Chapter Six

THE EFFECTS OF TONING, LISTENING, AND SINGING ON PSYCHOPHYSIOLOGICAL RESPONSES

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Toning is a technique in which the voice is used as a therapeutic tool for healing and revitalization. Toning is different from singing in that it consists of sustained vowel sounds on individual pitches with fewer consonants and textual material than singing of familiar songs. Chanting sustained, repeated vowel sounds for resonance of specific body organs is an ancient art practiced by various cultures which purportedly promotes internal awareness and increases concentration (McClellan, 1988). The breath is deepened, the vibration can regulate blood flow and increased oxygenation, and gland secretions may be increased or decreased (McClellan, 1988). "The method requires total involvement and concentration with the process, a commitment of will, conscious awareness of breath, a heightened awareness of hearing, and a highly sensitized internal feedback system" (McClellan, 1988, p. 59).

Clinical therapists, researchers, and psychiatrists have written about the voice as a curative factor in psychotherapy and about the diagnostic use of an infant's cry. The topic of the use of toning as a diagnostic tool has been researched by Bady (1985), who states that it is possible to identify neurotic personality types using vocal characteristics as an indicator of a psychiatric disorder.

Ostwald, Phibbs, and Fox (1968) used the diagnostic potential of the infant's cry to determine pediatric abnormalities. Ostwald (1963) has also carried out half-octave band measurements of sounds produced by psychiatric patients and discovered four acoustic stereotypes associated with individual personality types.

Toning, or chanting, has been applied as one of the more esoteric forms of sound-based therapies. According to the French physician, Alfred Tomatis, chanting has been part of daily life for monks in monasteries where the practice of traditional Gregorian chant 8 hours each day still continues (Weeks, 1989).

These monks sustain a legendary work schedule that consists of arising at 5 a.m. and retiring by 1 a.m., with the only interruption of manual labor being mealtime and 8 hours of Gregorian chant. This type of chant does not have a meter; thus, the timing is based on the human breath. The controlled exhalation necessary for the tone slows down respiration, heart beat, and blood pressure of those who are chanting. Therefore, eight times a day the monks experience a form of respiratory yoga. Others listening to the monks unconsciously alter their rate of breathing as well. The traditional Gregorian chant with traditional church architecture creates a sound rich in overtones ranging in frequencies from 2,000 to 4,000 Hz (Weeks, 1989). Tomatis hypothesized that a charge to the cortex is created by the chant, thereby increasing energy levels, concentration, and alertness. Documented clinical reports of toning include responses of "excitation, release of emotional trauma and physical discomfort, at the same time instilling mental unity and spiritual love" (Garfield, 1987, p. 57).

Jill Purce, author of The Mystic Spiral (1983) discussed the healing aspects involved in toning. She referred to the body as a wind instrument with holes waiting to play (sing). Purce stated that toning is a nonverbal method of "tuning our bodies that breaks through all of the layers of personal and cultural barriers surrounding our person. "Toning touches that which is most ancient within us; and this is healing" (Purce, 1988).

Vocal improvisation has been stated to be useful for a wide variety of clientele from such areas as psychiatry, medicine, and rehabilitation (Bruscia, 1987). An interesting distinction made, according to the Sokolov method, was between the effects of consonants and rhythms in providing structure on the one hand, to vowels and melody unblocking emotional energy on the other.

One of the conceptual differences between toning snd singing may be the more prolific use of vowels and melody in the former, compared with consonants and rhythm in the latter. Singing activities have been found to facilitate expressive language in speech delayed children (Seybold, 1971), in those with cleft palate disorders (Michel, 1960), and in aphasics (Krauss & Galloway, 1982). It is very likely that rhythm was the predominant element accounting for the acquisition of language through these procedures.

Musical performance, including singing, has also led to increased social development in the mentallly retarded (Cassity, 1978) and increased trust and cooperation among adults (Anshel & Kipper, 1988). Several mechanisms may have accounted for these improvements, particularly the social interaction prevalent in performance groups.

Activation of deep breathing is one of the proposed mechanisms accounting for the healthful benefits of toning. Deep breathing has been found to activate the parasympathetic nervous system and terminate the hyperventilation syndrome (Fried, 1987), and is central to many relaxation strategies. In clinical studies, improved pulmonary functioning has resulted from the reduced hyperventilation of asthmatics due to wind instrument playing (Marks, 1974).

A second proposed mechanism for the effects of toning involves high frequency stimulation of the brain. Tomatis has described a model in which the "ciliform cells of Corti are much more densely packed in the part of the basilar membrane reserved for the perception of high frequencies...so that the energy toward the cortex is much more intense when it comes from the zone of the high frequencies than when it emanates from the part reserved for the low frequencies" (Madaule, 1989, p. 83).

Research conducted on lateralization and cerebral dominance indicates a bias of the right hemisphere in processing music (Segalowitz, 1983). Carmon, Lavy, Gordon, and Portnoy (1975) found a greater relative increase in blood flow in the right hemispheres of patients who listened to classical guitar as opposed to speech; pure tones were unreliable in producing a right hemisphere advantage, and the complexity of the harmonic structure seemed to be important. Sidtis (1980) found that "the more harmonic overtones embedded in the sound, the greater the right hemisphere advantage" (p. 327). Since toning uses vowel formants and therefore overtones, it may be a method which can facilitate increased activity in the right hemisphere.

Little experimental research has been conducted examining the effects of toning or singing on physiological responses. In unpublished pilot research, Mickey (1988) found that singing could cause a significant increase in finger temperature in college students enrolled in a vocal ensemble. The finger temperature readings taken during the rehearsal were significantly higher $p < .01$) than the readings taken before and after the rehearsal. This result has future implications in that singing may be a relaxation technique that can be used by persons suffering from tension and anxiety.

Increased finger temperature has also been an elicited response from singing for those persons suffering from hypertension (high blood pressure) and migraine headaches (Brown, 1977). A study published in Medical World News, (1985) reported that a patient suffering from pulmonary edema (blocked pulmonary passages) improved her clinical status by singing. While singing---which uses up to 90% of the lungs' vital capacity---the patient's breaths became deeper, coughing was induced, and she was able to clear her lungs of large amounts of sputum; also, her arterial blood gas levels increased.

Hypotheses

The current study investigated the effects of music listening (a passive experience), singing of familiar songs (an active experience), and toning (an active experience), on the physiological responses of heart rate, peripheral finger temperature, frontalis electromyographic tension, and secretory immunoglobulin A (s-IgA) as well as on measures of cognition and affect. Null hypotheses stated that there would be no significant main effects on posttest measures of heartrate, peripheral skin temperature, EMG, s-IgA, imagery, or mood as determined by the Profile of Mood States (POMS).

Method

Subjects and Setting

Seventeen musically trained subjects were used in this study to minimize possible self-consciousness during the vocal production conditions of the procedure. It was felt that, if subjects had had some vocal training, then arousal responses due to novelty would be minimized. Subjects accomplished all testing procedures in a quiet, small, dimly lighted room.

Dependent Variables

Electromyographic tension (EMG). EMG readings, were taken from the frontalis muscle using silver-silver, chloride electrodes and a J&J I-330 computerized biofeedback system. The frontalis muscle is the muscle of choice in determining general psychosocial tone (Gaarder, 1971). Raw data consisted of posttest scores in microvolts (uv).

Heartrate (HR). Heartrate was measured by photoplethysmography of the nondominant index finger using the J&J I-330 computerized biofeedback system. This measure provided both cardiopulmonary information and indications of autonomic arousal. Raw data consisted of posttest scores in beats-per-minute.

Peripheral skin temperature (Temp). Skin temperature was measured on the non-dominant small finger using the J&J I-330 computerized biofeedback system. Temp. provided a measure of autonomic arousal not directly affected by breathing. Raw data consisted of posttest scores in degrees (F).

Secretory immunoglobulin A (s-IgA). The measurement of s-IgA was intended to provide a measurement of immune functioning with greater concentrations of s-IgA correlated with higher immunocompetence and greater relaxation (Rider, Achterberg, Lawlis, Govven, Toledo, & Butler, in press). From timed saliva collections, 5 ml samples were removed from which s-IgA was assayed using standard radial immunodiffusion techniques (Kallestad Diagnostics). Raw data consisted of posttest scores in mg/dl.

Profile of mood states (POMS). This test gives a measure of psychological change with respect to affective and cognitive dimensions. The six scales which this test yields are Anger, Tension, Depression, Vigor, Fatigue, and Confusion. Raw data consisted of posttest scores, with higher scores indicating more of the dimension measured.

Imagery. Subjects were asked to describe whether any imagery was present or not during the experimental control conditions. This measure was used to gain information concerning possible right hemisphere activation. Raw data consisted of nominal posttest scores indicating whether imagery was present.

Independent Variables

Control (C). Subjects in this condition sat in silence while doing nothing.

Listening (L). Subjects in this condition listened to a solo male Gregorian-style vocal chant, the "Kyrie Opening" from Harmonic Meetings (LC 7869) by David Hykes and the Harmonic Choir.

Toning (T). Subjects in this condition were asked to experiment randomly with their voices, culminating in a sustained vocalization on a single pitch. Subjects were asked to keep the tone production ongoing, breathing when necessary.

Singing (S). Subjects in this condition sang one or two verses of ten familiar songs while they listened to piano accompaniments. (These songs were: "You Are My Sunshine,""He's Got the Whole World in His Hands," "My Country Tis of Thee," "Amazing Grace,","Kum Ba Yah," "When the Saints Go Marching In," "Jingle Bells," "Michael, Row the Boat Ashore," "Oh, Susanna," and "Silent Night." Songs were played in comfortable keys for singing; if subjects could not remember verses, they were told to repeat familiar verses. Familiar songs were used to help minimize possible left-hemisphere involvement.

Procedure

Each subject individually accomplished testing under one control and three treatment conditions. The order of presentation was counterbalanced. Subjects encountered the four conditions on separate days, but during the same time period each day to control for circadian variations.

Subjects were instructed that they were participating in a study of different kinds of behaviors on psychophysiological responses. Psychophysiological recording equipment and stereo headphones were then connected to the subjects. After a 5-minute baseline, recording commenced with one of the four 10-minute treatment conditions. Subjects' eyes were closed during all conditions. Immediately after each condition, subjects completed the 2-minute timed saliva collection followed by the POMS. Subjects were then asked to report any imagery experienced during the conditions.

Results

Repeated measures analyses of variance (ANOVAs) were used to evaluate the raw data from each of the parameters. Posttest scores were used in the analysis (see Table 1), as no baseline group differences were found. Pretest repeated measures ANOVAs were as follows: EMG (F = 2.09, p < .2), heartrate (F = .31, p < .6), skin temperature (F = .26, p < .9), s-IgA (F = .31, p < .9), POMS-Anger (F = .25, p < .9), POMS-Tension (F =1.66, p < .2), POMS-Depression (F = .94, p < .5), POMS-Vigor (F = .86, p < .5), POMS-Fatigue (F = .47, p < .8), and POMS-Confusion (F = .42, p < .8).

ANOVA of EMG scores yielded a main effect (F = 2.87, p < .05). Therefore, the null hypothesis for EMG was rejected at the .05 level. Post hoc analysis indicated that the L condition was significantly lower (p < .05) than the T and S conditions on EMG tension (see Figure 1).

The ANOVA of heartrate scores yielded a main effect (F = 3.06, p < .04). Therefore, the null hypothesis for heartrate was rejected at the .05 level. Post hoc analysis revealed significantly lower heartrates for the L, T, and C conditions over the S condition (see Figure 1).

No significant main effect was found for ANOVA of skin temperature scores (F = .67, p < .6) (see Figure 1). The null hypothesis for skin temperature was therefore not rejected.

A significant main effect for s-IgA was found (F = 2.87, p < .05). Therefore, the null hypothesis for s-IgA was rejected at the .05 level. Post hoc analysis indicated that the C and L conditions had significantly higher s-IgA levels than the S condition, and that the T condition was not significantly different from any other condition (see Figure 1).

On the POMS no significant main effect was found for Tension

Table 1

Means (Posttests) and Standard Deviations by Condition

Measure	Control	Toning	Singing	Listening
Heartrate	71.51 (10.50)	71.27 (11.87)	76.62 (9.23)	69.26 (13.02)
EMG	2.41 (1.74)	2.98 (1.79)	3.05 (1.75)	1.93 (1.10)
Skin Temp.	86.59 (11.22)	87.21 (5.97)	89.67 (3.42)	87.91 (5.46)
s-IgA	43.35 (30.69)	36.16 (18.83)	28.54 (29.93)	47.23 (26.79)
POMS-Ten.	5.47 (4.63)	4.71 (4.17)	5.35 (5.93)	7.77 (6.49)
POMS-Dep.	4.47 (3.74)	2.53 (3.41)	3.65 (5.55)	5.71 (6.94)
POMS-Anger	1.59 (1.84)	3.41 (7.74)	3.30 (8.38)	3.18 (3.43)
POMS-Vigor	12.18 (7.16)	15.06 (6.46)	13.82 (7.88)	14.94 (6.47)
POMS-Fat.	8.47 (6.85)	5.53 (3.09)	5.54 (4.27)	5.00 (5.88)
POMS-Con.	5.77 (3.11)	4.18 (2.10)	5.78 (3.80)	6.59 (4.73)
Imagery	11	12	10	16

Figure 1

Heartrate	L	T	C	S	*
EMG	L	C	T	S	*
Skin Temp.	S	L	T	C	
s-IgA	L	C	T	S	*
POMS-Ten	T	S	C	L	
POMS-Dep.	T	S	C	L	
POMS-Vigor	T	L	S	C	
POMS-Anger	C	L	S	T	
POMS-Fat.	L	T	S	C	**
POMS-Con.	T	C	S	L	
Imagery	L	T	C	S	*

Figure 1. Conditions listed in order of effectiveness for each variable. Note. Conditions connected by same line are not significantly different from each other ($p < .05$).
*$p < .05$ ** $p < .06$

($F = 1.10$, $p < .4$), Depression ($F = 1.15$, $p < .4$), Anger ($F = .37$, $p < .8$), or Vigor ($F = 1.19$, $p < .4$). Null hypotheses for these scales were not rejected. A significant effect was revealed for Fatigue ($F = 2.6$, $p < .06$), enabling rejection of the null hypothesis at the .06 level. Post hoc analysis indicated that the L condition alone was significantly ($p < .05$) lower in Fatigue than the C condition.

A nonsignificant effect was found for Confusion, ($F = 1.63$, $p < .2$) leading to acceptance of the null hypothesis. The T condition was, however, significantly lower in Confusion ($p < .04$) than the C condition.

A Cochran Q test was used to evaluate imagery differences among conditions. The frequency breakdown for those reporting imagery in the respective conditions is as follows: L- 16, T- 12, C- 11, S- 10. A significant difference emerged at the .08 level ($Q = 6.80$). Post hoc analysis revealed that imagery was significantly higher ($p < .03$) in the L condition than in condition C and S. No significant difference was found between condition L and T.

Conclusions and Discussion

This study comprised an investigation of the effects of Toning, Singing, and Listening to toning on the psychophysiological responses of 17 trained musicians in a repeated measures design. Of the four physiological measures, three had a significant main effect. Listening promoted lower muscle tension and heartrate, and higher s-IgA than Singing. The subjects in the Control condition had a lower heartrate and higher s-IgA than those in the Singing condition. Toning was lower in heartrate than Singing. On the psychological variables, those in the Listening condition had more Imagery than those in the Control or Singing groups, and less Fatigue than Control. Toning produced less Confusion than Listening.

From these results emerges an apparent trend toward Listening as the most efficacious condition on the variables measured. Listening was highest in imagery and lowest in heartrate, implicating both "right hemispheric activation" and "deep breathing" mechanisms respectively. The importance of both imagery and deep breathing as self-regulatory processes is corroborated in this study.

It is difficult to assess the nature of the performance/non-performance demand of the experimental conditions on the results. On EMG and s-IgA there was a trend toward less beneficial outcomes in the active conditions (Toning and Singing) than the passive conditions (Control and Listening to toning). These might be the expected parameters to be favored on the nonperformance conditions since (forehead) musculature and saliva would appear to be affected by the act of vocalizing.

In comparing the two performance conditions, a strong and consistent trend was noted for the Toning to favor Singing. Although significant on only one measure (heartrate), Toning was "ahead" of Singing on 9 of 11 measures (Figure 1). This distribution was the only significant one of all the possible comparisons of the frequency distributions of any two conditions ($x^2 = 4.44$, $p = .05$). Therefore, a trend for Toning over Singing was found. The most likely explanation for this finding is the fact that heartrate was significantly lower in the Toning than the Singing condition due to the activation of deep-breathing mechanisms through Toning. Cognitive demand, especially of the Singing condition, could be another explanation, although no significant differences were found on such cognitive measures as Imagery and Confusion.

Possible problems of this study involve the comparisons of active and passive procedures over a short span of time. Future investigations on long term effects of toning and listening to toning are needed to avoid these problems. Since preference for type of music, familiarity, and expectations have been shown to significantly affect physiology, these variables should be taken into account in future research.

Another problem involves the comparison of singing and toning. Although an attempt was made to minimize the differences in cognitive and performance demands of the two conditions, some of the main effect may have related to the random nature of the toning condition.

Musicians were used as subjects in the present study to help minimize performance anxiety and self-consciousness during the toning and singing conditions. Nevertheless, this study should be expanded to the general population. Differences in cerebral lateralization in music listening between musicians and nonmusicians might address the "cortical stimulation" hypothesis.

The therapeutic use of the voice is particularly new in the field of music therapy. Results of this study demonstrate the need for future research on this potentially innovative form of treatment.

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