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Tomatis Method Stimulation: Effects on Student Educational Interpreters

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This study explored the impact of the Tomatis Method of sound stimulation on student interpreters at a merged higher education institution in South Africa. Interpreters were randomly allocated to a pre-post, experimental (n=9) and non-intervention control group (n=9) (age range =19-36; ethnicity = 17 white, 1 coloured). The experimental group received sound stimulation via the Tomatis Method. Interpreting performance, personality functioning, attention/concentration and mood states were assessed. Non-parametric, statistical analysis indicated significantly enhanced interpreting technique and psychological well-being in the experimental group. Openness to feelings was enhanced in the control group but attention, concentration and memory was reduced. Replication and extension of educational interpreting across multicultural tertiary contexts and the impact of Tomatis stimulation in improving performance necessitate further study.

Keywords: Simultaneous interpreting; psychological well-being, Tomatis Method; sound stimulation

Post-apartheid South Africa gradually introduced cultural diversity and multilingualism to tertiary institutions. A government directive to reduce universities resulted, among others, in the establishment of the North-West University (NWU) in 2004; a merger between Potchefstroom University for Christian Higher Education, University of North-West (UNW) and Vista University's Sebokeng Campus. NWU thus became a multilingual, tri-campus institution, comprising Afrikaans-, English- and Tswana-speaking students.

Need for Simultaneous Interpreting

Afrikaans, the predominant language on the Potchefstroom Campus, was maintained as medium of instruction, English at the Mafikeng Campus, and parallel medium (Afrikaans/English) at the Vaal Campus. To overcome the obstacle of retaining Afrikaans, while simultaneously accommodating non-Afrikaans students, a system of educational interpreting was introduced experimentally, with English as target language. Simultaneous interpreting implied a trained interpreter listening to an Afrikaans lecture and immediately rendering it verbally into English.

Despite a lack of evidence-based findings on this kind of interpreting in tertiary contexts, positive student responses led to the implementation of whispered simultaneous educational interpreting across the Potchefstroom Campus; making NWU the first South African university to use the Sennheiser Whispered Interpreting system. This system allows interpreters to speak so softly that no special arrangements are necessary to isolate them from students and no special equipment is required to hear lecturers. Interpreters use ultra-sensitive radio-transmitter microphones to render interpreted versions of lectures in very low voices, received by non-Afrikaans students via radio-receiver headphones (Van Rooy, 2005).

Using Student Interpreters

Students and other persons interested in becoming interpreters are recruited by the University's Language Directorate, attend basic training, and have to successfully complete a standardized interpreting test. After attending an interpreting course approved by the Institutional Committee for Academic Standards (ICAS), in-service training is implemented in order to carry out quality control and evaluations (Verhoef, Blaauw, Cloete, Olivier, & Zerwick, 2008).

Although every effort is made by the interpreting services to equip students to become effective interpreters, they may still experience stress due to minimal interpreting experience and limited knowledge of coping with the ensuing demands. Given the simultaneous nature of the process they are under great time and cognitive pressure, as it is impossible to clarify conceptual or linguistic uncertainties with lecturers beforehand (Verhoef, 2006). However, access to lecturer's PowerPoint presentations and course study guides associated with target lectures, are perceived as useful in preparing for interpreting sessions.

Heightened cognitive pressure experienced by simultaneous interpreters can be conceptualized by Gile's Effort Model (Gile, 1999). Operational components of interpreting performance comprise three efforts, namely: Listening and Analysis Effort; Production Effort (speech production in simultaneous interpreting); and Short-Term Memory Effort (essentially dealing with memory operations from the moment a speech segment is heard to the moment of reformulating it in the target language or disappearing from memory). Gile's Effort Model can be used to account for errors and omissions in the target text, in the absence of particular technical or other difficulties that can be identified in the source speech. Gile (1999, p.159) states that:

> *. . . most of the time, total capacity consumption is close to the interpreter's total available capacity, so that any increase in processing capacity requirements and any in-*

stance of mismanagement of cognitive resources by the interpreter can bring about overload or local attention deficit (in one of the Efforts) and consequent deterioration of the interpreter's output.

Clearly, simultaneous interpreting poses great challenges to interpreters' attention, concentration and memory skills.

Tomatis Method

Against this background, the Tomatis Method (TM) (Tomatis, 1991, 1996) may be useful to strengthen educational interpreters' skills to achieve and maintain optimal interpreting performance. Tomatis' major invention, the Electronic Ear (EE), was developed *". . . in order to assist the human ear to establish or re-establish its full potential"* (Thompson & Andrews, 2000, p. 176). The EE stimulates sound through special headphones by making use of bone and air conduction (Thompson & Andrews, 2000). Sound stimulation was developed during the last half of the twentieth century by Tomatis when his research led to the establishment of three laws: (i) the voice only contains the harmonics that the ear can hear; (ii) if the possibility is given to the ear to correctly hear distorted frequencies of sounds, these frequencies are immediately and unconsciously restored into the voice; and (iii) if the imposed audition is sufficiently maintained over time, one's audition and phonation will be modified permanently (Davis, 2004; Tomatis, 1996). Three phases are distinguished in the TM, namely: (i) auditory training to 'open up' the ear to develop better listening; (ii) breaks for integration that allow the person to experience, integrate and habituate new listening patterns; and (iii) audio-vocal training to develop the necessary audio-vocal control to maintain gains independently of the Electronic Ear (Thompson, 2004).

Tomatis (Tomatis, 1996; Thompson & Andrews, 2000) distinguished between *listening;* the active, motivated tuning in to what you want to hear, and *hearing*; an automatic action of sound perception. Listening, as opposed to hearing, is crucial in simultaneous interpreting and involves the process of language comprehension. Interpreters have to listen intently to grasp the meaning of the spoken source language as rapidly and precisely as possible. Tomatis was also concerned with 'self-listening'; whereby controlled auditory stimulation can alter one's self-listening and phonation. He stated: "If one listens to one's own voice, heard with a good quality and conditions one's ear sufficiently in this manner, the changes will be maintained" (Thompson & Andrews, 2000, p.176). This may impact on interpreters' audio-vocal control and improve their performance, as the speech production effort is associated with self-monitoring (Gile, 1999). Self-listening may be of great importance in whispered interpreting because precise control is needed to communicate in a whispered voice, without sounding unclear or speaking too loud, soft, high, or low.

Developed to stimulate rich interconnections between the ear and the nervous system (Thompson & Andrews, 2000) cognitive gains from the TM, possibly also applicable to interpreters, include improved attention span, concentration, mental alertness, awareness, and improved executive skills, that is the ability to focus, shift and maintain goal-directed behaviour (Belk, 1992). In studying the interconnections between ear, brain and voice, Tomatis found that ". . . attention and memory are improved by way of stimulating the attention pathways of the reticular activating system, through the thalamus and on to projections in the frontal lobes" (Thompson & Andrews, 2000, p.184). According to Thompson and Andrews (2000), sensory integration, reaction time and auditory information processing can be improved by stimulating these pathways. If these improvements can be achieved in educational interpreters, they may be able to improve interpreting speed and accuracy, thereby enhancing interpreting performance. According to Moser-Mercer (2001) simultaneous interpreting is a complex cognitive skill that the human brain can adapt to, given the right conditions and conditioning. Thus, conditioning the ear with the TM may impact on various cognitive abilities.

Furthermore, studies have shown that the TM enhances aspects of personality, including emotional coping and vigour (Du Plessis, Burger, Munro, Wissing & Nel, 2001). Interpreters may thus cope better with stress and other demands inherent in interpreting, as they are constantly adjusting to a diversity of subjects, lecturers and accents, while confronting an ever present threat of failure (Kurz, 2003). Additionally, Thompson (2004) states that listening to filtered music via the Electronic Ear enhances the tension of the tympanic membrane which fosters psychological well-being so that the client's self-confidence, awareness of abilities, and willingness to use his/her voice from a position of empowerment, are increased. This may be useful to educational interpreters who have to convey lecturers' messages with self-confidence and may benefit users; as it may be easier to comprehend interpreters who communicate clearly, energetically and confidently.

Goals of the Study

The goal of the study was to determine whether sound stimulation through the Tomatis Method would improve participating student interpreters' interpreting performance, personality functioning, attention/concentration, memory, and mood states.

Research Question

What are the effects of Tomatis stimulation on student interpreters' 1) interpreting performance, 2) personality functioning, 3) attention/concentration and memory, and 4) mood states?

Rationale

Interpreting performance (IP) implies the ability to interpret Afrikaans lectures into English rapidly, accurately and in a calm voice so that non-Afrikaans students' understanding of interpreted material is facilitated. The rationale for assessing IP is to arrive at an objective evaluation of interpreting performance.

Personality functioning in an interpreting context implies the ability to cope with stress and negative affect associated with the intimidating interpreting process as well as a positive, energetic and confident way of conducting the interpreted message. The rationale for assessing this variable was that increases in affect balance, positive emotions and extraversion could reflect a positive change in participants' personality functioning, interpreting performance and general psychological well-being.

Attention/concentration and memory in the interpreting context refer to the ability to maintain the high level of focus throughout the interpreting period and recall the lecturer's message efficiently. The rationale for this variable was that interpreters can invest more energy in other interpreting efforts, according to Gile's Effort Model (Gile, 1999) if their ability to attend and focus is enhanced.

Mood states refer to the relationship between negative mood states and one positive mood state, vigour. The assumption is that while negative mood states dominate, vigour, the positive mood state, will be suppressed. However, if the negative mood states are reduced as a result of an intervention, vigour will increase and the resultant profile will resemble an ice-

berg with vigour at its peak. Thus, the rationale for assessing mood states was to determine whether vigour would be enhanced, if the negative mood states could be reduced through the Tomatis stimulation. Increased vigour could enable interpreters in conveying lecturers' messages with more energy while simultaneously enhancing positive affect.

Method

Research Design

A two-group, pre-post assessment design was used to determine changes in the experiences of participating educational interpreters. By randomly allocating student interpreters to experimental and control groups, a more rigorous study was ensured.

Research Context and Participants

A convenience sample of male (n=9) and female (n=9) educational interpreters of a large South African university who were fluent in Afrikaans and English participated. Participants consisted of pre- and postgraduate students aged between 19 and 36, of which 17 were white, and one coloured. They were allocated randomly to an experimental (n=9) and non-intervention control group (n=9). Table 1 illustrates the profile of experimental and control group participants.

Procedure

Permission for the study was granted by the Ethics Committee of the Faculty of Health Sciences of the North-West University. Participants provided individual written informed consent. Pre-assessment was completed individually, prior to the Tomatis stimulation and involved the following tests: Digit Span and Letter-Number Sequencing subtests of the Wechsler Adult Intelligence Scale (WAIS III), NEO Personality Inventory Revised (NEO PI-R) and Profile of Mood States (POMS). The Interpreting Performance Evaluation (IPE) was conducted separately (see Data Collection below).

The Tomatis stimulation was conducted in an area designed and equipped for group and individual listening purposes within the Institute for Psychotherapy and Counselling. Two stimulation phases of 60 half-hour sessions were conducted over two periods of three weeks each, interspersed by a break for neurological integration of three and a half months. During Phase One, participants spent a total of 30 hours passively listening to CD's with Mozartian music, alternated with Gregorian chants, through headphones, while just relaxing, talking informally to each other, drawing, or playing board games. During Phase Two, they listened individually to a 9-CD series of English words and texts, each progressively filtered to develop their ability to perceive language sounds accurately. During a space between words and phrases on the CD's, participants had to repeat the word or phrase into a microphone while maintaining an upright posture. They received feedback via air and bone conduction. In this way their right ears were progressively stimulated as well as the language areas in the left hemisphere, thereby strengthening their right auditory pathways to the brain. At completion of these language CD's, provided by Tomatis Développement in Luxembourg, the participants continued to read aloud in similar fashion from books of their choice.

Post-assessment occurred within one month post-programme and quantitative data was scored and analysed by the University's Statistical Consultation Services. Post-assessment on WAIS III had to be interrupted due to one experimental participant not feeling well close to the final examinations. Another date was set, but he failed to attend and thus only eight participants completed the test (see Table 2). As will be seen in Table 3, only seven control group participants completed the NEO PI(R) and six of the nine control group members completed WAIS III post-assessments. Despite several text messages, phone calls and a schedule of possible dates for the assessment, they failed to attend.

Data Collection

Interpreting Performance Evaluation. Pre-post evaluation was conducted by a 'blind' panel of four: three interpreting experts and a speech therapist. Performance was evaluated on the South African Translators Institute's (SATI) internationally acknowledged 10-scale assessment grid for simultaneous interpreting. The grid is also used for the South African interpreting accreditation examinations and applied for educational interpreting evaluation at the North-West University. Scales included:

(i) accuracy and coherence of message; (ii) target language vocabulary and register; (iii) target language grammar, idiom and purity; and (iv) interpreting technique (fluency of delivery, voice quality and booth behaviour).

In this study a high degree of homogeneity in the ratings of each scale by each rater was obtained. A mean item alpha reliability of 0.97 and inter-rater reliability of 0.90 were obtained. Inter-item Cronbach alphas ranged between 0.95 and 0.96 and inter-rater reliability between 0.84 and 0.92

Wechsler Adult Intelligence Scale (WAIS III). Two subtests of the WAIS III (Kaufman & Lichtenberger, 1999) were used, namely Digit Span and Letter-Number Sequencing; both form part of the Verbal Comprehension Index. Digit Span measured: working memory; attention; concentration; conceptual tracking; short-term acquisition and retrieval; and sequential auditory processing. Letter-Number Sequencing measured: working memory; attention; concentration; conceptual and executive skills; fluid intelligence; visualization; short-term acquisition; and sequential processing. These scores rendered information on participants' abilities to perceive stimuli passively, sustain attention span and concentration, track concepts and monitor their own functioning, as well as their proneness to anxiety, distractibility and negativism.

WAIS III, standardised for the entire South African population, is a reliable test with outstanding standard errors of measurement and high reliability coefficients. Split-half reliability is 0.90 for Digit Span and 0.82 for Letter-Number Sequencing, and test-retest reliability is 0.82 for Digit Span and 0.75 for Letter-Number Sequencing (Kaufman & Lichtenberger, 1999). The Pearson correlation coefficients for this study were 0.02 (correlation between pre- and post-test scores for both subtests), 0.07 (correlation between post-test scores of subtests), and 0.00 (correlation between pre-test scores of subtests). These correlations can be interpreted as sufficiently high concurrent reliabilities.

NEO Personality Inventory Revised (NEO PI-R). The NEO PI-R (a 240-item, self-report scale) was developed by Costa and McCrae (1992) to measure five broad domains of normal personality which correlates with psychological well-being, namely: Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C), each consisting of six facets of personality.

Although not standardized in South Africa, the NEO PI-R was found to be valid and reliable on a number of populations. Reliability indices of the domains range from 0.86 to 0.92 and

reliability of subscales from 0.56 to 0.81 (Costa & McCrae, 1992). Chronbach alphas for South African populations were lower than those of Americans (Costa and McCrae, 1992), ranging from 0.69 to 0.83 for the abovementioned, and with all the Chronbach alphas for subscales having lower reliability indices than that proposed by Costa and McCrae (Van der Walt, 1996). In this study Cronbach alphas for domains ranged from 0.79 to 0.90, whereas reliability indices for subscales ranged from: N (0.86 to 0.90), E (0.80 to 0.86), O (0.72 to 0.82), A (0.75 to 0.78), and C (0.69 to 0.82).

Profile of Mood States (POMS). McNair, Lorr and Droppelman (1992) developed the POMS, a 65-item five-point adjective rating scale, developed as a ". . . rapid, economical method of identifying and assessing transient, fluctuating affective states" (McNair et al., 1992, p.1). The POMS measures six identifiable mood or affective states: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigour-Activity, Fatigue-Inertia and Confusion-Bewilderment. In this study, the Tension and Vigour factors could be of special importance.

Alpha coefficients obtained by McNair et al. (1992) ranged from 0.78 to 0.93. Although not standardized for South African populations, a mean Cronbach alpha reliability index of 0.72 was found in one Tomatis-related South African study (Du Plessis et al., 2001), indicating good reliability.

Data Analysis

The SAS System for Windows Release 9.1 (SAS Institute Inc., 2003) was used for statistical analysis. Pre-post differences within and between groups were determined by non-parametric statistics, using the Mann-Whitney Test and Willcoxon Sign Rank Test respectively. Descriptive statistics and Cronbach Alpha reliability indices were computed for each scale and/or subscale and inter-rater reliability was determined for the Interpreting Performance Evaluation. Paired t-tests were performed to compare pre-post-means within each group. Using the GLM Procedure of SAS, analysis of covariance (ANCOVA) was performed to compare post-test means of the two groups, first correcting for possible differences between groups at pre-assessment. For the POMS, a repeated measures analysis of variance was implemented to determine within-subject effects. Pre-test scores were subtracted from post-test scores in all cases, except Vigour, the positive mood state, where post-test scores were subtracted from pre-test scores. Statistical significance was measured by means of p-values. Practical significance was excluded as statistically significant differences in small groups suggest practical significance.

Ethical Considerations

Ethical guidelines by the Health Professions Council of South Africa for Psychologists were followed. This study was part of the project "An exploration of enabling contexts" for which ethical approval was granted by the Ethics Committee of the North-West University (clearance number 05K14). Informed consent was obtained from all participants and information communicated included aims of the research project, expectations from prospective participants, use of data for research purposes, termination of study participation, confidentiality, risk factors, accountability, and inquiries. Participants were informed about the stages of the Tomatis programme as well as its potential impact.

Research Results

In Table 1 the profile of the experimental and control groups are portrayed. Group similarities and differences, evident on the profiles, will be elaborated upon in the discussion of results.

In Table 2 the significance of pre- and post-test differences within the experimental group are provided with regard to the Interpreting Performance Evaluation (IPE), Wechsler Adult Intelligence Scale (WAIS III), and NEO-Personality Inventory (R) (NEO-PI R).

In the case of the IPE a statistically significant increase occurred on the Target Language Grammar, Idiom and Purity subscale (p=0.04). In the NEO-PI(R) statistically significant increases occurred with regard to: Self-Consciousness (p=0.01), Vulnerability to Stress (p=0.04), Positive Emotions (p=0.01) and Actions (p=0.01). In contrast, there was a statistically significant reduction in Feelings (p=0.04) and Dutifulness (p=0.02) facets.

Table 3 shows the significance of pre-post differences within the control group regarding the IPE, WAIS III, and NEO-PI (R) is indicated.

Statistically significant increases in the IPE were noted on the following subscales: Target Language Vocabulary and Register (p=0.00), Target Language Grammar, Idiom and Purity (p=0.00), Interpreting Technique (p=0.05), and Overall Inter-

Table 1

Profile of Experimental and Control Group Participants

	Experimental Group	Control Group
Gender:	Male: 4; Female 5	Male: 5; Female 4
Mean Age:	24 years	26 years
Home Language*:	Afrikaans: 4; Bilingual (Eng/Afr): 5	Afrikaans: 8; German:1
Mean Interpreting Experience:	19 months	21 months
Appointment Status:	Full-time: 1; Part-time: 8	Full-time: 5; Part-time: 4
Study Degree:	Pre-graduate: 4; Post-graduate: 5	Pre-graduate: 4; Post-graduate: 5
Resignations during 2009:	2	None

Note. Although participants identified these as their mother tongue languages, all 18 participants were fluent in both Afrikaans and English, and thus bilingual.

Table 2

Significance of Pre-Post Test Differences for IPE (n=9), WAIS III (n=8) and NEO PI(R) (n=9) Within the Experimental Group

Dependent variable	Min	Max	M-diff	SD-diff	t	p
IPE						
Accuracy and coherence of message	-0.42	1.88	0.38	0.76	1.49	0.16
TL vocabulary and register	-0.95	1.08	0.12	0.59	0.62	0.55
TL grammar, idiom and purity	-0.12	1.96	0.50	0.61	2.45	0.04*
Interpreting technique	-0.08	2.17	0.47	0.76	1.87	0.1
Overall IP	-0.11	1.77	0.37	0.59	1.88	0.1
WAIS III						
Digit span	-2	5	0.75	2.61	0.81	0.44
Letter number sequencing	-3	4	0.25	2.55	0.28	0.79
NEO_PI(R)						
N4_Self-consciousness	-2	5	2.33	2.12	3.30	0.01*
N6_Vulnerability to stress	-1	4	1.33	1.66	2.41	0.04*
E6_Positive emotions	-1	3	1.44	1.24	3.51	0.01**
O3_Feelings	-3	0	-1.11	1.36	-2.44	0.04*
O4_Actions	-1	3	1.67	1.41	3.54	0.01**
C3_Dutifulness	-5	0	-2	1.94	-3.10	0.02*

Note. TL: Target Language; IP: Interpreting Performance; Min: minimum difference; Max: maximum difference; M-diff: Mean difference (post mean-pre mean); SD-diff: standard deviation of difference; t-value: test statistic; p-value: statistical significance; * $p \leq 0.05$, ** $p \leq 0.01$

preting Performance (p=0.00). With regard to WAIS III, a statistically significant reduction occurred on the Letter Number Sequencing subscale (p=0.03). The NEO-PI(R) indicated reductions on the Activity (p=0.01) facet of Extraversion and Actions (p=0.01) facet of Openness which were statistically significant. A statistically significant increase occurred on the Dutifulness (p=0.05) facet of Conscientiousness.

In Table 4 the significance of differences between the experimental and control group at post-test, adjusted for pre-test differences, with regard to the IPE, WAIS III, and NEO-PI (R) is provided.

During the post-assessment of IPE, the experimental group scored higher than the control group on the Interpreting Technique subscale (p=0.05) to a statistically significant degree. In the NEO-PI(R), the experimental group exceeded the control group to a statistically significant degree with regard to Extraversion (p=0.04) and its Activity facet (p=0.01). The control group exceeded the experimental group in the Feelings facet (p=0.00) of Openness.

In Table 5 the significance of pre-, in-program, and post-test differences in the POMS, within the experimental group, is provided.

The POMS showed a statistically significant reduction in Fatigue-Inertia at both in-program and post-test (p=0.01 and p=0.05 respectively). Tension-Anxiety and Confusion-Bewilderment showed reductions close to the 5% level of significance for the post-programme assessment (p=0.06). In Table 6 the univariate test of hypothesis with regard to the POMS, for effects within the experimental group, is provided.

A statistically significant increase from pre- to in-program and from pre- to post-test occurred between various means of the experimental group on the Fatigue-Inertia subscale (p=0.03).Also, Total Mood Disturbance had a decrease close to the 5% level of significance with p=0.06.

Graph 1 shows the mean scores of the experimental group on the POMS and indicates the formation of the Iceberg Profile obtained as a result of reductions in Tension-Anxiety, Depression-Dejection, Anger-Hostility, Fatigue-Inertia and Confusion-Bewilderment, and a tendency towards increased Vigour-Activity.

Discussion

Despite random selection the profiles of study participants in Table 1 reflected an unanticipated advantage of the control group over the experimental group in terms of age (two years older); interpreting experience (21 versus 19 months, respectively); and appointment status (five fulltime interpreters versus one, respectively). Since full-time interpreters were allowed opportunities to interpret outside the tertiary environment, they inevitably accrued more experience and confidence during the study period than the experimental group. The resignation of two experimental participants from interpreting for academic reasons well ahead of post-assessment, at the beginning of the second semester, also impacted negatively on their post-interpreting performance evaluation. Yet, despite these inter-group discrepancies the experimental group's functioning was enhanced to such an extent that they outperformed the control group on several crucial outcomes, in all likelihood due to the impact of the TM.

With regard to the Interpreting Performance Evaluation, within-group differences showed improvements in one subscale in the experimental group and four subscales in the control group. Presumably, the higher number of improvements in the

Table 3

Significance of Pre-Post Test Differences for IPE (n=9), WAIS III (n=8) and NEO PI(R) (n=9) within the Control Group

Dependent variable	Min	Max	M-diff	SD-diff	*t*	*p*
IPE						
Accuracy and coherence of message	-0.33	0.88	0.24	0.36	2.03	0.08
TL vocabulary and register	-0.04	0.83	0.41	0.31	4.07	0.00**
TL grammar, idiom and purity	-0.04	0.75	0.34	0.24	4.35	0.00**
Interpreting technique	-0.04	0.75	0.22	0.28	2.36	0.05*
Overall IP	0.00	0.76	0.30	0.22	4.15	0.00**
WAIS III						
Digit span	-1.00	3.00	1.00	1.41	1.73	0.14
Letter number sequencing	-5.00	0.00	-2.33	1.86	-3.07	0.03*
NEO_PI(R)						
E4_Activity	-7.00	-1.00	-3.00	2.08	-3.81	0.01**
O4_Actions	-5.00	-1.00	-2.57	1.72	-3.96	0.01**
C3_Dutifulness	-3.00	-1.429	1.51	1.94	-2.50	0.05*

Note. TL: Target Language; IP: Interpreting Performance; Min: minimum difference; Max: maximum difference; M-diff: Mean difference (post mean-pre mean); SD-diff: standard deviation of difference; t-value: test statistic; p-value: statistical significance; * p≤0.05, ** p≤0.01

Table 4

Analysis of Covariance (ANCOVA) for IPE, WAIS III and NEO PI(R) of Post-Tests Corrected for Pre-Test counts, to Compare Groups (df = 1)

Dependent variable	*Type III SS*	Adj. PM *Exp*	Adj. PM *Control*	F	P
IPE					
Accuracy and coherence of message	0.32	7.38	7.11	2.17	0.16
TL vocabulary and register	0.08	7.16	7.30	0.51	0.49
TL grammar, idiom and purity	0.19	7.47	7.26	2.06	0.17
Interpreting technique	0.56	7.23	6.87	4.72	0.05*
Overall IP	0.13	7.31	7.13	1.67	0.22
WAIS III					
Digit span	0.50	11.83	12.22	0.10	0.76
Letter number sequencing	13.37	14.24	12.18	2.85	0.12
NEO_PI(R)					
Extraversion (E)	162.97	118.93	112.37	5.24	0.04*
Activity (E4)	32.34	19.26	16.38	9.58	0.01**
Feelings (O3)	21.02	24.86	27.18	13.63	0.00**

Note. TL: Target Language; IP: Interpreting Performance; Min: minimum difference; Max: maximum difference; M-diff: Mean difference (post mean-pre mean); SD-diff: standard deviation of difference; t-value: test statistic; p-value: statistical significance; * p≤0.05, ** p≤0.01

Table 5

Significance of Pre-in and -Post Test Differences on the POMS within the Experimental Group

Dependent variable	Min	Max	M-diff.	SD-diff.	t	p
Tension-Anxiety_2	-14	7	0.22	6.32	0.11	0.92
Tension-Anxiety_3	-4	14	3.89	5.33	2.19	0.06
Depression-Dejection_2	-13	24	3.00	12.11	0.74	0.48
Depression-Dejection_3	-10	32	4.56	13.91	0.98	0.35
Anger-Hostility_2	-13	26	5.22	13.10	1.20	0.27
Anger-Hostility_3	-16	29	5.44	13.97	1.17	0.28
Vigour-Activity_2	-21	3	-4.33	6.91	-1.88	0.10
Vigour-Activity_3	-24	4	-5.78	8.98	-1.93	0.09
Fatigue-Inertia_2	0	14	6.00	4.69	3.84	0.01**
Fatigue-Inertia_3	-5	18	6.11	7.77	2.36	0.05*
Confusion-Bewilderment_2	-7	16	3.67	8.19	1.34	0.22
Confusion-Bewilderment_3	-3	14	4.22	5.78	2.19	0.06
Total Mood Disturbance_2	-20	80	24.78	36.22	2.05	0.07
Total Mood Disturbance_3	-25	103	32.33	46.84	2.07	0.07

Note. Tension-Anxiety_N represents the contrast between the Nth level of the variable Tension-Anxiety and the first level. Min: Minimum difference; Max: Maximum difference; M-diff: Mean difference (pre-mean, post-mean); SD-diff: Standard deviation of difference; t: test statistic; p: statistical significance; * $p \leq 0.05$, ** $p \leq 0.01$

Table 6

Repeated Measures Analysis of Variance on the POMS (df = 2 & 16)

Dependent variable	Error Mean	Mean Square	F	p
Tension-Anxiety	18.84	42.93	2.28	0.14
Depression-Dejection	68.43	48.26	0.71	0.48
Anger-Hostility	73.49	85.44	1.16	0.33
Vigour-Activity	24.87	81.37	3.27	0.09
Fatigue-Inertia	20.91	110.04	5.26	0.03*
Confusion-Bewilderment	19.12	47.37	2.48	0.15
Total Mood Disturbance	712.04	2564.7	3.62	0.06

Note. df: degrees of freedom; F: F statistic; p-value: statistical significance; * $p \leq 0.05$, ** $p \leq 0.01$

control group might be due to a practice effect as they were able to gain more interpreting exposure prior to post-assessment.

Regarding Interpreting Technique, pre-post between-group differences showed a significant difference in favour of the experimental group. However, to attain a satisfying interpreting product all four subscales need to be taken into account. Although not statistically significant, the experimental group also outperformed the control group on all other criteria except Target Language Vocabulary and Register, suggesting an improvement in their overall interpreting performance. According to the assessment grid for simultaneous interpreting, enhanced Interpreting Technique indicated improvements in (i) fluency of delivery, for example little or no hesitation or backtracking; (ii) ability to vary following distance; and (iii) voice quality, for example voice and breath control and distance from microphone.

Improvements could be attributed to the active phase of the TM; during which their voices were fed back to their ears via air and bone conduction and presented in a way that is designed to enhance voice quality and encourage audio-vocal self-control.

With regard to the WAIS III, which measured attention, concentration and memory, no statistically significant increases occurred within- or between-groups, though the control group experienced a statistically significant decrease in Letter Number Sequencing, possibly due to increased tension and fatigue towards the end of the academic year. The fact that the experimental group did not show the same decrease in scores might be explained by their reduced negative mood states and tendency towards increased vigour, as indicated by the POMS Ice Berg Profile. Another reason may be that the WAIS III is an indication of IQ, which compounds are known to be stable.

Within the experimental group, enhanced Positive Emotions and Actions facets (preference for novelty and variety) confirmed participants' statements of generally feeling less uptight and inhibited. Increased Self-Consciousness might imply that participants became more aware of themselves due to the process of self-listening as part of the active phase of the programme. Increased Vulnerability to Stress and Decreased

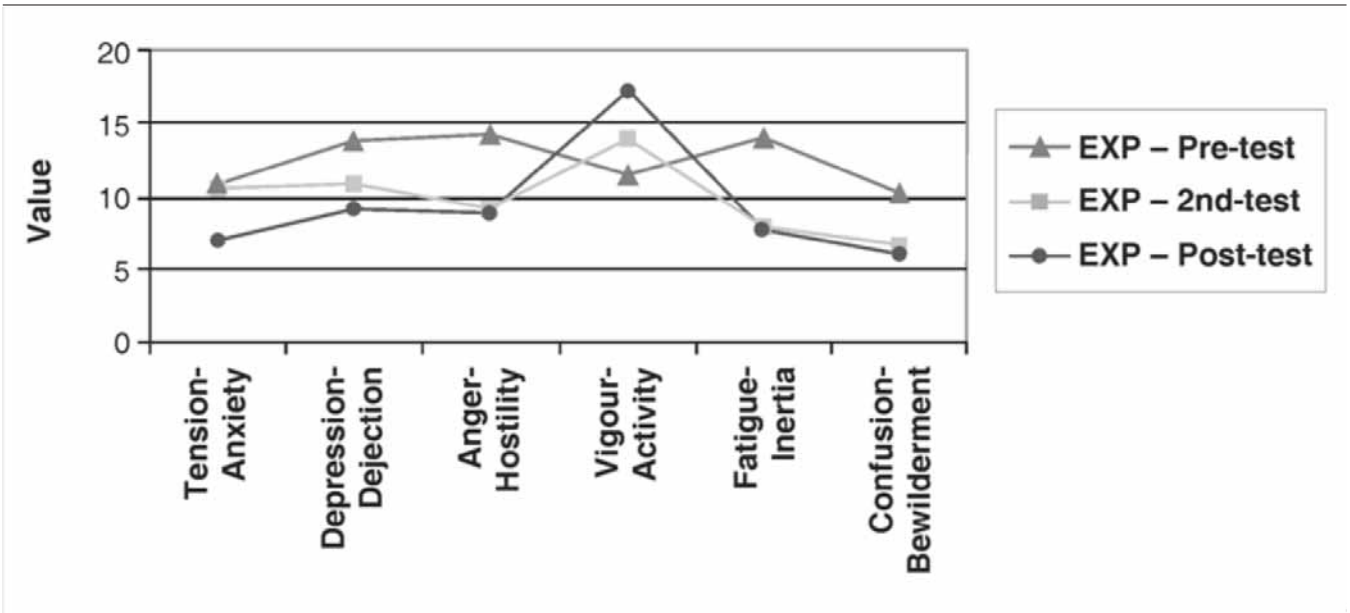

Figure 1. Pre-, In-Program and Post-Test Mean Scores on the Profile of Mood States for the Experimental Group (n=9)

Dutifulness, starkly contrasting with participants' qualitative feedback, will be clarified in the qualitative manuscript.

In the control group, decreases in Activity and Action facets might suggest increased levels of fatigue and lack of enthusiasm towards the end of the year as a result of accumulated stress and pressure in the interpreting environment. Increased Dutifulness could possibly be a result of being increasingly encouraged to fulfil their interpreting obligations throughout the year, since most of the control group were full-time interpreters from whom greater responsibility was expected.

Between-group differences also showed enhanced Extraversion in favour of the experimental group, suggesting that the TM brought about positive changes in their tendency to be more outgoing, assertive, active, talkative, cheerful, energetic, and optimistic (Costa & McCrae, 1992).

Limitations

Limitations of this study are, firstly, that sample size was restricted to nine experimental participants, due to the limited number of Electronic Ears available. Although adequate for qualitative research, the sample size remains too small to perform more complex statistical calculations.

Secondly, the control group did not complete the POMS assessment due to non-availability of participants, leaving a gap in the comparison of mood states. Non-completion of all psychological post-tests by a minority of control members, despite repeated efforts to contact them, was ascribed to their tight interpreting and academic schedules. Though constituting another limitation, it was not regarded as invalidating the major findings.

Since the effect of the TM may only peak months after programme completion, a follow-up ought to have been included. However, as some members of both groups completed their studies at the end of the year this was impossible and, thus, results may not reflect the true impact of the TM.

The imbalance in group composition (control group advantage) might have influenced the outcomes of the study as comparison between the groups is affected negatively. Finally not all participants completed all tests as indicate

Conclusions

Experimental participants experienced an improvement as interpreters, as evidenced by statistically significant improvement on Interpreting Technique. Additionally, they experienced statistically significant personality enhancement in terms of Extraversion. The beneficial impact of the Tomatis Method was thus extended beyond its traditional clinical context to that of educational interpreting, though replication remains essential. The importance of this study lies in its contribution to interpreters' performance and well-being, thereby enhancing the multilingual environment at the NWU.

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