Multimodal enhancement of culturally diverse, young adult musicians: a pilot study involving the Tomatis method

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Musicians, seeking stress relief and vocal/instrumental enhancement, often turn to the Tomatis Method of sensori-neural integration training, based on the interdependence and interaction between hearing and listening, psychological attitude and speech and language. The paucity of impact studies on musicians, despite its acclaimed efficacy, has prompted the current multidisciplinary pilot study, involving a two group, pre-post experimental design. Listening aptitude, psychological well-being and vocal (voice) quality were assessed in availability samples of culturally diverse young, adult musicians (n=28), recruited from two tertiary institutions and assigned to a control group (n=10) and an experimental group, consisting of sub-experimental group one (n=10) and sub-experimental group two (n=8). Reasonable preprogramme group equivalence was established between the two sub-experimental groups and the control group. A Tomatis programme of 87.5 half hour listening sessions and concomitant counseling was completed by the total experimental group (n=18). Results indicated practically significant enhancement of: (i) listening aptitude on the Listening Test and (ii) psychological well-being, in terms of reduced negative and increased positive mood state (vigor) on the POMS in both sub-experimental groups, together with enhanced behavioural and emotional coping in sub-experimental group 1 on the CTI. (iii) Vocal enhancement, perceived both by singer-participants in both sub-experimental groups and a professional voice teacher, culminated in (iv) distinctly enhanced musical proficiency in 28% of all programme participants. Despite indications of multimodal enhancement, further research, necessitated by current methodological limitations, remains a prerequisite for achievement of definitive results.

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The value of music therapy as a means of "destressing" South Africans amid the turbulence of current socio-political change has recently been noted (Pavlicevics, 1999). In response, the music-specific turbulence experienced by young adult musicians and the enhancement potential of a musically based method of sensori-neural integration training is discussed in this article.

A wider reading than the South African context suggests that musicians, including singers and student singers, have to contend with numerous issues intrinsic to the performing arts: high levels of performance anxiety, stress control because of its effects on voice quality (Nagel, 1988; Dews & Williams, 1989), depression and anger (O'Connor & Dyce, 1997; Cohen & Kupersmith, 1986), introversion, especially in females (Campbell, 1997) and superego-strictness (Dews & Williams, 1989). Debilitating psychological effects, often necessitating psychotherapy, are further complicated by musicians' resistance to psychologists inexperienced in the subtle nuances of musicianship (Brodsky & Sloboda, 1997).

Among the diversity of methods enjoying long-standing support from professional voice users, including musicians, the Tomatis method of sound stimulation, devised by Alfred Tomatis (1920 -) ranks as a well-known, yet controversial example. Son of an opera singer in Paris, France, Tomatis qualified as an ear, nose and throat specialist. Researching hearing losses emanating from industrial noise in factory workers for the French government and simultaneously responding to voice impairments, suffered by many of his father's singer friends who sought his expertise, he discovered functional links between hearing and speech which became the basis of his method of auditive stimulation.

In particular, his research indicated that:
(i) the voice contains only the frequencies heard by the ear;
(ii) if an imperfect ear is given the chance of hearing correctly, the voice instantly and unconsciously improves;
(iii) it is possible to transform the voice through auditive stimulation over time, by means of the electronic ear, an apparatus devised and refined by himself, in order to stimulate the ears into proper functioning, *i.e.* acquiring the functions of listening and monitoring language and laterality (Weeks,1988).

The process became known as audio-psycho-phonological training (APP), sound stimulation, auditive training or simply, the Tomatis Method (TM). It is applied in multidisciplinary contexts with voice and communication problems, in 250 centres worldwide. Since its inception this innovative approach has evoked divergent responses. Enthusiastic endorsement continues from some professionals across disciplines, as well as a diverse clientele seeking psychological symptom relief,

speech fluency, resolution of learning problems, acceleration of foreign language assimilation and vocal/instrumental enhancement. Recurrent concerns about unsubstantiated, or unconvincing claims regarding vocal enhancement, have resulted in allegations of charlatanism, emphatic dismissal and pleas that singers and scholars refrain from involvement in the TM.

As researchers in the field of voice, professional voice teachers and clinical psychologists applying the Tomatis Method with musicians, the daunting challenge of addressing the ambiguity of the Tomatis method with musicians, and particularly singers, has haunted us, because of the discrepant degree of its substantiation for various psychological problems versus the paucity of studies on its impact with musicians.

Within the pathogenic paradigm there is growing evidence of its efficacy in pathology reduction: *i.e.* learning difficulties (Stutt, 1983), stuttering (Van Jaarsveld, 1973, 1974); anxiety (Du Plessis & Van Jaarsveld, 1988); mental retardation (De Bruto, 1983) and autism (Gilmor & Madaule, 1988). However, from a fortigenic perspective (enhancement of human strengths, Wissing & Van Eeden, 1998), the TM contains potential for enhancement of psychological well-being, *i.e.* Rolf's study with psychology students (1998).

In contrast Tomatis' seminal work with musicians, spanning several decades, has attracted virtually no research attention. To date, only three English publications were identified, a qualitative case study description of the TM with singers and musicians (Madaule, 1976), a case study of singing voice enhancement (Manners, 1996), and an internet testimonial by an enthralled violinist (Lawrence & Lawrence, 1998). Clearly the dearth of research of the TM with musicians has progressively invalidated its standing in the eyes of its most outspoken critics who rightly judge the acceptability and respectability of a given method by its prominence in current scientific literature.

The problem is compounded since Tomatis practitioners are primarily running private Listening Centres, devoid of research-related infra-structure. Yet the sustained attendance of Tomatis programmes by musicians, suggests that the favourable results claimed by Tomatis are still observed by its practitioners.

Aims

By combining their skills in a multidisciplinary evaluation of the Tomatis method, the current researchers endeavoured to find explanations for its acclaimed efficacy with musicians. Thus, the subjective awareness of enhancement, commonly reported by musicians across three dimensions, namely listening (auditive), well-being (psychological) and/or singing (phonological) after completing a Tomatis programme, had to be demystified empirically.

Thus a pilot study, conducted with an experimental group of music students attending a course in the TM, was aimed at enhancing participants':

- listening aptitude, despite prior musical training;
- psychological well-being;
- vocal quality; and
- vocal/instrumental proficiency.

Method

Research Design

A two group, pre-post-programme design was used.

Participants

The experimental group consisted of student musicians, recruited from:

(i) the Music Division, Potchefstroom University (n=10), designated sub-experimental group 1, and

(ii) Pretoria Technikon's Opera School (n=8), designated sub-experimental group 2, numbering thirteen singers and 5 instrumentalists.

The control group (n=10) consisted of 5 singers and 5 instrumentalists recruited from Potchefstroom University only, to facilitate assessment requirements. Both sub-experimental groups and the control group constituted availability samples of registered music students who had at least completed school grade 8 level musical training.

Instrumentation

Listening aptitude

The Listening Test (Tomatis, 1973) is a direct outcome of Tomatis' distinction between hearing - a passive or unconscious awareness of sound, measured by the hearing test (audiogram) - and listening - an act of will or conscious desire to listen, presumed to arise as early as 4.5 months before birth, when the unborn baby can perceive its mother's voice (Tomatis, 1978, 1991, 1996). The Listening Test tests for threshold evaluation for frequencies ranging from 125 to 8000 hz., rendering air and bone conduction curves. It also assesses the individual's ability to recognize pitch differences in neigbouring sounds, and spatialization and laterality (Weeks, 1988). Thus it reflects how the desire to listen is utilized or resisted and reveals listening strengths or listening weaknesses. It constitutes the diagnostic backbone of the TM.

Psychological well-being

This was assessed by means of the following tests and projective drawings.

Profile of Mood States (POMS), (McNair, Lorr & Droppleman, 1992).

This 65 item questionnaire, designed to reflect various mood states - including Depression, Anger, Fatigue, Vigor, Confusion and Tension - was developed as a brief screening instrument. Its relevance for the current study was based on its presumed sensitivity to detect mood changes associated with the programme. Although not standardised for South African populations, a mean Cronbach alpha reliability index of 0.72, found in the current study, confirmed its feasibility.

Constructive Thinking Inventory (Epstein, 1993)

This 108 item questionnaire, designed to measure the extent to which individuals benefit cognitively from past experience, consists of a global scale, called global constructive thinking, as well as 6 main scales, expressing constructive or destructive thinking, as a measure of well-being. It was included to assess the impact of the programme on cognitive aspects of well-being. Low Cronbach alphas of 0.43-0.70, found in this study, necessitated cautious interpretation of the results, as the test has not been standardised in South Africa.

Projective drawings

To tap inner experiences during the programme, wax crayon drawings, based on instructions to "draw a picture which reflects your present experience of yourself as a thinking, feeling, communicating and music making person" were requested at regular intervals (Burger, 1999: 208). Brief written comments about the drawings were also requested.

The rationale of the drawings was based on (i) the observation that, regardless of age, participants of the TM appear to enjoy spontaneous drawings especially using wax crayons; and (ii) the

intuitive notion that the above instructions would evoke aspects of participants' experiences and attitudes activated by the entire process. Subtle changes in subsequent drawings, *e.g.* new colour preferences, as well as specific features like openings in drawings of structures, would according to the Tomatis approach be perceived as indicators of growth/change (Tomatis, 1995).

Acoustic properties of voice

The energy of speech extends over a bandwidth of more than 10 kHz. A readily intelligible speech signal can be transmitted with a total bandwidth of less than 5 kHz. The long term average spectrum (LTAS) is the average of a number of power spectra, using the Fast Fourier Transform (FFT) algorithm (Kent & Read, 1994). This spectrum of speech is the distribution of acoustic energy across frequencies (usually 0kHz. up to 4 kHz. for a long sample of speech (ideally about 40 sec.). Most of the longterm energy is in the lower frequencies (lower than 1kHz.). This is the case with "normal", untrained voices in particular.

The aim of voice training is to enhance energy concentrations in the higher frequency range, especially in the region of the third and higher formants (2 kHz and above). It is a well-known fact that the language sounds (phonemes), specifically those of the vowels, can be described and characterised in terms of the first two formants (F1 and F2; below 2 kHz), and in some cases F3 too (Kent & Read, 1992; Rietveld & Van Heuven, 1997). F4 and F5 are mainly responsible for the uniqueness of the speech sounds (including vowel quality) of specific speakers.

The general assumption is that an enhancement of the acoustic energy of the latter frequency ranges will result in better voice projection, which is the ideal for the voice artist. Obviously then, voice trainers should concentrate on enhancing the region of F4 and F5.

Research findings have characterised good singers' voices (mainly work done by Sundberg, 1987 and others), as well as actors' voices (cf. Leino, 1993; Leino & Kärkkäinen, 1995) in terms of the presence of prominent peaks of energy in LTAS (respectively called singer's and actor's formants), whereas in poor voices these peaks are either underdeveloped or absent. In the case of the actor's formant of male persons, such prominent peaks are present between 3 and 4 kHz. The singer's formant occurs in the 2 – 3 kHz range.

Examination of such acoustic properties of artists' voices in terms of the nature and range of energy and frequency of the formants mentioned are a valuable and reasonably objective means of inspection and evaluation (cf. Sundberg, 1987, Leino, 1993). Weiss (1985) pioneered its application within the Tomatis method and established long term average spectra enhancement effects on speech in three Francophone student actors following a course in the Tomatis Method. Hence, the pilot study was also aimed at determining whether Weiss' findings concerning vocal quality enhancement in actors could be replicated with music students and corroborated by a professional music teacher.

Statistical techniques

Pre-programme group equivalence was determined by the significance of pre-assessment differences between sub-experimental group 1, 2 and the control group, through an analysis of variance based on Tukey's Test. Programme outcome was determined by the significance of post-assessment differences **between** and **within** groups, respectively by means of the t-test. Statistically significant findings ($p \leq 0.05$) were subjected to Cohen's d statistic (Cohen, 1988) to determine whether practical/psychological significance ($d > 0.8$) had been achieved.

Procedure

Informed consent was obtained after participants had been identified. Pre-programme assessment across auditory, psychological and phonological dimensions was preceded by an otological screening, to exclude anatomical and functional defects of the vocal folds, ears and nose. One prospective participant was excluded by the ENT because of nicotene-related complications. Voice recordings were made in the university sound studio, according to set procedures (Baken, 1987). The Listening Test was administered by a speech therapist, experienced in its administration. Psychological assessment by an intern psychologist followed.

Sub-experimental group 1 and 2 respectively completed their Tomatis programmes involving the first leg of 60 half-hour sessions, followed by a 4 week break, and the remaining 30 sessions. Listening sessions were conducted at a rate of 4-6 half-hours per day at an average of 4 days a week. Post-programme assessment involved the Listening Test, psychological tests and new voice recordings. The latter were to be analysed by means of a computer programme, and subsequently the tapes were studied by a professional voice teacher, to determine whether potential vocal enhancement in participants were also discernable to him.

The control group attended no inputs other than pre- and post-assessment and neither were any placebos involved. However, they were invited to attend a course of the TM subsequent to completion of the study. Two students expressed interest but terminated their involvement within two days of commencement.

The Tomatis programme

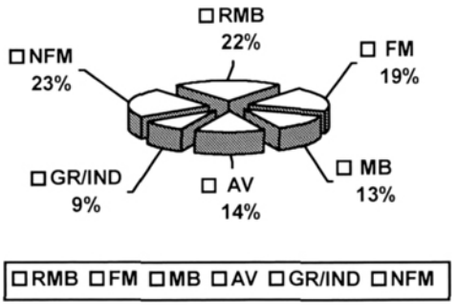
The programme duration and components are depicted in Diagram 1. Essentially it consisted of two phases, *i.e.*

(i) *a passive phase* of listening through headphones to sound, initially nonfiltered music (NFM, see Diagram 1), progressively filtered by eliminating the frequencies below 8kHz (RMB, see Diagram 1) in tapes containing Mozart's concertos, alternated by Gregorian chants and nonfiltered music. The objective was to stimulate participants' hearing in the high frequencies (FM, see Diagram 1) thus sensitizing their perception of the higher frequencies and renewing their prenatal desire to communicate (Tomatis, 1996). At some stage, the filtered sounds were gradually defiltered to reintroduce participants to nonfiltered sound (MB, see Diagram 1). Participants were able to lie down or draw, write or talk to each other, while listening; and

(ii) *an active phase* during which singer-participants repeated taped "songs" into a microphone, and perceived vocal feedback, enriched in the higher and middle frequencies, through the head phones (AV, see Diagram 1). Instrumentalists played their musical instruments (violin, flute and bassoon), similarly receiving feedback, enriched, in the middle and higher frequencies, from the sound of their instruments. This was aimed at expanding their awareness of utilizing their entire bodies during vocalizing/instrument playing and enhancing their ability to control and modulate their singing voices or the sound produced on their musical instruments (Tomatis, 1996). The slightly different structuring of the active phase in comparison to current practices at the Centre Tomatis, in Paris, France (Coelen & Millio, 1998) was necessitated by time constraints.

Since a direct link between the quality of a singer's listening aptitude, voice quality and body integration has been claimed by Tomatis (Madaule, 1994) the third author, a voice and body integration educator, au fait with the TM (Munro & Larson, 1996), demonstrated appropriate body integration and followed up participants experiencing difficulties with body integration throughout the active sessions.

Concurrent group counseling and cognitive-behaviourally structured individual sessions (GR/IND, see Diagram 1), positively perceived by musicians (Brodsky & Sloboda, 1997), was complemented by handouts on the theory underpinning the TM (Burger, 1999).



RMB = reversed musical birth; **FM** = filtered music;
MB = musical birth; **AV** = audio-vocal sessions;
GR/IND = group/individual counselling; **NFM** = non-filtered music

Diagram 1. Proportionate programme components

Results

Preprogramme group equivalence

Since group assignment was based on participants' availability, pre-programme group equivalence had to be determined.

Biographical factors

The young adult participants' mean age was 22.9 years. Since 12 male and 16 female students participated in the study, both genders were well represented across the groups. Black-white participant ratio for the total experimental group (n=18) was 1:3 and 1:4 for the control group. Predictably, the university students of sub-experimental group 1 and the control group had more prior exposure to musical training, while sub-experimental group 2, comprizing 50% black members from disadvantaged communities, had less.

Listening aptitude

Of the 13 frequencies only one significant difference occurred **between** the total experimental and control group, confirming global listening aptitude equivalence across the total experimental and control group.

Psychological well-being

Predominant negative mood states on the POMS, including tension, depression and anger, confusion and fatigue, **between** groups, suggested compromized levels of psychological well-being among all project participants. It was underscored by evidence of unresolved financial, familial and intra-psychic issues, emerging during individual counseling with both sub-experimentals. Constructive thinking evidenced one difference **between** groups namely personal superstition scores for sub-experimental group 2 (p=0.0045, d=1.743) exceeding those of sub-experimental group 1, thus confirming globally equivalent psychological well-being.

Vocal quality

Unanticipated methodological obscurities, associated with problematic loudness levels during voice recordings and calibration, nullified pre-and post-programme comparison of vocal emissions within and between groups by means of the LTAS analysis. An unresolved issue, its clarification hinges on further research. It was concluded that despite discrepant musical training associated with socio-economic differences, the groups were relatively comparable in terms of biographical variables, listening aptitude and levels of psychological well-being.

Post programme findings

Listening aptitude

Pre-post differences **within** groups on the Listening Test depicted a number of practically significant improvements in the listening curves of the total experimental group (n=18). This finding was in keeping with Tomatis' assertion that stimulation of the middle ear muscles induces an increased sensitivity to transmit sound rich in high frequencies, and a lowered sensitivity towards sound rich in lower frequencies (Van Jaarsveld, 1979).

Post-programme curves not only reflected ascending lines in some cases, but included enhancement of other listening parameters, *i.e.* replacement of *left ear* control by *right ear* control, thus confirming attainment of self-listening, a prerequisite for optimal vocal proficiency, according to Tomatis (1991). Only 3 control group members complied with post-assessment listening evaluation, hence differences **between** groups were rendered invalid.

Psychological well-being

Pre-post differences **within** groups showed practically significant reductions of negative mood states on the POMS in both sub-experimental groups, together with practically significant increases of vigor, a positive mood state, as indicated by the following:

sub-experimental group 1: tension (p=0.0126,d=0.98); depression (p=0.0066,d=1.11); anger (p=0.0190,d=0.90); fatigue (p=0.0036,d=1.23); confusion (p=0.0077,d=1.08); vigor (p=0.0068,d=1.11);

sub-experimental group 2: tension (p=0.0046,d=1.45); depression (p=0.0133,d=1.16); anger (p=0.0080,d=1.29); fatigue (p=0.0036,d=1.52); confusion (p=0.0350,d=0.92); vigor (p=0.0242,d=1.01).

The results indicated significantly *reduced*:

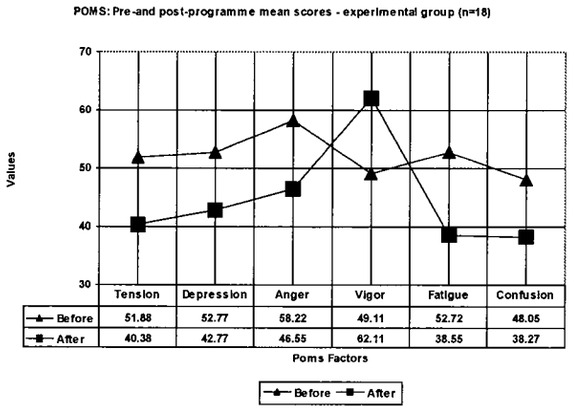
- musculoskeletal and somatic tension;
- antipathy and hostility, lethargy, exhaustion and disorganization.

Significantly *increased* levels of energy, positive affect and friendliness occurred in both sub-experimentals. Increased energy and subjective well-being, considered a response to the high frequency stimulation, is commonly observed by Tomatis practitioners.

As practically significant differences occurred within both sub-experimental groups, their respective pre-post mean scores were

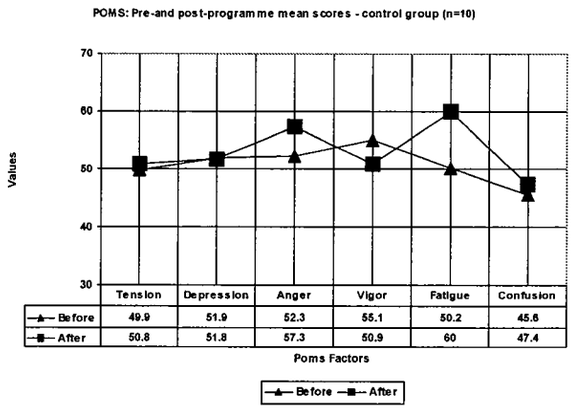
combined to illustrate the programme impact on mood states, and specifically the emergence of the iceberg profile (McNair, 1992), in the total experimental group, resulting from enhanced vigor (see Graph 1).

Graph 1. Pre-and post-programme mean scores on the Profile of Mood States for the total experimental group (n =18)



Pre-post mean scores as illustrated in graph 2, indicated that no significant changes occurrred in the control group.

Graph 2. Pre-and post-programme mean scores on the Profile of Mood States for the control group (n =10)



Pre-post differences **between** groups revealed that reduction in sub-experimental group 1 on: tension (p=0.0087,d=1.28); anger (p=0.0262,d=1.21); fatigue (p=0.0015,d=1.53); confusion (p=0086,d=1.45) and increased vigor (p=0028,d=1.45), differed practically significantly from those of the control group, thus underscoring the significance of negative mood state reduction and enhancement of vigor in sub-experimental group 1. In sub-experimental group 2 reductions of negative affect on: tension (p=0087,d=1.41) and fatigue (p=0015,d=1.73), and increased vigor (p=0028, d=1.61), differed practically significantly from the Control group scores, thus confirming the reality of changes in sub-experimental group 2 as well.

A female participant of sub-experimental group 2, in her mid-thirties, presented with dysthymic disorder, according to the DSM IV (APA, 1994), despite prior psychotherapy. Five months after the programme, she still struggled emotionally despite an enhanced awareness of the control and range of her voice. At the time of writing, somewhat later, she had resumed psychotherapy with a new therapist, expressed a desire to continue with Tomatis training and re-acknowledged voice quality enhancement.

Differences **within** groups on constructive thinking confirmed that sub-experimental group 1 showed practically significant increases on:

- global constructive thinking (p=0.010,d=1.508), denoting enhanced cognitive flexibility, characteristic of self-acceptance and acceptance of others;
- emotional and behavioural control respectively (p=0.0139,d=0.975) and (p=0.0056,d=1.145), indicating enhanced coping with stressful situations, avoidance of negative thinking, generalization and oversensitivity, suggestive of effective action, optimism, energy and diligence;
- lie free categorical thinking (p=0.0025,d=1.307); validity scores (p=0.0008,d=1.574), supported by a tendency (medium effect) towards lie free responses (p=0.0428,d=0.745), indicative of increased honesty.

Global, but not significant tendencies towards improvement were noted for sub-experimental group 2. The control group achieved a practically significant higher score on esoteric thinking (p=0.0318,d=0.803), indicating reduced belief in questionable phenomena, *e.g.* astrology.

Differences **between** groups revealed increased emotional coping (p=0.0053,d=1.183), in sub-experimental group 1, practically significantly exceeding scores for sub-experimental group 2 and the control group. Clearly, sub-experimental group 1 improved their emotional coping. However the control group's emotional coping score (p=0.0053,d=1.619) was practically significantly higher than that of sub-experimental group 2. Thus, without programme participation the control group also increased their emotional coping. On the Validity scale sub-experimental group 1's score (p=0.0160,d=1.483) practically significantly exceeded that of sub-experimental group 2, confirming increased response honesty.

Vocal quality

As indicated above, unforseen technical calibration difficulties prevented the actual comparison of pre-post singer formant curves. Visual scrutiny of the results of participants who excelled in post-programme musical achievement nontheless suggested singer formant gains, warranting further research. Clarification of programme impact on vocalization was thus based on documentation of perceptions of the voice teacher of his contact sessions with singer-participants of sub-experimental group 1 and the control group, since they all attended voice lessons with him.

The voice overview of singer-participants of sub-experimental group 1, 16 months post-programme, revealed tendencies towards improved:

- awareness of body integration and body/voice integration;
- learning curves during voice classes;
- intonation and voice control, without force;
- handling of "voice breaks" in some cases;
- psychological coping with the demands of singing.

No negative programme-associated effects were perceived.

Sub-experimental group 2 participants were instructed to journalize their singing-related subjective experiences during

and postprogramme, and evaluate programme impact 6 months after its completion. Their subjective responses overwhelmingly parallelled the qualitative responses documented by the professional voice teacher with regard to the effects of the programme on singer-participants in sub-experimental group I.

These findings concurred with Tomatis' belief that a singer ought to have "a special perception of a sound being produced" (1991: 43) and that this special perception was provided by the ear. Likewise Sataloff & Sataloff (1991:219) stated that the ear was a "critical part of the singer's instrument" and that the singer's hearing had a direct influence on "vocal adjustments during singing".

Vocal/instrumental proficiency

Five programme participants achieved professional recognition outside the parameters of the pilot project, within months of programme completion. Four singers won competitions or obtained opera roles, and the fifth, a bassoonist, won a major musical competition.

Significantly, a comparative degree of honour was bestowed on only one control group member. A post-programme vocal/instrumental proficiency 'hit' rate of 28% versus 10%, was thus obtained within 5 months of programme completion. Favouring the experimental group, the success ratio served as further illustration of the enhancement potential of the Tomatis Method.

Interestingly, the drawings of the 5 successful participants were suggestive of a gradual opening up of the listening function, possibly providing the "winning edge" in these highly motivated young black and white adults (Du Plessis, Wissing, Munro, Burger & Nel, 1998). A poignant illustration came from an articulate, young black singer who obtained an opera role after the programme. In the course of the programme he responded to the drawing instruction by producing a wall (see computerized representation as drawing 1). Within his life context, this presumably portrayed his awareness of being isolated by many negative life events, including a childhood under apartheid, exacerbated by his painful awareness of having to defend himself against daily risks of death in violence wracked townships.

His final drawing (computerized representation as drawing 2), another wall, now featuring an opening through which colourful flowers were visible, was possibly suggestive of an opening up of a way through his wall of isolation to a future of hope, or even - albeit speculatively - conveying the opening of his desire to listen, thus re-connecting him to his environment, his music and significant others in a meaningful way - or perhaps for the first time in his life.

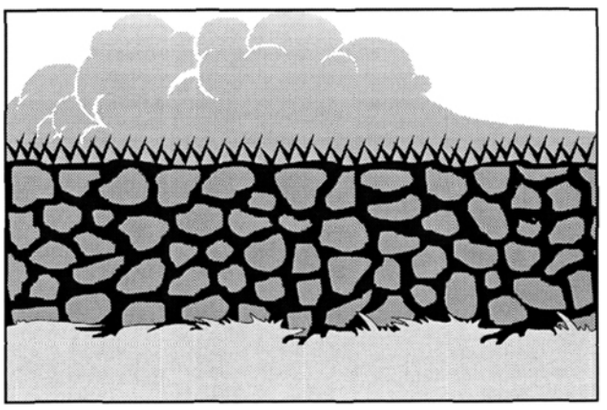
Discussion

Despite not fully achieving its aims, the auditory stimulation programme rendered favourable outcomes. The range of positive effects from auditive to vocal enhancement, are understood in terms of the multiple effects of sound modified by means of the electronic ear. In this constellation of effects the re-activation of the presumed prenatal desire to communicate, lying at the heart of communication, according to Tomatis (1991, 1996), serves as an important wake-up call to become receptive to sound, despite already being immersed in music. Once listening is facilitated, it leads to enhanced communication and vocalization, in view of the functional links between these structures. Since the stimulation is directed to the sensori-neural pathways from the ear, to the brain stem, to the brain, it is believed to "correct immature or incorrectly wired sensori-neural connections" (De la Roque, 1998: 3), directly impacting on attention, processing speed and reaction time - vital prerequisites of musical proficiency. The positive outome was also facilitated by participation in groups whose cohesion progressively increased during the programme, amid daily attention by interested researchers, sharing a common love and destiny in the form of music.

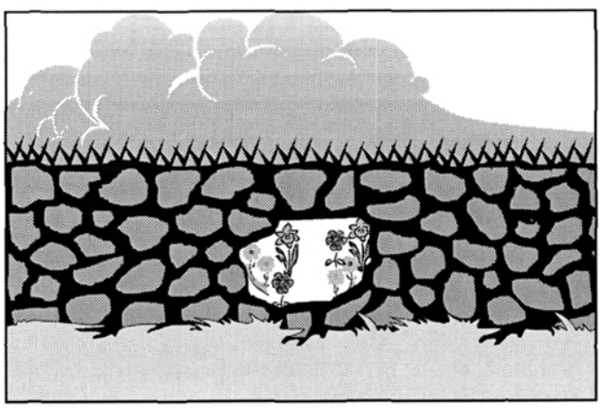
Likewise the contribution of individual and group therapy cannot be underestimated, despite not being able to isolate and evaluate the contribution of each aspect of the total process. Especially in the case of the opera school participants, who were well acquainted with each other, and attended during the April holiday, group therapy appeared to fulfill an important function of alleviating individual members' anxieties, presumably related to the programme content.

Individual therapy also fullfilled an important function as it provided opportunities to confront a diversity of irrational ideas, fears and confusions, which presumably were expressed more freely as a result of the sound stimulation. In one instance, about half-way through the programme, the black singer whose drawings appeared above, stated that despite enjoying the course and feeling relaxed, he had to "get out" (of the programme) since "this is not real life". His explanation was that township life implied never being sure whether he would still be alive at the end of a day, and neither whether he would emerge alive at the end of a taxi trip, nor "ever being alone in a room" (referring to his home situation). His ultimate, gnawing

Drawing 1. Computerized representation of a wall drawn by a male, black student singer



Drawing 2. Computerized representation of wall with flowers, visible through a hole – final drawing by the same student.



doubt was whether he would ever flourish as an opera singer, since Europe "has only had white opera singers". Opportunities for self-expression in this manner presumably served as important means towards growth during the process. The interpretation of this young man's drawings, discussed above, is grounded in the Tomatis approach, which posits that openings appearing in drawings of structures, like the hole in the wall of drawing 2, might be indicative of an awareness of a new possibility emerging in the drawer's life situation, and is associated with the phase of music birth (see Diagram 1), an image of transformation which fits in well with his post-programme musical proficiency

Despite the positive outcome, some methodological limitations are noted. Firstly the control group was not fully representative of the University-opera school mix of the total experimental group, as they were limited to music students from Potchefstroom University only, due to financial constraints. Since all project participants, including the control group, were selected from the universe of student musicians, no adverse effect regarding auditory and vocal enhancement, as well as the perceptions of the professional voice teacher, is suspected.

However, significantly increased coping scores in the control group, without any formal intervention, might have obscured/reduced the true magnitude of psychological enhancement in both sub-experimentals, and particularly the Opera School based sub-experimental group 2. Increased coping in control members could arguably result from vigorously engaging with their highly challenging university based musical studies. However, the significance of their increased coping scores was overshadowed by their 70% failure (7 out of 10 members) to attend their second Listening Test, despite multiple, personal reminders, acknowledged on and prior to the assessment day and hence disconfirmed.

Secondly, the retention of gains was not controlled. However, the favourable success ratio of 28:10 can be regarded as indicative of maintained gains, at least in some cases. In the context of post-apartheid South Africa, the fact that two of the five participants who achieved outstanding vocal proficiency, were black, predictably raises two issues: (i) The question whether their success accurately reflected performance enhancement by the TM, or resulted from assumed affirmative action. Definitive evidence will remain elusive. However, the professional voice teacher's judgement of significant vocal gains in both these students, as well as the significant psychological concomitants, gleaned inter alia from the final drawing of one of them, strengthen the case in favour of the enhancement effect of the TM. (ii) A more basic question is whether the 8 Opera School based participants of sub-experimental group 2, would more likely achieve vocal proficiency, even without the Tomatis Programme, than the rest of the University based participants and control group. That 3 of the 5 successful students hailed from the Opera School and 2 from the University, favours the idea that Opera School students are more likely to achieve vocal proficiency, possibly because of perceived proximity to the music "scene". However, given the international standing of the voice teacher/lecturer of all the University based singer participants, equal opportunity to achieve vocal proficiency had to be assumed for all experimental participants, regardless of the educational institution concerned.

Thirdly, the small sample size prevent generalization of findings, while a different strategy is required for measurement of singer's formant and definitive results mandate replication with a larger sample, attending more stimulation sessions, before optimal outcome will be attained.

Conclusion

Enhanced listening aptitude and the subjective perceptions of both voice teacher and singer-participants in sub-experimental group 1 and 2 on intonation, confirmed that the stimulation via the TM resulted in vocal enhancement, confirming perceived vocal gains. Enhanced psychological well-being, expressed in practically significantly increased vigor/activity, amid cultural diversity, as well as emotional coping in sub-experimental group 1, confirmed its psychological enrichment impact. Enhanced vocal endeavour associated with enhanced auditive acuity, confirmed Tomatis' view of the pivotal role of auditive control over singing and the effect of auditive stimulation on vocal proficiency and endorsed his claims about its multi-modal impact.

Increased coping scores in the university based, no intervention control group, possibly resulting from sustained engagement of taxing musical studies, yet largely nullified by their post-assessment behaviour, underlined methodological limitations, necessitating replication with larger randomized samples. Nonetheless, the results confirmed practically significant enhancement of listening and psychological well-being, complemented by qualitatively perceived vocal gains in participants and professional voice teacher, and amplified by concomitant post-programme vocal achievement.

Notes

1. Based on the Master's dissertation submitted to the Faculty of Health Sciences of the Potchefstroom University for CHE by the second author under the supervision of the first author.

2. Since the experimental group consisted of participants from Potchefstroom University (n=10) and Pretoria Technikon (n=8) it was deemed necessary to control for possible differences between these two sub-experimental groups on measures of psychological well-being, but not on the Listening Test, in view of their mutual musical involvement.

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