the needs of students is an ethic of care carried
out on the highest level.

5). What vocal repertoire can inherently replicate these breathing exercises as a constructive
intervention? Perhaps not all vocal repertoire addresses the elements that we have pointed out
work to modify Obsessive Compulsive behaviors. Ley (1999) describes how hyperventilation is
an element leading to the onset of a panic attack (Ley, 1999). Perhaps music that is in very short phrases with extremely frequent inhalations might work opposite the goals of singing for healing. However, Edwards (2008) describes how all exhilatory actions are activating to the parasympathetic nervous system (Edwards, 2008). Because we look for parasympathetic function as a marker of reducing Obsessive Compulsive behaviors, perhaps any singing can be suited to this purpose! The repertoire we look for might actually be of little importance.

**Future Implications**

What we might actually be looking for is intentionality. The repertoire truly may not matter. It is time that we give our musical practice as educators serious consideration as a form of medicine, even for those who are not “sick”. We are looking at an intersection of music, music education, music therapy and spiritual practices when we look at performing music with the specific intention of creating healing. The main focus of this thesis- looking for ways of modifying Obsessive Compulsive behavior through singing actually serves as a way of assuaging skeptics. What future research needs to address is a more explicit application of yogic philosophy about breathing in singing and how signing might be used for spiritual evolution.

This thesis touched on the term *prana* briefly but has not touched on any of the deeper philosophical principles of Yoga, principles that describe the phenomena of human consciousness through cataloging the movements of *prana* through the body and mind and the conscious will applied to move this prana to stimulate *Kundalini* energy to reach higher levels of awareness not typically accessed in everyday life (Kumar, 2000).

We have created a familiarity with the power that yogic breathing and singing has in creating physiological changes and how those physiological changes create cognitive changes. What further research needs to address is what to do with these physiological and cognitive
changes. Kurt Leland (2005) in his book “Music and the Soul” provides a highly practical system of “the Yoga of listening” whereby music is used as a means of arousing the Kundalini energy to reach those higher levels of awareness. This thesis has worked at giving a wider audience of readers a practical way of seeing what Kundalini Yoga and its methods can do physiological and cognitively. We have created a specific example of what Kundalini Yoga is and allowed the term Kundalini to be associated with creating changes in a human being. What remains now is to expand this understanding of Kundalini beyond an association with physical and cognitive changes to the completion of the timeless trinity- body, mind and of course soul. We have elaborated an extremely specific application of moving Kundalini energy, but spoke of it mostly in familiar Western terms. As research moves on, we can weaken the dependence on Western terminology and unclutter the mystical terms of the Yoga tradition. The healing we see as apparently available for Obsessive Compulsive Disorder through singing is the healing created by the movement of Kundalini energy upward to higher levels of awareness. We are now ready to talk about how we teach inner growth, advancement and healing in school music. Future research can ground this in an expanding vocabulary and understanding that will charge how we teach music in schools and how we create music with a deeply practical and intentional method of moving ourselves as humans past the lowly levels of disease and want into abundance and a thriving, unentangled mind enlightened by integrated physical and cognitive function of the highest degree- a degree that points straight upward to the third point of the timeless trinity.
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APPENDIX A

Data Collection Tools

Pre- Survey

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly? ........................................... 0  1  2  3  4

2. In the last month, how often have you felt that you were unable to control the important things in your life? .......................................................... 0  1  2  3  4

3. In the last month, how often have you felt nervous and “stressed”? ........... 0  1  2  3  4

4. In the last month, how often have you felt confident about your ability to handle your personal problems? ........................................... 0  1  2  3  4

5. In the last month, how often have you felt that things were going your way? .......................................................... 0  1  2  3  4

6. In the last month, how often have you found that you could not cope with all the things that you had to do? ........................................... 0  1  2  3  4

7. In the last month, how often have you been able to control irritations in your life? .......................................................... 0  1  2  3  4

8. In the last month, how often have you felt that you were on top of things? 0  1  2  3  4

9. In the last month, how often have you been angered because of things that were outside of your control? ........................................... 0  1  2  3  4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? .......................... 0   1   2   3   4

Modified Yale- Brown Obsessive Compulsive Scale

The Yale-Brown Obsessive Compulsive Scale is used to measure the type and severity of the dimensions of Obsessive Compulsive Disorder (OCD). We are using a number of questions selected from the scale to use in identifying the effects of the activities in our study today. Please read each question carefully and circle your answer. We have defined the terms “obsession” and “compulsion” below as a reference point for your completion of the survey. Read each question and its clarification and then circle the number best describing how you feel.

OBSESSIONS are unwelcome and distressing ideas, thoughts, images or impulses that repeatedly enter your mind. They may seem to occur against your will. They may be repugnant to you, you may recognize them as senseless and they may not fit your personality.

COMPULSIONS, on the other hand, are behaviors or acts that you feel driven to perform although you may recognize them as senseless or excessive. At times, you may try to resist doing them but this may prove difficult. You may experience anxiety that does not diminish until the behavior is completed.

1. TIME OCCUPIED BY OBSESSIVE THOUGHTS
0 = None.
1 = Mild, less than 1 hr/day or occasional intrusion.
2 = Moderate, 1 to 3 hrs/day or frequent intrusion.
3 = Severe, greater than 3 and up to 8 hrs/day or very frequent intrusion.
4 = Extreme, greater than 8 hrs/day or near constant intrusion.

Q: How much of your time is occupied by obsessive thoughts?

When obsessions occur as brief, intermittent intrusions, it may be difficult to assess time occupied by them in terms of total hours. In such cases, estimate time by determining how frequently they occur. Consider both the number of times the intrusions occur and how many hours of the day are affected.

Ask: How frequently do the obsessive thoughts occur? Be sure to exclude ruminations and preoccupations which, unlike obsessions, are ego-syntonic and rational (but exaggerated).
*Disregard the hour time marks if it is irrelevant to you. Use the scale of occasional, frequent, very frequent and near constant as your scale.

2. INTERFERENCE DUE TO OBSESSIVE THOUGHTS
0 = None.
1 = Mild, slight interference with social or occupational activities, but overall performance not impaired.
2 = Moderate, definite interference with social or occupational performance, but still manageable.
3 = Severe, causes substantial impairment in social or occupational performance.
4 - Extreme, incapacitating.

Q: How much do your obsessive thoughts interfere with your social or work (or role) functioning? Is there anything that you don't do because of them?

If currently not working determine how much performance would be affected if patient were employed. If a full time student, school qualifies in this manner as work.

3. DISTRESS ASSOCIATED WITH OBSESSIVE THOUGHTS
0 = None
1 = Mild, not too disturbing
2 = Moderate, disturbing, but still manageable
3 = Severe, very disturbing
4 = Extreme, near constant and disabling distress

Q: How much distress do your obsessive thoughts cause you?

In most cases, distress is equated with anxiety; however, patients may report that their obsessions are "disturbing" but deny "anxiety." Only rate anxiety that seems triggered by obsessions, not generalized anxiety or associated with other conditions.

4. RESISTANCE AGAINST OBSESSIONS
0 = Makes an effort to always resist, or symptoms so minimal doesn't need to actively resist
1 = Tries to resist most of the time
2 = Makes some effort to resist
3 = Yields to all obsessions without attempting to control them, but does so with some reluctance
4 = Completely and willingly yields to all obsessions
Q: How much of an effort do you make to resist the obsessive thoughts? How often do you try to disregard or turn your attention away from these thoughts as they enter your mind?

Only rate effort made to resist, not success or failure in actually controlling the obsessions. How much the patient resists the obsessions may or may not correlate with his/her ability to control them. Note that this item does not directly measure the severity of the intrusive thoughts; rather it rates a manifestation of health, i.e., the effort the patient makes to counteract the obsessions by means other than avoidance or the performance of compulsions. Thus, the more the patient tries to resist, the less impaired is this aspect of his/her functioning. There are "active" and "passive" forms of resistance. Patients in behavioral therapy may be encouraged to counteract their obsessive symptoms by not struggling against them (e.g., "just let the thoughts come; passive opposition) or by intentionally bringing on the disturbing thoughts. For the purposes of this item, consider use of these behavioral techniques as forms of resistance. If the obsessions are minimal, the patient may not feel the need to resist them. In such cases, a rating of "0" should be given.

5. DEGREE OF CONTROL OVER OBSESSIVE THOUGHTS
0 = Complete control.
1 = Much control, usually able to stop or divert obsessions with some effort and concentration.
2 = Moderate control, sometimes able to stop or divert obsessions.
3 = Little control, rarely successful in stopping or dismissing obsessions, can only divert attention with difficulty.
4 = No control, experienced as completely involuntary, rarely able to even momentarily alter obsessive thinking.

Q: How much control do you have over your obsessive thoughts? How successful are you in stopping or diverting your obsessive thinking? Can you dismiss them?

In contrast to the preceding item on resistance, the ability of the patient to control his/her obsessions is more closely related to the severity of the intrusive thoughts.
Post Survey

Modified Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts right now. In each case, you will be asked to indicate by circling how you feel.

0 = not at all  1 = a little bit  2 = moderately  3 = significantly  4 = totally

1. If something unexpected were to happen right now, do you feel you would be able to handle it calmly? .................................. 0  1  2  3  4

2. Do you feel that you have control over the important things in your life? .............................................. 0  1  2  3  4

3. Do you feel nervous or stressed right now? 
   0  1  2  3  4

4. Do you feel confident about your ability to handle your personal problems right now? 
   .................................................. 0  1  2  3  4

5. Do you feel that things are going your way? 
   .................................................. 0  1  2  3  4

6. Do you feel that you could cope with all of the things you have to do right now? 
   .................................................. 0  1  2  3  4

7. Do you feel that you can control irritations in your life right now? 
   .................................................. 0  1  2  3  4

8. Do you feel that you are on top of things right now? 
   .................................................. 0  1  2  3  4

9. Are you feeling angered about things outside of your control? 
   .................................................. 0  1  2  3  4

10. Do you feel that difficulties are piling up so high that you cannot handle them? 
    .................................................. 0  1  2  3  4
Modified Yale- Brown Obsessive Compulsive Scale

The Yale-Brown Obsessive Compulsive Scale is used to measure the type and severity of the dimensions of Obsessive Compulsive Disorder (OCD). We are using a number of questions selected from the scale to use in identifying the effects of the activities in our study today. Please read each question carefully and circle your answer. We have defined the terms “obsession” and “compulsion” below as a reference point for your completion of the survey. Read each question and its clarification and then circle the number best describing how you feel.

**OBSESSIONS** are unwelcome and distressing ideas, thoughts, images or impulses that repeatedly enter your mind. They may seem to occur against your will. They may be repugnant to you, you may recognize them as senseless and they may not fit your personality.

**COMPULSIONS**, on the other hand, are behaviors or acts that you feel driven to perform although you may recognize them as senseless or excessive. At times, you may try to resist doing them but this may prove difficult. You may experience anxiety that does not diminish until the behavior is completed."

1. **TIME OCCUPIED BY OBSESSIVE THOUGHTS**
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   1 = Mild, less than 1 hr/day or occasional intrusion.
   2 = Moderate, 1 to 3 hrs/day or frequent intrusion.
   3 = Severe, greater than 3 and up to 8 hrs/day or very frequent intrusion.
   4 = Extreme, greater than 8 hrs/day or near constant intrusion.

**Q:** Do you feel inclined to spend much of your attention right now on obsessive thinking?

2. **INTERFERENCE DUE TO OBSESSIVE THOUGHTS**
   0 = None.
   1 = Mild, slight interference with social or occupational activities, but overall performance not impaired.
   2 = Moderate, definite interference with social or occupational performance, but still manageable.
   3 = Severe, causes substantial impairment in social or occupational performance.
   4 - Extreme, incapacitating.
Q: How much interference do you feel that your obsessive thoughts would cause you right now?

3. DISTRESS ASSOCIATED WITH OBSESSIVE THOUGHTS
0 = None
1 = Mild, not too disturbing
2 = Moderate, disturbing, but still manageable
3 = Severe, very disturbing
4 = Extreme, near constant and disabling distress

Q: How distressed do you feel right now if you were to have obsessive thoughts?

4. RESISTANCE AGAINST OBSESSIONS
0 = Makes an effort to always resist, or symptoms so minimal doesn't need to actively resist
1 = Tries to resist most of the time
2 = Makes some effort to resist
3 = Yields to all obsessions without attempting to control them, but does so with some reluctance
4 = Completely and willingly yields to all obsessions

Q: How much of an effort do you feel the need to make to resist the obsessive thoughts right now?

5. DEGREE OF CONTROL OVER OBSESSIVE THOUGHTS
0 = Complete control.
1 = Much control, usually able to stop or divert obsessions with some effort and concentration.
2 = Moderate control, sometimes able to stop or divert obsessions.
3 = Little control, rarely successful in stopping or dismissing obsessions, can only divert attention with difficulty.
4 = No control, experienced as completely involuntary, rarely able to even momentarily alter obsessive thinking.

Q: How much control do you feel you would have over your obsessive thoughts? Do you feel you would have success in dismissing them?
APPENDIX B

Scores

Carmire Burana
Fortuna Imperatrix Mund

1. O Fortuna
Pezante

Soprano

O Fortuna, velut Luna staut variabilis,

Contralti

O Fortuna, velut Luna statu variabilis,

Coro

O Fortuna, velut Luna statu variabilis,

Tenor

O Fortuna, velut Luna statu variabilis,

Basso

O Fortuna, velut Luna statu variabilis,

Pezante

3/c $d = 60$

poco stringendo

3/$p$ $d = 120 - 132$

sempre crescendos aut crescendos; vita

sempre crescendos aut crescendos; vita

sempre crescendos aut crescendos; vita

sempre crescendos aut crescendos; vita

sempre crescendos aut crescendos; vita

sempre crescendos aut crescendos; vita
89. Ralph Vaughan Williams,
O vos omnes (1922)

Andantino (in free rhythm.)

SOPRANO.

II

I

ALTO.

II

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null
Elgar, Go, Song of Mine

song of mine, .. To break the hardness of the heart of man:

song of mine, .. To break the hardness of the heart of man:

song of mine, .. To break the hardness of the heart of man:

song of mine, .. To break the hardness of the heart of man:

song of mine, .. To break the hardness of the heart of man:

Go, song of mine, .. To break the hardness of the heart of man:

Quasi R. molto espress.

Go, song of mine, .. To break the hardness of the heart of man:

Quasi R. molto espress.

Go, song of mine, .. To break the hardness of the heart of man:

Quasi R. molto espress.

Go, song of mine, .. To break the hardness of the heart of man:
Thou Art That: Sat Nam

Keith "Ram Prakash" Curbow

SOPRANO

ALTO

70 bpm

SA TA NA MA

TENOR

BASS

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