The MISE Method. A new communicative approach for evaluating and training singing through mental imagery: executive implications

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Abstract:
Describing the qualities of a singer's voice is a challenging task, even for experts. Voice pedagogues usually evaluate vocal qualities through auditions, after which they make subjective judgments. As a means of communication, language has limitations in expressing concrete sound sensations, and sometimes such a description can be abstract for the singer. Our work aims to design and validate a new educational approach for vocal assessment and training, using the Mental Images for Singing Education (MISE Method). In addition, we analyze whether this pedagogical methodology favors the improvement of vocal technique and the learning of concepts according to the level of experience of the students and their executive performance. Our results show that the introduction of Mental Imagery produces beneficial effects in the teaching and learning of vocal techniques, regardless of the initial performance level. This makes the MISE Method an effective assessment and training tool, allowing the formalization of a communication language hitherto used intuitively in the singing classroom. However, our results were inconclusive at the cognitive level, so future research is needed to expand the study of executive processes according to the type of mental images used.

KEYWORDS: Educational communication. Teaching methods. Art education. Singing. Neuropsychology. Neuroeducation.

1. Introduction

The voice is the main human means of communication. Nonetheless, its description is conditioned by the auditory perception capacity of each individual and their knowledge of the vocal field. The difficulty is greater in the case of the singing voice, where the fusion of oral and musical language increases the variety and breadth of parameters, that must be considered. Singing is a complex phenomenon, in which auditory control over the sound material is essential (Cámara Izaguirre, 2004). Being able to explain in words the quality, characteristics, and technical skills can be abstract for the student, mainly due to the limited capacity of language to express concrete sound sensations. In this sense, Mitchell (2014) states that "to describe a sound, listeners focus on the most easily perceivable technical and visual aspects of the performance, which are simpler to state and generally avoid describing the overall sound of the singer" (p. 187).
Externally, the vocal and technical characteristics of singers can be evaluated through two methods:

1) Subjective judgments using audition to assess the vocal quality and interpretative capacity of the singer. In the process of learning to sing, the teacher's clear perception of any changes in the quality of the voice is essential, offering the student technical solutions through enriched feedback that allows them to adapt a teaching program that is suited to their needs (Mitchell, 2014).

2) Acoustic analyses, which appear to be more reliable (Larrouy-Maestri et al., 2013; Stadler Elmer and Elmer, 2000).

The singer can also self-evaluate through two techniques: self-observation (with mirror) and self-listening (recording). Southcott and Mitchell (2013) confirmed the considerable pedagogical value of high-fidelity digital recordings as a means of feedback for the student singer and as a tool for voice perception.

Various didactic resources can be employed in the teaching-learning process of singing, such as associating sounds with body gestures, usually centered on the hands (Bustos, 2003), along with metaphors (Sousa, Silva, and Ferreira, 2010), and visual images. Recently, it has been shown that the use of the latter improves teacher-student communication, student performance, and increases concentration for the interpretation of the musical work (Merzero et al., 2017; Merzero-Moreno et al., 2018). An example of this is shown in the research conducted by Paney and Tharp (2021), in which they tested the positive effect of visual feedback on vocal practice and vocal perception of the potential as a singer through the computer game *SingingCoach.* The authors explain that visual feedback may improve singing, but this progress stops in the short term if the feedback is removed. Nonetheless, participants' ratings of their own singing increased significantly over the 10 weeks, probably because the computer game SingingCoach encouraged them to practice more frequently.

Another didactic resource traditionally used in teaching singing is mental imagery (MI), which has been scarcely studied in the specialized literature, but it has a wide corpus of evidence, for example, in sport setting (Lindsay et al., 2021). Since singing is a highly cognitive task, it is valuable for singers to implement imagery in their training, as this improves vocal technique, character development and reduces performance anxiety (DeSantis, Deck, & Hall, 2021). Recent research in the field of choral music has also revealed the effectiveness of the use of verbalized imagery by choral directors to communicate singers how to create and change vocal responses (Black, 2022). There is no predetermined program, as each pedagogue employs those MI that they consider useful for the learning process.

Another noteworthy aspect is that musical imagery is multimodal, that is, MI in musicians are not necessarily specific to the motor, somatosensory, auditory or visual aspects of the images, but musicians integrate them all (Lotze, 2013). In this same line, Morales-Villar and Sáez-Zea (2019) have suggested that these images have an added value, since they can generate a more complex sensory experience, both of a visual and proprioceptive or kinesthetic nature. The latter, in addition, have proven to be an effective complement that helps improving instrumental practice (Lotze, 2013).

At the same time, after verbal instruction, MIs are generated by the singer themselves from previous experiences, setting in motion complex cognitive processes that are fundamentally of an executive nature (Tirapu-Ustarroz et al., 2011). This imagery is intended to transmit to the student the physical-acoustic sensations they will perceive when working on certain vocal aspects. The singer's self-perception of the sound sensations linked to breathing, phonation, emission, articulation, and resonance of the voice are very important aspects for the development and effective progress of vocal technique.

In recent years there has been considerable interest in studying the effect of music training on cognitive function, that is, improving cognitive ability, especially at the executive level (Meyer, Oguz, & Sledge Moore, 2020). Specifically, Roden and colleagues have shown a transfer effect of training music to specific executive domains, such as the phonological loop and central executive components of working memory (Roden, Grube, Bongard, & Kreutz, 2014). However, there is no evidence whether the level of executive performance of the singers favors the use of MI in teaching singing.

The main objective of this work is to develop and validate the MISE method as a pedagogical tool that allows:

a) The external evaluator to assess five parameters of the singer's vocal technique (breathing in singing, voice support, sound concentration in phonation, voice flexibility, and resonance).
b) The singer to have strategies and technical resources that favor their learning process through MI, thus allowing them to self-evaluate and carry out their learning in an autonomous way.
c) The teacher and student to establish a protocolized communication strategy that favors understanding between them.

In particular, the following specific objectives are addressed:

O1 To quantify improvement in the five aspects of vocal technique considered by applying a scale specifically designed for this method (MISE instrument).

O2. To investigate the effectiveness of the MISE method for improving the five aspects of vocal technique as a function of the singer's level of experience.
O3. To analyze whether executive functions favor the use of MI in teaching singing and whether there are significant differences according to general cognitive level.

2. Method

2.1. Participants

The sample was composed of 55 singers with three educational levels:

a. Students of the Degree in Primary Education-University of Jaén, subject: Vocal Interpretation and Creation.
b. Students of the Master's in Research and Aesthetic Education: Arts, Music, and Design-University of Jaén, itinerary: Research and teaching musical language in conservatories.
c. Expert students from the international program of high performance in opera singing "Jaén Ópera Joven" (VI and VII editions).

The undergraduate and master's degree students were selected using non-random sampling, while the expert students were selected from among 99 applicants using an artistic/training curriculum and audition (audiovisual recording of an opera aria of their choice) by three expert judges. These three judges are recognized professionals with more than 20 years of experience in the artistic and academic field. Expert 1 is a pianist specializing in the accompaniment of lyrical singers, a regular in theaters and festivals of the highest international level, a repertoire and vocal technique coach, and a university doctor. Expert 2 is a speech therapist, singing teacher and a professional operatic singer on an international level. Expert 3 is a singing teacher and lyrical singer, a university professor with a doctoral thesis in singing teaching.

2.2 Procedure/Instruments

The training process was individual, with a duration of five days in each edition. The training consisted of five lyrical interpretation *masterclasses* and three workshops delivered by experts.

2.2.1. Daily Masterclasses (40 minutes). These were delivered by an internationally renowned opera repertoire pianist in which opera arias were performed. The teacher made corrections in vocal interpretation, pronunciation, voice projection, and used other stylistic resources. On the last day of training, the teacher assigned each student one of the works that had been used during the course, to be performed in a final public concert.

2.2.2. Workshop on neuropsychological aspects of singing (90-120 minutes). In this workshop, an expert neuropsychologist administered a cognitive battery that included the following three widely studied and validated executive tests:

Raven's Progressive Matrices Test (Raven et al., 1994; Raven et al., 1996). This visual test measures intellectual capacity and general mental ability. We applied the advanced version, the APM (Advanced Progressive Matrices) scale designed to assess people with above-average ability.

Similarities of the WAIS-IV (Wechsler Adult Intelligence Scale-IV) (Wechsler, 2012a; Wechsler, 2012b). This test assesses verbal comprehension, specifically the ability to express relationships between two concepts, associative thinking, and verbal abstraction ability.

Wisconsin Card Sorting Test (WSCT) (Heaton et al., 1993). This test evaluates the capacity for abstract reasoning, concept formation, and the switching of cognitive strategies in response to changes in environmental contingencies.

2.2.3. Workshop on body awareness in lyrical singing (60-80 minutes). This was conducted by two physiotherapists specialized in artistic posturology.

2.2.4. Group workshop on career management for opera singers (120 minutes). This was delivered by a specialist critic from an international opera magazine.

All study participants were individually administered with the MISE method in the presence of experts. The objectives of the method are as follows:

1. To allow the expert to evaluate (through specified criteria) the characteristics and technical resources of the singers.
2. To help generate *feedback* between the pedagogue and the singer and awareness and self-perception of their voice.
3. To provide, through MI, strategies that the singing student or singer can use to favor the improvement of their learning process.
4. To provide the singing teacher with didactic tools and resources that they can use while training the voice of their students.

This method works on five specific vocal aspects that belong to the following basic areas of vocal technique (Table 1).

Insert here Table 1

Administration of the method consisted of the following seven phases:

1. Obtaining prior information about the participant concerning their official or private musical training, specifically their singing studies, level of training, and professional experience as a soloist or in vocal ensembles (choir).
2. Execution of the vocal exercise by the singer, related to each technical aspect proposed by the expert judges (Pre-Test).
3. Double evaluation of the level of execution of the vocal exercise using the MISE instrument, designed using a Likert-type scale from 0 to 5:
    a) On behalf of the singer. Copy for the participant (Annex 1)
    b) On the part of the expert judge. Expert evaluator's copy (Annex 2)

Previously, the researchers who designed MISE trained the three expert judges on the Likert scale, who independently and simultaneously evaluated all the participants.

4. MI elicitation associated with the vocal exercise: an expert judge gives a verbal command to the learner.
5. Repetition of the vocal exercise by the singer (Post-Test).
6. Second assessment of the performance level of the vocal exercise using the MISE instrument.
    a) On behalf of the singer. Copy for the participant (Annex 1)
    b) On the part of the expert. Expert evaluator's copy (Annex 2)
7. Singer's self-assessment of the changes experienced while using MI through a brief written description.

This process was repeated for each vocal exercise with an estimated administration time of 20-30 minutes.

Table 2 describes the vocal exercises and the MIs associated with each aspect, which fall into different sensory (visual and tactile) and motor categories.

Insert here Table 2

2.3 Ethical issues

The purpose of the research was explained to all participants, after which they were asked to give their verbal informed consent to take part in the study and for the treatment of the data, following

current legislation on personal data protection. The data were stored in an anonymous database, with the assignment of a registration number so that it was not possible to identify the participants. All data, both in physical and digital format, were kept by the research team. Furthermore, the research has followed the Declaration of Helsinki (World Medical Association, 2013) in its design and implementation.

3. Results

3.1. Evaluation rubric

The MISE methodology was validated in terms of content validity (Aera, APA 1999; Eignor, 2013). An evaluation rubric was designed to ascertain the content validity, representativeness, and appropriateness of the MIs.

The quality and consistency of the questionnaire were rated very positively by seven professionals/experts, with mean scores exceeding 3.57 points and standard deviations of less than one point. Thus, the overall quality reached 4.62 points, and the adequacy of the MIs for the aspects studied was 4.45 points (Table 3).

Insert here Table 3

3.2. Sample profile

The sample consisted of 55 singers who were Bachelor's (20%), Master's (36%), or Expert (44%) students with an average age of 27.3 years (age range 21-40 years).

In the sample, all the participants have studied music, 19 (34.5%) have studied singing (official or not); 13 (23.6%) have completed official singing studies and 40 (72.7%) have obtained an official music degree in another instrument (other than singing) and 53 (96.3%) reported playing an instrument.

60% were women (28 sopranos and five mezzo-sopranos), and 40% were men (10 tenors, 9 baritones, and 3 basses) of various nationalities, and all were members of choirs/vocal ensembles. In addition, the group of experts had extensive professional experience as soloists (Table 4).

Insert here Table 4

3.3. MISE Instrument

We studied the validity and reliability of singing assessment. As we expect that MISE method provides a significant improvement, we have tested whether self-improvement and improvement scores match between evaluators. We calculated the interclass correlation coefficients (ICC-absolute agreement) to determine the inter-rater reliability. This also allowed us to explore the credibility and validity of the self-evaluation by comparing the agreement with the expert judges´ evaluations.
ICC output values above 0.7 suggested an acceptable agreement among participants and expert judges, indicating than evaluators provided close ratings, except for breathing category with ICC reaching 0.695, near to this threshold (Table 5).

Insert here Table 5

Next, we analyzed the scores achieved by the participants and the evaluations made by the expert judges.

Concerning subjective self-perception/evaluation, the scores obtained by the sample of singers participating in the study are shown in Tables 6 and 7. The singers showed initial mean scores below 2 points in all aspects except for breathing. However, after the use/introduction of the MISE, the mean scores were around 3 points and reached 3.70 points for Resonance (Table 6).

Insert here Table 6

Concerning the objective scores given by the expert judges proposing and evaluating the task, the mean scores were slightly lower (Table 7).

Insert here Table 7

Perceptions given in the Singer's self-assessment of the changes experienced while using MI through a brief written description, were analyzed. The responses were subjected to a categorization process (Zhang et al., 2014). In order to unify and standardize the information, similarity measures were used, according to criteria of lexical proximity and/or synonymy. Perceptions were re-stated in one of the following forms: Improved physical sensation; Improved sound; Overall improvement; No improvement; Other. Results mainly showed a notable improvement in physical sensation and sound, although in support and flexibility 21.2% declared that they did not feel improvement after the introduction of the MI (Table 8).

Insert here Table 8

3.4. Improvement

To determine the influence of an individual training session with MISE on improving the five proposed vocal aspects (O1), we considered subjective and objective dimensions, i.e., the levels of self-perceived improvement made by the individual and the levels of improvement considered by the expert judges.

When the MIs were introduced, the levels of self-perceived improvement reached mean values between 1.11 and 1.95 points. The expert judges assessed these levels of improvement, awarding mean values ranging between 1.16 and 2.02, showing similar variability in their criteria among categories (Table 9).

The distribution of "improvement" was considered normal (Kolmogorov-Smirnov test, $p>0.05$), and we used parametric methods for comparisons. In all cases, there were significant differences in the mean values of the pre and post test in favor of the scores after the MISE (t-Student, $p<0.05$).

We studied these differences in detail and found that self-perceived improvement and improvement perceived by the expert judges were significantly higher than one point (t-Student Ho: $\mu \leq 1$, $p<0.05$), except in 1- *Breathing* given by expert judges, where no significant evidence of improvement above than one point was found ($p=0.14>0.05$).

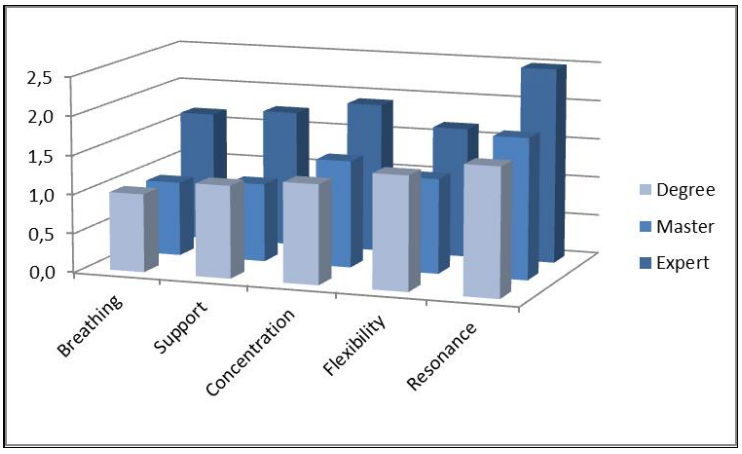
Insert here Table 9

There were no significant sex differences in the self-perceived improvement reported by the participants (Mann-Whitney U, $p>0.05$).

Concerning levels of expertise (O2), there were significant differences in self-perceived improvement in Breathing and Resonance (Kruskal-Wallis test, $p<0.05$), with the source of this difference being the group of expert participants (Figure 1).

Figure 1.

Self-perceived improvement: mean levels.



Finally, to give response to the O3 objective, first we analyzed whether the level of executive functions favored the use of MI in the teaching of singing, and second, we assessed whether there were significant differences according to the level of cognitive capacity, for the group of expert students.

The results obtained through the MISE instrument revealed self-perceived improvement levels above 1.5 points (Table 10). It should be noted that, after the use/introduction of the MI, the students reported mean levels of self-perceived improvement in Concentration and Resonance, with scores of 1.92 and 2.50 points, respectively. Thus, the expert judges perceived the improvement with greater homogeneity.

Insert here Table 10

After the analysis and correction of the three neuropsychological instruments/tests, the main descriptive measures obtained by the participants were calculated (Table 1A - Appendix 3), along with the correlation between the neuropsychological variables of the Wisconsin test that were of interest for our study (Table 2A - Appendix 3). Again, no statistically significant inter-questionnaire correlations were found, confirming that they evaluate executive processes of a different nature.

According to Raven's test scores, capacity was enhanced in 50% of the participants, although no significant differences in improvement as a function of capacity were found (Mann-Whitney U test, $p>0.05$).

Next, the correlation was analyzed between various executive aspects, measured through neuropsychological tests, and self-perceived improvement in "singing", quantified through the MISE instrument (Table 11).

Insert here Table 11

A moderate negative correlation was found between WAIS-IV Similarities and improvement in Breathing, Concentration, and Flexibility. The presence of negative correlations indicates that, the lower the score on the WAIS Similarities test, the greater the perceived improvement with the use of MI. Overall, we found no significant correlations between the various parameters considered in the Wisconsin Test (Table 11).

4. Discussion

After analyzing the results, we observed that the MISE instrument has high content validity. The evaluation rubric used by professional experts indicates that our instrument has outstanding quality and reliability. We have confirmed that the instrument provides an adequate evaluation of the five vocal aspects considered, being especially useful for the items related to concentration, flexibility, and resonance. In addition, the experts rated very positively the adequacy of the MIs for the aspects studied.

The sample, although limited in number, is highly representative. It is characterized by a high level of education, musical training, and extensive vocal experience in choral ensembles. The sample represents the various maturing processes of the singer's voice (wide age range), the different technical levels of vocal performance (from people with no formal education and little experience in singing to experts with high levels of training and experience as professional soloists), and the main vocal types for both sexes (although this was not homogeneous, reflecting real-life circumstances with a greater frequency of sopranos and tenors compared with bass voices).

The MISE method, using MI, provides a reliable and consistent measure of overall vocal quality by analyzing, through student self-perception, the main aspects of the singing voice: breathing, support, phonation, flexibility, and resonance. This makes it an innovative strategy for communication between the teacher and the singer. This is also the first didactic methodology with a dual utility. On the one hand, it provides the teacher with an objective tool to evaluate and train the singing voice, and, on the other hand, it allows the students to carry out self-evaluation and self-management of their learning.

Our results showed that, following administration of MI, there was a significant improvement of more than 1 point in the self-perceived ratings of the singers in the five aspects evaluated by the MISE method, particularly resonance. Moreover, a reasonable level of improvement was also observed in terms of the objective ratings given by the expert judges.

Currently, there is little research on the application of MI in singers. Keller (2012) analyzed the role of mental images in musical performance, although not specifically for singing, an area studied in depth by DeSantis, Deck and Hall (2021). Also, it is revealing the recent research by DeSantis, Deck, Hall and Holand (2022), that determineds that professional singers do not use imagery more than singing students. However, the authors conclude that women singers can use images for characterization to a greater extent than men.

Merzero-Moreno, Laucirica, and Ordoñana (2018) proposed the use of visual imagery as a didactic resource in the singing classroom and demonstrated that these can improve the quality of the teaching-learning process. We consider that MIs have an added value. Visual images require only the perception and recognition of the image. At the same time, MIs, after verbal instruction, are generated by the students themselves from previous experiences, setting in motion complex cognitive processes, mainly of the executive type. In addition, generating an MI may evoke a visual experience along with a proprioceptive or kinesthetic one, thus creating a more complex sensory experience.

Concerning the neuropsychological results, after analyzing the Raven's Progressive Matrices Test-APM scale, we found, as expected, that cognitive capacity was outstanding in 50% of the participants. However, we did not find significant differences in the improvement produced in singing when using MI according to this capacity.

We have observed a moderate negative correlation between the scores obtained on the WAIS-IV battery Similarities subtask and self-perceived improvement in the Concentration and Flexibility (MISE) aspects. Those students who, after the administration of MI, improved their vocal performance were those who obtained lower scores on this test of verbal reasoning and abstraction. We postulate, therefore, that these results could be because both tasks involve the implementation of cognitive processes of a substantially different nature; the creation of MIs is a visual process, while the performance of concept abstraction in the WAIS-IV subtask is verbal.

Globally, we also found no significant correlations between the various neuropsychological variables analyzed using the Wisconsin Card Sorting Test and self-perceived improvement (MISE).

5. **Conclusions**

It is evident that the introduction of MI through the MISE method produces beneficial effects in teaching and learning vocal techniques, regardless of the starting level of performance. In addition, this method provides a great deal of relevant information on aspects of vocal technique, is easy to administer, and requires relatively little time to complete (20-30 minutes). All this makes it an effective educational resource, formalizing a language of communication that until now has been used intuitively in the singing classroom, facilitating both the teaching process, and enabling the student's self-learning.

One of the main limitations of our study is the small sample size. This is due, mainly, to the fact that the expert students had to have a high qualification at the vocal level. In addition, in this group the selection of participants was not done randomly but using an artistic/training curriculum and audition (audiovisual recording of an opera aria of their choice) by three expert judges. We are aware that the Likert-type rating scale has a strong subjective component. To solve this possible problem, we analyzed the degree of concordance between the scores awarded by expert judges and participants, since our study aimed to quantify the degree of improvement in the five technical parameters proposed, rather than assess the level achieved.

In future research, it is intended to apply the MISE method and continue evaluating its effectiveness by expanding the study sample, as well as replicating this research with professionals of the non-singing voice and vocal rehabilitation to study the improvement that the MISE method produces in these cases. In addition, given that from a neuropsychological standpoint, the results were inconclusive and we recommend increasing the battery of neuropsychological tests administered to assess other cognitive processes of an executive nature. Additionally, it would be of special interest to extend the study in order to analyze the perceptions declared by the participants, applying qualitative methods (content analysis) and network visualization to display the relationships among them.

Author Contributions:

Conceptualization M.C.M-V, C.S-Z and F.J.C-C; Formal Analysis R.F-P; Methodology, R.F-P; Supervision, M.C.M-V, C.S-Z and M.V-T; Writing – original draft M.C.M-V, C.S-Z, R.F-P and F.J.C-C; Writing – review & editing M.C.M-V, C.S-Z , R.F-P and M.V-T.
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TABLES AND FIGURES

Table 1.

Aspects of vocal technique that are trained and evaluated with the MISE method.

	AREA OF VOCAL TECHNIQUE	ASPECTS WORKED ON USING THE MISE METHOD
Aspect 1	Breathing in singing	Continuity in the breath
Aspect 2	Voice support	The activation level of the musculature involved in breathing.
Aspect 3	The concentration of sound in phonation	Adequate closure of the vocal cords for sound production
Aspect 4	Voice flexibility	Ease of voice conduction without loss of sound characteristics
Aspect 5	Resonance	Sound vibration on the hard palate

Table 2.

MI and vocal exercises included in the MISE Method.

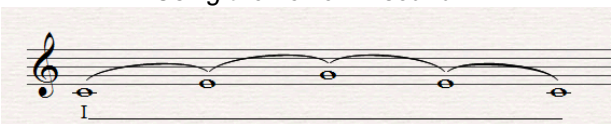
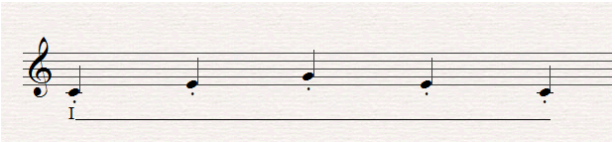
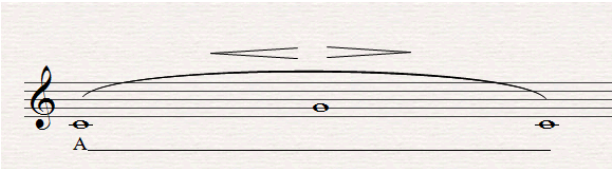
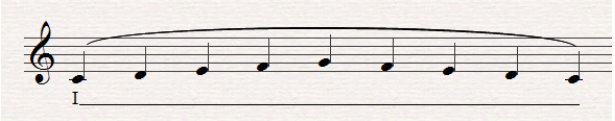
ASPECT OF VOCAL TECHNIQUE	MENTAL IMAGE	VOCAL EXERCISE
Continuity in the breath. Breathing	Making large soap bubbles.	*Fifths with third jumps by performing portamentos. Using the vowel "I" sound* 
The activation level of the musculature involved in breathing. Voice support	Slowly emptying a large syringe filled with fluid.	*Slurred fifths with third jumps. Using the vowel "a" sound.* 
Adequate closure of the vocal cords for sound production. The concentration of sound in phonation	Picking something up with precision tweezers.	*Fifths with third jumps exercise Using the vowel "I "sound.* 
Ease of voice conduction without loss of sound characteristics. Voice flexibility	Slowly tightening and untightening a rubber band	*Fifths exercise performing a messa di voce With the vowel "a" sound.* 
Sound vibration in the hard palate. Resonance	Injecting fluid into the front of the hard palate.	*Fifth range exercises (scale step) With the vowel "I" sound.* 

Table 3.

Evaluation rubric used by professionals/experts.

ASPECT	UTILITY OF THE ITEM	ADEQUACY OF THE IMAGE FOR THE ASPECT
1. *Breathing*	4.57	4.43
2. *Support*	3.57	3.57
3. *Concentration*	5	4.86
4. *Flexibility*	5	4.57
5. *Resonance*	5	4.86
Global	**4.62**	**4.45**

Table 4.

Professional experience.

CATEGORY	EXPERIENCE (YEARS)			
	Soloist	%	Choir/ vocal ensemble	%
Expert	1	8	1	36
	2	33	2	27
	3	25	3	9
	4	17	5	9
	5	17	More than 5	18
		100%		100%
Master's Degree	None	90	From 1 to 3	55
	Less than 5	5	4	25
	10 or more	5	5 or more	20
		100%		100%
Grade	None	100	None	33
			From 1 to 3	33
			From 4 to 15	17
			More than 15	17
				100%

Table 5.

Interclass correlation coefficients of improvement by the MISE.

Category	ICC	Sig.
1. *Breathing*	0.695	0.004
2. *Support*	0.708	0.011
3. *Concentration*	0.755	0.009
4. *Flexibility*	0.775	0.000
5. *Resonance*	0.783	0.000

Table 6.

Singer's perception before and after introducing the MISE.

PRETEST					POSTEST				
Aspect	Mean	Standard deviation.	Min	Max	Aspect	Mean	Standard deviation.	Min	Max
1. *Breathing*	2.02	0.938	1	4	**1. *Breathing***	3.12	0.98	1	5
2. *Support*	1.72	1.054	0	3	**2. *Support***	2.98	1.30	1	5
3. *Concentration*	1.74	1.061	0	4	**3. *Concentration***	3.26	1.00	1	5
4. *Flexibility*	1.71	1.235	0	5	**4. *Flexibility***	3.05	1.21	1	5
5. *Resonance*	1.74	0.938	0	3	**5. *Resonance***	3.70	1.10	3	5

Table 7.

Expert judges´ assessment before and after introducing the mental images.

PRETEST					POSTEST				
Aspect	Mean	Standard deviation.	Min	Max	Aspect	Mean	Standard deviation.	Min	Max
1. *Breathing*	1.44	1.05	0	4	**1. *Breathing***	2.60	1.40	1	5
2. *Support*	1.02	1.12	0	4	**2. *Support***	2.49	1.43	1	5
3. *Concentration*	1.56	1.18	1	5	**3. *Concentration***	3.07	1.29	1	5
4. *Flexibility*	1.49	0.98	0	3	**4. *Flexibility***	2.88	1.23	1	5
5. *Resonance*	1.33	1.04	0	4	**5. *Resonance***	3.35	1.32	2	5

Table 8.

Singer's perceptions.

	1. *Breathing*	2. *Support*	3. *Concentration*	4. *Flexibility*	5. *Resonance*
Physical sense improvement	54.5	30.3	42.4	36.4	51.5
Sound improvement	18.2	39.4	48.5	30.3	36.4
General improvement	18.2	6.1	--*	9.1	9.1
No improvement	9.1	21.2	6.1	21.2	3.0
Others	--*	3.0	3.0	3.0	--*

Table 9.

Overall descriptive results of the improvement obtained: Subjective and objective dimensions.

SELF-PERCEIVED IMPROVEMENT			IMPROVEMENT-EXPERT JUDGES		
Aspect	Mean	Standard deviation.	Aspect	Mean	Standard deviation.
1. *Breathing*	1.16	0.61	**1. *Breathing***	1.16	0.97
2. *Support*	1.25	0.90	**2. *Support***	1.46	0.82
3.*Concentration*	1.50	0.83	**3. *Concentration***	1.55	0.88
4. *Flexibility*	1.40	1.06	**4. *Flexibility***	1.41	0.95
5. *Resonance*	1.95	0.81	**5. *Resonance***	2.02	0.91

Table 10.

Self-perceived and objective improvement scores in the expert group of students.

SELF-PERCEIVED IMPROVEMENT					EXPERT-IMPROVEMENT				
Aspect	Mean	Standard deviation.	Min	Max	Aspect	Mean	Standard deviation.	Min	Max
1. *Breathing*	1.67	0.49	1	2	**1. *Breathing***	1.83	0.72	0	3
2. *Support*	1.75	1.14	0	4	**2. *Support***	1.67	0.89	0	3
3.*Concentration*	1.92	1.16	0	4	**3.*Concentration***	1.58	0.98	0	4
4. *Flexibility*	1.50	1.62	0	4	**4. *Flexibility***	1.92	0.79	1	3
5. *Resonance*	2.50	0.79	2	4	**5. *Resonance***	1.92	0.99	0	4

Table 11.

Correlations (R2) between the neuropsychological variables considered and self-perceived improvement in the five aspects of the singing voice.

NEUROPSYCHOLOGICAL VARIABLES		BREATHING	SUPPORT	CONCENTRATION	FLEXIBILITY	RESONANCE
Similarities DS (WAIS-III)	**R2**	-.572*	-.289	-.611*	-.501*	.235
	Sig.	(.036)	(.389)	(.046)	(.016)	(.486)
No. attempts applied DS (WCST)	**R2**	-.368	-.243	.122	-.160	-.142
	Sig.	(.239)	(.448)	(.705)	(.620)	(.659)
Perseverative responses DS (WCST)	**R2**	-.523	-.244	-.061	-.419	-.287
	Sig.	(.081)	(.444)	(.851)	(.176)	(.366)
Perseverative errors DS (WCST)	**R2**	-.493	-.254	-.070	-.383	-.277
	Sig.	(.104)	(.426)	(.828)	(.218)	(.383)
No. of categories completed DS (WCST)	**R2**	.426	.208	.248	.403	.197
	Sig.	(.167)	(.518)	(.437)	(.194)	(.539)
Learning to learn DS (WCST)	**R2**	.330	.067	.179	.312	.344
	Sig.	(.294)	(.836)	(.578)	(.323)	(.273)

Note: DS: direct score; * Correlation is significant at the 0.05 level; WCST-Wisconsin Card Sorting Test.