Pranayama and Prosody: Unilateral Nostril Breathing to Enhance Recognition of Emotional Tone

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Abstract

The ability to detect the emotional prosody of others is important for effective communication and empathy. Prior research has shown this to be dominant in the right cerebral hemisphere. Pranayama is the Sanskrit name for the breathing techniques of yoga. Certain techniques in this category, such as Unilateral Nostril Breathing (UNB), have been shown to physiologically shift hemisphere dominance. This research study hypothesized that left-sided UNB (LUNB) would cause a shift to right-hemisphere dominance, which would increase the ability to detect and correctly identify the emotional tone of another. Participants were randomly assigned to 3 groups: a control group (deep breathing through both nostrils), LUNB, and RUNB. Techniques were practiced for ten minutes each. A test of emotional perception was administered to all groups before and after the breathing exercises. Upon initial testing, the groups did not significantly differ in terms of pre-post changes. However, after a second set of analyses were done, where the deep breathing control group was excluded and handedness was accounted for, significance was discovered. Comparing LUNB and RUNB groups *did* show the LUNB group to be better at detecting fear via prosody.

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As social beings, humans rely heavily on the ability to effectively communicate and empathize with one another. Successful communication is the basis for positive encounters throughout personal relationships as well as many occupations. Though the need and desire to communicate with and understand one another efficiently has continued to grow in complexity throughout time, due to mass communication and modern lifestyles, they have both been present throughout humanity.

It is becoming increasingly apparent that our social interactions, mental states, physical health, and emotional well-being and understanding are all inter-related. This is a principal commonly known as “Holistics.” For some time, modern, primarily Western, thought had shied away from this idea. However, the current popularity of Eastern philosophies and practices, and the increasing discovery of tangible mind-body connections in medicine, has prompted and promoted the search for further connections and natural means of enhancement in all areas.

Yoga is one such practice that works in a holistic fashion to promote well-being on all levels. Though most simply think of physical postures (*asanas*) as the basis of yoga, other areas, including emotional health and communication do come into play when truly living a yogic lifestyle. Some claims about yogic techniques may have appeared to be outrageous not long ago, but are now being found to have true merit. One such technique is the practice of pranayama.

Pranayama is a Sanskrit word. This practice works to control (*yama*) the life force (*prana*) through the breath, and is the fourth of the eight limbs of Raja (“king” or “royal”)

Yoga. These limbs come directly from the ancient text of Patañjali's *Yoga Sutras* (Shearer, 1982). The eight limbs are regarded as steps for better subjective and physical well being, ultimately leading to "samadhi," or enlightenment, according to the passage. The breath is highly regarded in yoga and control of it is considered extremely important as it is believed to be the link of the body to the mind, and to the "spirit."

Of course, breathing is one of the most immediate necessities for survival. Oxygen must be supplied on a constant basis for all domains of mental and physical functioning. Accordingly, different yogic breathing exercises can serve many purposes. Today, pranayama is commonly used to relax, increase energy, strengthen the lungs and expand their capacity, to focus mentally, and so on. One does not need to believe in, nor conform to, all of the philosophical tenets of yoga in order to benefit from the physical postures, breathing techniques, or other practices it has developed throughout its 5,000-6,000 year history. The modern studies of yoga have offered empirical support for the efficacy of yogic practices including breath training regimens (Gilbert, 1999).

There are several main yogic principles of proper breathing, listed by Gilbert (1999). One should breathe into the abdomen rather than the chest in order to fully expand the lungs. Breathing should take place through the nose rather than the mouth in order to warm, humidify, slow, and filter the air coming in. Breathing should be slow and smooth rather than taking short or choppy breaths, in order to take more oxygen in with each breath and to calm and steady the nervous system. The breath is also observed by yogis (practitioners of yoga) in order to understand it better, keep it under control, and to assist in concentration, relaxation, and/or meditation.

It becomes apparent that there is a close relationship between the breath, body, and mind. Breathing patterns can mirror our mental and physical conditions. For instance, if one is rushed or sporadic in their thinking or activities, the breath will often follow the same pattern. On the other hand, when one is calm, the breathing process is smoother. This relationship is convenient since one can control the breath to affect and change their physical and mental state of being. When one takes the time to slow their breathing, it can greatly reduce stress levels and thus settle the "fight or flight" response of the autonomic nervous system. Gilbert (1999) calls this the bi-directional mind-body influence.

Alternate Nostril Breathing (also called "forced nostril breathing," or, in Sanskrit: "nadi-shodhana" or "anuloma viloma") is one of the more common techniques described by Gilbert (1999). Besides being believed to enhance prana and raise "kundalini" (dormant vital energy), Alternate Nostril Breathing (ANB) is said to hold several physical and mental benefits. ANB facilitates the proper breathing described earlier (through the nose, slow and steady, deep, concentrated upon, etc.) and, as such, brings about all of the benefits related to it. However, there is believed to be much more going on psychophysiologically speaking.

Subbalakshmi and colleagues (2005) conducted a study that looked at the immediate effects of ANB on the cardiovascular and pulmonary systems as well as higher functions of the brain. Their study consisted of 3 groups of 10 individuals each. The participants of the experimental and control groups were matched for age, sex, and body mass index (BMI). Control group A was made to simply relax for 20 minutes on a couch. Control group B participated in quiet, focused breathing, with eyes closed, for 20 minutes. The experimental group was taught, and then performed ANB, again, for 20 minutes. Subjects were studied individually and at the same times of day. Each was studied right before their 20 minute participation and within five minutes after. Heart rate, systolic and diastolic blood pressures, peak expiratory flow rate (speed of exhale), simple problem solving ability, and mental efficiency were all examined.

The baseline readings of all three groups were similar. However, after the 20 minute regimens, significant declines in heart rate and systolic blood pressure, significant improvements in peak expiratory flow rates, and reduction in the time taken to solve mathematical equations, was only seen in the experimental group. No significant differences in control A or B were reported. This showed that normal relaxation and/or focus on breathing alone could not compare to ANB in results. The authors mention balancing of the brain's hemispheres as a possible mechanism.

The authors cite increases in alpha wave activity, noted in other research on yogis, as a possible correlate to the results of their own study. Alpha waves are seen during an alert but deeply relaxed state, as observed in electroencephalogram's (EEG). They state that the observed reduction in heart rate, partnered with increases in cutaneous peripheral vascular resistance (reduction in blood flow to the surface of the skin) noted in yogis after meditation, also indicate physiological relaxation along with their heightened mental alertness. Thus, pranayama, specifically ANB, seems to improve both mental and physical health and functioning. The next study is an excellent example of this.

Kamei and colleagues (2001), looked at correlations between pranayama induced alpha rhythms, and natural killer cell (NKC) activity in the body. A NKC signals the immune system to function, playing a major role in fighting off viruses and tumors. In this study, eight veteran yoga instructors (4 men and 4 women) participated. During testing, brain rhythms were continuously recorded via electrodes placed on the subjects' foreheads. Participants rested for 10 minutes, practiced asanas (poses) for 15 minutes, pranayama for 15 minutes—which consisted of various techniques not specified in the report—and then meditated for 20 minutes using mantra meditation (a repeated sound or syllable used as a focal point). Blood samples were taken through a catheter, inserted 20 minutes before the rest period. Blood was drawn directly before and after each exercise took place.

Alpha waves significantly increased in 7 of the subjects, and both alpha and theta waves increased in the last. Enhanced immune function appeared to be related to the activation of alpha rhythms. Interestingly, only after the pranayama was NKC activity reported to significantly increase. The authors speculated that stimulation of the respiratory center of the pons and/or changes in blood oxygen levels resulted in the increase of neurotransmitters. They state that the exact mechanism, however, is inconclusive. Yet it was clear that pranayama helped to boost the immune system and, according to Kamei, et al (2001), enhance mental health.

Going back to the principle of “bi-directional mind-body influence,” it would seem that a healthier physical body (i.e. one with a boosted immune system) would help to heighten cognitive functioning. A body that does not need to worry about illness or injury as much can lend more resources to cognitive functioning, after all. We continue to find strong connections between the body, mind, and the breath. This has included a specific connection involving inhalation and hemisphere activity.

In the average person, Gilbert (1999) states that, a dominant nostril prevails and shifts about every 1.5 to 3 hours. This is commonly experienced as one finds it easier to breathe through one nostril than the other, or finds one to feel clearer than the other, at any given time. Depending on which nostril is dominant, the opposite hemisphere of the brain has been observed to show more activity (Saucier, 2004). Yogis have claimed that unilateral nostril breathing can prepare one for certain cognitive tasks (Gilbert, 1999). Ideally, one might coordinate one's activities with the cognitive functions linked to the hemisphere of the brain that was presently dominant.

Though the body does naturally work to switch hemisphere-dominance throughout the day, yogis believe that the alternating rhythm is often disturbed, so performing ANB could help assist in balancing the two hemispheres once again. If one desired to manually switch the dominant hemisphere, in order to be better equipped for a specific task, Unilateral Nostril Breathing (UNB), also described by Gilbert (1999), would do the trick. Gilbert (1999) explains that the cool air being inhaled through the dominant nostril can apparently suppress the dominance of the hemisphere directly above it, allowing the opposite hemisphere to then dominate. However, not all studies have shown this.

Stancak and Kuna (1994) studied the EEG readings of 18 trained subjects when participating in UNB. They called this technique "Forced Alternate Nostril Breathing (FANB)," however the description of what was practiced showed that they were actually studying UNB. Half of the subjects practiced consistent left nostril inhalation and right nostril exhalation, while the other half practiced right nostril inhalation and left nostril exhalation. Both of these were practiced for two rounds of 10 minutes each. Subjects rested before, in-between rounds one and two, and after the UNB took place.

During the first 10 minute round, EEG readings indicated increases in beta 1 and 2 bands which, the authors state, point to increased cortical excitability. They believed this was most likely caused by the partial occlusion of the airways. During the second round, increased power in the alpha band of the EEG was observed, which was said to suggest a tendency toward synchronization when the breathing technique had been prolonged. Readings returned to baseline during each rest period and immediately following the UNB. This showed that the changes in the brain were not due to spontaneous changes in the nervous system activity. Reduced asymmetry of the beta 1 band showed that UNB also had a clear balancing effect between the hemispheres. These changes occurred regardless of which side the UNB took place. Thus, although the practice of UNB was shown to relax, stimulate brain activity, and balance the hemispheres, just as ANB is said to, it did not seem to switch the dominance in this study. Still, despite these results, other studies have pointed to an ability to manually switch hemisphere dominance with UNB.

Saucier and colleagues (2004) studied the effects of UNB on dichotic listening for emotional tones. They mention that breathing through the left nostril (indicating right hemisphere dominance) is associated with enhanced spatial functioning, while breathing through the right nostril (indicating left hemisphere dominance) is associated with enhanced verbal skills. Furthermore, they discuss the fact that dichotic listening for word targets exhibits a right ear (left hemisphere) advantage, while listening for emotional targets exhibits a left ear (right hemisphere) advantage. The authors of this study wanted to investigate whether UNB could affect lateralized cognitive ability in these areas.

Sixty participants, 23 males and 37 females, took part in the study. Nostril dominance was confirmed upon arrival at which time participants were randomly assigned to breathe out of either their dominant or non-dominant nostril for the duration of the study. All participants engaged in 2 minutes of UNB prior to any testing to ensure that a minimum baseline was met. In this study, the traditional yogic protocol for UNB was not used. Rather, one nostril was blocked completely allowing for all inhalation and exhalation to occur through the opened nostril.

Four rhyming words were spoken in four emotional tones. These were “bower, dower, power, and tower;” in the four emotions of angry, happy, sad, and neutral. For the emotional targets portion of the testing, subjects were instructed to circle “yes” when they heard an angry voice, and “no” when they did not. When listening for words, they were to circle “yes” when they heard the voice speak the word “bower,” and “no” when they did not. There were 144 trials of each completed.

The authors noted a significant three-way interaction between dichotic listening task, nostril dominance, and nostril assignment. UNB appeared to induce atypical performance in the detection of emotional tones in right nostril dominant participants. It did not, however, seem to alter dichotic listening for the word targets. They conclude that UNB may enhance right hemisphere lateralized functions.

These findings are intriguing. So much could be studied involving UNB and how it affects our hemisphere dominance and performance on associated tasks. However, the emotional aspect of our last study is particularly interesting. The ability to detect emotional tones is a skill that many overlook and usually take for granted. In certain psychological and cognitive disorders, this skill can be significantly lacking.

Magnee, Gelder, Engeland, & Kemner, (2008) studied deficits in recognition of emotions experienced by individuals with Pervasive Developmental Disorder (PDD). This category includes conditions such as Autism. Magnee, et al (2008) note that, successful social-affective communication relies on immediate perception of both visual and auditory emotional cues as well as multi sensory integration (MSI).

Twelve high functioning adults with PDD and thirteen cognitively healthy adult controls participated in the study. All were given the Wechsler Adult Intelligence Scale, Dutch edition (WAIS-III-NL), and were also found to be free of other neurological disorders and substance abuse. PDD adults and controls were matched for age and IQ scores. Subjects were compared while processing fearful faces and happy faces. MSI was studied, using EEG, by distinguishing the effects of cross-modal presentation. Six fearful and six happy facial expressions were partnered with congruent or incongruent emotionally-toned audio. Subjects were permitted to take all the time they needed to come to their answers.

It was found that the PDD individuals differed from the controls in their MSI of fearful information from visual and auditory samples. Though both groups showed similar readings concerning visual emotion processing, the PDD group showed irregularities in processing of the fearful face/voice combinations. The authors state that, because of the importance of immediate MSI for social competence, MSI differences in PDD may be correlated to the deficits shown in their emotional behavior. Deficits in one's ability to detect and understand the emotions of others can be seen in socially inept disorders, such as psychopathy, as well.

Blair and Mitchell (2002) echo the sentiments of the above researchers, as they state that the processing of emotional expressions is fundamental for normal socialization and interaction. They studied the ability of psychopathic and non-psychopathic adults to process emotional prosody. They used the Hare Psychopathy Checklist-Revised (PCL–R;

R. D. Hare, 1991), to determine each subject's status.

The experiment consisted of two groups. Thirty-nine men participated all together. All were incarcerated individuals who were separated based on their diagnosis of psychopathy. Blair et al (2002) presented participants with neutral words that were spoken with intonations conveying happiness, disgust, anger, sadness, or fear. Participants were asked to identify the emotion of the speaker based on vocal affect, not the definition of the word. Subjects were given as much time as they needed to answer each. The choices of which emotion might be heard were continuously available for the participants to view. It should be noted that these advantages, which were also seen in the previous study, would not be available during real-life interactions.

It was found that psychopathic individuals were severely impaired in identifying fearful voice intonations. There was also a strong correlation found between a high score on the psychopathy scale and an impaired ability to identify sad vocal affect. There was no significant difference seen between the two groups and their ability to recognize other emotional tones.

Blair and colleagues (2002) believe that these findings strengthen the claims that psychopathy is a neuro-cognitive disorder. They state that it is apparent across a person's life-span as children who display psychopathic tendencies also show such impairments. These, of course, could be considered extreme cases; yet average people can have difficulty picking up on the subtle emotional cues of others as well. This is something that can impair the quality of one's interpersonal relationships and even ones occupation.

Stewart and Reynolds (2002) review the importance of empathy in doctor-patient interactions and quality of care. They state that empathy is a multi-dimensional concept with moral, cognitive, emotive, and behavioral components. Research in the areas of mental health and nursing has shown that it plays a key role in care.

Clinical empathy is defined as encompassing an ability to understand a patient's situation, perspective, and feelings (and attached meanings), to communicate that understanding and check its accuracy, and to act on this understanding in a helpful and therapeutic way for the patient (Stewart, et al, 2002). Emotionally, empathy calls for an ability to experience and share in another's emotional state and feelings. Morally, they claim an altruistic force should be present. Empathy also calls for the cognitive ability to identify and understand another's emotional state objectively. Finally, it requires the behavioral ability to convey the understanding of a person's feelings to that individual and respond appropriately.

When all of the above are present, empathy can improve outcomes in the consultation process. Stewart and colleagues (2002) believe that empathetic consulting in primary care should be encouraged. They state that empathy can be successfully taught in medical school, especially if it is done during the student's actual interaction with patients using focused experiential teaching methods. They believe that the human dimension of the clinical encounter is important and that the tradition of "holism" (or holistic health) is a strong basis.

If a person, such as a doctor, nurse, therapist, or everyday individual for that matter, were able to practice UNB before going into a consultation, therapy session, or emotional discussion of any kind, both parties could potentially benefit. UNB could help enhance and prepare a person cognitively for each of the above factors of empathy, as well as calm them, and help them to be focused for the task at hand. One could also speculate that looking at this area might help in the understanding and treatment of cognitive disorders such as PDD and psychopathy as well.

If the claims given to ANB, UNB, and other pranayama techniques are correct, one should wonder why they are not being utilized more often in psychology, medicine, the work place, or everyday functioning. Clearly, they could potentially hold practical applications, possibly helping to naturally improve functioning and efficiency. The above studies do pose a few questions themselves, especially in relation to UNB.

Does practicing UNB for a specific hemisphere truly change the brain's performance in certain tasks? Would a person's ability to detect emotional affect be significantly enhanced with its practice? Would their empathy be significantly increased as a result? These are some of the questions the current study attempted to answer. This study hypothesized that left-sided UNB (LUNB), bringing forth right-hemisphere dominance, would be found to increase a person's ability to detect and correctly identify another's emotional tone.

Method

Participants

Subjects were volunteers from a college community. This study took place at a state college located on the East coast. All participants were required to be at least 18 years of age. Sixty-two volunteers successfully completed the experiment (*M* = 23.43, *SD* = 5.25). Fifteen of these were male and 47 were female with an age range of 19 to 44 years and an ethnic breakdown of 5 Asian, 3 African American, 2 Hispanic, and 52 Caucasian. Groups were brought together via undergraduate psychology courses. Compensation was given in the form of extra credit at the discretion of each professor.

No compensation was supplied by the researcher; however, all were thanked for their time, efforts, and cooperation in the experiment.

Materials

This experiment used the Emotional Perception Test (EPT) to study each participant's ability to detect emotional tones (Green et al., 2001). The EPT uses recorded neutral statements (e.g. "Please use the door on the left") conveying a variety of emotional tones, each read by a professional actress. Participants were to listen to each statement and work to identify which of five emotions was being expressed: happy, angry, frightened, neutral, or sad. They recorded their answers on a multiple choice, double-sided worksheet. The front of this worksheet also held a place to identify demographic information (age, sex, and ethnicity) as well as hand preference (right or left handed) and present nostril dominance (right or left), which subjects were instructed on how to determine.

Procedure

Participants were randomly assigned to groups. Each subject was given an informed consent form. This gave a basic description of what was to take place and the rules that were to be followed during the experiment. Participants were asked not to talk with one another and to pay attention as closely as possible. The form explained that subjects would participate in an exercise in which they would listen to neutral phrases being spoken in a variety of emotional tones. They would be asked to identify each. Participants would then be taught a specific yogic breathing technique and would practice it for 10 minutes before taking part in the same exercise again to see what effect, if any, it might have on their perception of these tones. The form did not state what the potential effect was expected to be.

The informed consent form made it clear that their participation in this experiment was completely voluntary and that not participating would not involve any penalty. It made them aware of any potential compensation and stated that they were responsible for making sure any credit that they were entitled to was received.

The form also stated that there was little possibility of any adverse effects. However, when altering the breath, there could be a slim chance of causing irregularity or light-headedness. If one were prone to things like hyperventilation or asthma, it could possibly cause problems, but the chances were very minute. In fact, techniques such as the proposed are often used as part of treatment regimens for such disorders. All were told to be aware of their bodies and if they felt any adverse effects, to stop the practice immediately.

If participants were currently suffering from a very congested nose, or abnormalities of the sinuses, septum, etc. they were asked to please not participate as this may have skewed the results. Finally, the form supplied the contact information of the researcher and supervising faculty. Participants were required to verify their age, print their name, sign, and date the form and return it to the researcher before participating in the study. They were assured that all personal and identifying information would be kept completely confidential.

Once forms were collected, a double-sided work sheet was handed out. Subjects were asked to fill in their demographic information. They were then asked to determine their dominant nostril by briefly breathing through each, one at a time, to see which was the easiest to breathe through. They recorded this on their work sheet. The first part of testing then began.

Subjects listened to the EPT (Green et al., 2001) and filled out the corresponding worksheet. After completion of this first round, subjects were either taught a deep diaphragmatic breathing (see protocol in box below) and asked to practice this breath for 10 minutes; or UNB in either the left or right nostrils (see protocol in box below), again, practicing for 10 minutes. This depended on which group they were randomly assigned to. Subjects were then asked to flip their worksheet over to once again test their ability to detect emotions, using the same recordings. "Practice effect" was not considered to be an issue as all subjects had the same chance of correctly or incorrectly identifying the information regardless.

Once complete, all worksheets were collected and a debriefing form was handed out. This form recapped what had taken place and stated the hypothesis of the study. It thanked all for their participation and supplied the contact information of the researcher and faculty once more. If subjects had any further questions, comments, or concerns, or desired to view the results of the study upon completion, they were invited to contact the researcher.

Pranayama Protocols

Diaphragmatic Breathing:

Subjects were asked to take slow, smooth breaths in and out through the nose, both nostrils opened. As they inhaled, they were told to breathe deeply, expanding their abdomens and sides "like a balloon." As they exhale, they were instructed to "press their navels toward their spines," using their abdominal muscles to expel the air fully from the lungs. This deep breathing technique was repeated until everyone felt comfortable and was then practiced for 10 minutes.

Unilateral Nostril Breathing (UNB):

Subjects were instructed to fold the index and middle fingers of their right hand in toward the center of their palms. Their ring and pinky fingers were to stay together and extended, thumb also extended. If this was too difficult, they were permitted to rest the tips of the index and middle fingers on the forehead in-between the eyebrows, holding the other fingers in the same way as described above. If still too difficult, they were asked to simply fold the middle, ring, and pinky fingers in, and extend the index and thumb only. The first, and the second, hand positions are the traditional ways to practice the technique in yoga, which is why they were asked to try these first.

If assigned to left-sided UNB (LUNB), the hand was held up to the nose and the thumb, in any position, was used to close the right nostril. The participant was told to inhale fully through the left nostril, using slow, deep, steady breathing. They were then asked to pinch both nostrils closed, hold, and then release the thumb from the right nostril, still closing the left, to exhale fully from there. Subjects then pinched the nostrils closed once more and repeated, inhaling through the left again and exhaling through the right.

If assigned to right-sided UNB (RUNB) the above was practiced in the same way but in a reverse order. Instead of inhaling through the left, subjects opened the right nostril first, inhaled, and pinched; open the left nostril, exhaled, pinched, and repeated this pattern. Just as with the diaphragmatic breathing, participants practiced briefly, until they felt comfortable with the technique, and then breathed using the regimen for 10 minutes.

Results

This study hypothesized that LUNB, bringing forth right-hemisphere dominance, would be found to increase a person's ability to detect and correctly identify another's emotional tone. Initially, an analysis of variance was conducted to test for pre-post differences among the three groups, looking at each of the five subtests (angry, happy, frightened, neutral, and sad). However, none of these findings showed significance (Table 1).

Upon further scrutiny of the data, it was decided that removal of the control group was in order. A true control group is meant to involve an inactive treatment. However, a "sham breathing condition" would be impossible to implement. The control group in this study was instructed to practice deep breathing through both nostrils, whereas the other groups performed UNB. Thus, one could say that the control was actually included in both experimental conditions simultaneously and far from "inactive." This proved problematic. Furthermore, in the course of a Multivariate Analysis of Covariance (MANCOVA), handedness was observed to affect scores on the EPT (p =.006). The effects of other demographic differences were not significant.

For the above reasons, the MANCOVA was limited to the Left and Right UNB groups and handedness was taken into account. This retesting revealed differences between the groups in the *Fear* subtest of the EPT, F (2, 42) = 4.677, p = .015. The LUNB group showed improved pre-post performance whereas the RUNB group's scores decreased, F (3, 61) = 4.51, p = .007, (Table 2, Figure 1). There were no statistically significant differences seen in the other emotional subtests.

Discussion

The results *did* show a statistically significant increase in one's ability to detect an emotional tone when LUNB was practiced. The LUNB group did better on prosodic recognition of fear, following the exercise, while the RUNB group actually did worse. Therefore, it would appear that this breathing technique was successful in shifting dominance to the right hemisphere. This finding is consistent with that of Saucier, et al (2004), discussed previously.

Though empathy was not empirically studied in the present research, one would expect to find its increase with the practice of LUNB, especially when examining how empathetic functioning is connected to the right cerebral hemisphere in other studies. Prior research on the degenerative condition of frontotemporal dementia shows that right temporal lobe atrophy severely impairs both facial and prosodic recognition of emotion, greatly affects interpersonal skills as well as the ability to convey or even to feel emotions, and completely removes the ability to empathize in some patients (Perry, et al., 2001). If such socio-emotive impairments are seen when the lobe is damaged, it stands to reason that these social and emotional skills would be improved when a healthy version of the right hemisphere is activated and dominant.

Another connection to the findings of previous studies, is that fear was the sole subtest to produce statistically significant differences in the current results. In the research of Blaire, et al (2002) on psychopathy and Magnee, et al (2008) on PDD, fear was the only emotion the two groups were significantly impaired in detecting. Why other emotions do not seem to produce statistical differences in these tests is left to speculation. Perhaps the detection of fear is one of the most necessary from a survival standpoint which might be why it produces the strongest, and in these cases the only, effect in testing (both positive and negative). In the present research, it was originally anticipated that differences would be found on all of the emotional subtests. As with most studies, limitations must be taken into account.

The use of convenience sampling caused issues including the homogeneousness of the participants. The large majority of subjects were 20-something-year-old Caucasian females and all volunteers were college students. One could argue that this might make it difficult to generalize results to the rest of the population. It is interesting to note that the majority of left handed participants were found in the LUNB group as well. The sample-size was a small one to work with from the beginning. The removal of the control was further limiting. Finally, conducting the experiment in group settings proved less than ideal as it was unclear if all participants had successfully learned and properly performed the pranayama techniques. Unfortunately, while pre-nostril-dominance was documented, post-nostril-dominance was not recorded. This would have been useful in confirming that the correct dominance was in place for each group during the post EPT. The presence of so many other subjects could have been a distraction as well.

Suggestions for future research would be to obtain a larger and more diverse sample and to perform the experiment on a one-on-one basis in order to guarantee that subjects are properly trained in, and performing, the breathing techniques. For further assurance, documenting post-nostril-dominance, or better yet, utilizing EEG techniques would be superlative. It may be necessary to exclude left-handed and ambidextrous participants in order to obtain clearer results in the future as well.

The results of this study help to expand and contribute to the current body of literature on pranayama (of which research is sparse), as well as emotional and social functioning, and cerebral activity. As we continue to increase our knowledge of the brain, and its relationship to our physical, emotional, and even social health and functioning, we paint a clearer picture of the biopsychosocial whole that composes humanity. From both a yogic and scientific perspective, this is an ever important endeavor.

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Table 1. Mean Pre-Post Differences on the EPT among LUNB, RUNB, and Control (Diaphragmatic Breathing) Groups.

	Left	Control	Right	*F*	*p*
Happy	-0.53	-0.83	-0.62	0.28	0.756
Angry	-0.53	-0.39	-0.27	0.29	0.751
Fear	0.05	-0.67	-0.73	1.64	0.204
Neutral	-0.16	0.22	-0.27	0.69	0.507
Sad	0.37	0.06	0.77	1.93	0.155

Table 2. Estimated Marginal Means. Significant difference shown in boldface type.

	LUNB			RUNB		
	Mean	*SE*		*Mean*	*SE*	
Happy	-0.55	0.23		-0.60	0.19	
Anger	-0.55	0.25		-0.25	0.21	
Fear	**0.24**	**0.32**		**-0.87**	**0.27**	
Neutral		-0.25	0.22		-0.20	0.19
Sad	0.41	0.22		0.74	0.19	

Figure 1. Estimated Marginal Means of LUNB (1) vs RUNB (2).

0100090000037400000002001c00000000000400000003010800050000000b0200000000
050000000c02ed08260b040000002e0118001c000000fb029cff000000000000900100000
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