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PERCEPTUAL AND ACOUSTIC ANALYSIS OF BRAZILIAN ACTRESSES' VOICES
ANÁLISIS PERCEPTIVO Y ACÚSTICO DE LAS VOCES DE LAS ACTRICES BRASILEÑAS

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Abstract

Purpose: The present study aimed to compare actresses' and non-actresses' voices through perceptual and acoustic analysis and also to determine possible correlations between variables. Special attention was given to the identification of the actor's formant (AF). **Method:** Thirty actresses and thirty non-actresses participated as subjects. All participants were recorded reading at their habitual loudness level from a 200-word reading task. The acoustical variables obtained through the Longer Term Average Spectrum (LTAS) analysis included: (1) equivalent sound level (L*eq*), (2) speaking fundamental frequency (SFF), (3) alpha ratio, (4) level difference between the F1 and F0 regions (L1 - L0) and (5) energy level of 30 spectral points separated by 160 Hz. Voice samples from both groups were perceptually assessed by five external raters. A total of 70 voice samples were evaluated: 30 actresses, 30 non-actresses and 10 repeated samples in order to assess the intra-rater concordance. Perceptual variables were: (1) pitch, (2) vocal extension, (3) loudness, (4) sonority, (5) breathiness, (6) hyper and hypofunctional voice production, (7) articulation and (8) overall voice quality. **Results:** Actresses' voices were perceived to be lower, louder and more sonorous, with more vocal extention, better articulation, and better overall quality. There were no significant differences for hypofunction and breathiness. With the exception of SFF, which was significantly lower for actresses, no differences between groups were demonstrated for acoustic parameters. Furthermore, acoustic parameters did not correlate with perceptual variables. No evidence of the AF in actresses' spectrums was found. **Conclusion:** While Perceptual analysis depicted differences in voice quality between actresses and non-actresses, there were no differences between these groups demonstrated for acoustic variables, including no evidence of the *AF* in actresses' spectrums. Perceptual and acoustic parameter correlations were also not found.

Keywords: Actors, Actresses, Voice quality, Voice training, LTAS, Perceptual analysis.

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Resumen

Propósito: El propósito del presente estudio fue comparar voces de actrices y personas sin entrenamiento vocal a través de análisis perceptual y acústico, así como también determinar posibles correlaciones entre las variables. Especial atención fue puesta en la identificación del formante del actor. **Métodos:** Se incluyeron treinta actrices y treinta personas de género femenino sin entrenamiento vocal. Se realizó grabación de las voces de todas las participantes mientras leyeron un texto de 200 palabras en un nivel de intensidad conversacional. La variables acústicas obtenidas a través de Espectro promedio a largo plazo fueron: (1) nivel de sonido equivalente, (2) frecuencia de habla conversacional, (3) proporción alfa, (4) diferencia de energía de las zonas de F1 y F0 y (5) nivel de energía de 30 puntos espectrales separados por 160 Hz. Las muestras de voz de ambos grupos fueron analizadas perceptualmente 5 jueces externos. Un total de 70 muestras fueron evaluadas: 30 actrices, 30 personas no entrenadas vocalmente y 10 muestras repetidas para evaluar la concordancia entre los jueces. Las variables perceptuales fueron: (1) tono, (2) extensión vocal, (3) sonoridad, (4) cualidad de voz resonante, (5) cualidad de voz soplada, (6) percepción de tensión muscular, (7) articulación and (8) cualidad general de la voz. **Results:** La voz de las actrices fueron percibidas más bajas en tono, altas en sonoridad, con mayor extensión tonal, mejor articulación y mejor cualidad vocal general. No se encontraron diferencias significativas para la cualidad de voz soplada y percepción de tensión muscular. Con excepción de la frecuencia de habla conversacional, la cual fue significativamente más baja en las actrices, no hubo diferencias entre los grupos para en las variables acústicas. Además, las variables acústicas no correlacionaron con las perceptuales. No se encontró evidencia de la presencia del formante del actor en las actrices. **Conclusión:** A pesar que el análisis perceptual mostró diferencias en la cualidad vocal entre las voces de las actrices y personas sin entrenamiento vocal, no hubo diferencias entre estos grupos para las variables acústicas, incluyendo la carencia del formante del actor en las voces de las actrices. Tampoco se encontraron correlaciones entre las variables acústicas de perceptuales.

Palabras clave: Actores, actrices, cualidad vocal, entrenamiento vocal, LTAS, análisis perceptual.

INTRODUCTION

Since the 1980s, research regarding the actor's voice has been intensified. Studies have been addressed mainly through acoustic and auditory-perceptual analysis of the voice. One of the most common acoustic tools to study the actor's voices has been the Long Term Average Spectrum (LTAS), which is extensively used to assess the so called actor's formant (AF). The AF is defined as a spectral peak around 3.5 kHz which is considered a differentiating feature of good voice quality (Leino, 1993). Leino reported that poor voice quality is different from good voice quality by the steepest spectral slope and suggests that the spectral slope declination has perceptual relevance in the evaluation of voice quality (Leino, 1993). A gentle spectral slope and a prominent peak at 3 kHz and 4 kHz appear to be a few of the main features which characterize a good speaking voice (Leino, 1993; Master, Biase, Pedrosa & Chiari, 2006; Nawka, Anders, Cebulla, & Zurakowski, 2002; Munro, 2002; Pinczower, & Oates, 2005; Bele, 2006; Leino, 2009; Leino, Laukkanen, & Radolf, 2011; Master, De Biase, Chiari, & Laukkanen, 2008). The AF has been found in some American and European actors to be a spectral prominence of approximately at 3.5 Hz (Leino, 1993; Bele, 2006; Leino, 2009; Leino, Laukkanen, & Radolf, 2011). Brazilian actors have demonstrated similar results. Master et al. aimed to compare actors' and non-actors' voices, the actor's voice showed a smaller difference between low and high harmonics of the spectrum (less spectral tilt), stronger energy level of the AF range, and a higher degree of perceived projection (Master, De Biase, Chiari, & Laukkanen, 2008).

The AF is explained physiologically as a resonance phenomenon. Nolan (1983) suggested that the actor's formant is accomplished in the same way as the singer's formant according to Sundberg (1974). When the cross-sectional area in the pharynx is at least six times wider the laryngeal tube opening, the epilarynx acts as an independent resonator. Therefore, an extra formant is added to the vocal tract transfer function (the singer's formant). According to Sundberg (1974), the lowering of the larynx, typical of male classical singing, seems to explain the ratio between the cross-sectional area of the low pharynx and epilaryngeal tube opening. However, a low vertical laryngeal position is not necessarily desirable in the actor's voice technique. To this regard, earlier studies have demonstrated the presence of a spectral prominence in speaking voice samples to be around 3500 Hz without lowering the larynx. In a magnetic resonance imaging (MRI) and acoustic study, Laukkanen, Horáček, Krupa, & Švec (2012). found that following vocal exercises using artificial lengthening of the vocal tract in a female subject with a background in speaking voice training, the ratio of the transversal area of the lower pharynx over that of the epilarynx increased. Moreover, acoustic changes showed more energy in the speaker's formant cluster region. Additionally, the distances between the formant frequencies of F3 and F4 and F4 and F5 decreased. Similar MRI and acoustic findings were observed in another study designed to identify acoustic changes in voice production following a warm-up of two professional voice users (Laukkanen, Horáček, & Havlík; 2012). Furthermore, in a study designed to investigate the origin of the speaker's formant, authors found that after voice exercises performed by a professional male actor, the strong spectral peak at 3.5 kHz was present in all vowels, and formed by the clustering of F4 and F5. The results of computer modeling from the same investigation suggested that a speaker's formant could be obtained through a slight narrowing of the epilaryngeal region, widening of oral pharynx and narrowing of the front part of it (Leino, Laukkanen, & Radolf, 2011). The underlying nature of the AF is still not completely understood and it is the subject of several speculations

Regarding auditory perception of voice, most studies carried out with actors have focused on the perception of voice projection. The vocal needs of actors often require an increased loudness under the sub-optimal acoustic conditions inherent in most theaters. In order to accomplish an increased loudness without producing vocal damage, actors are required to learn how to maximize loudness through technical and expressive exercises. Furthermore, the term "vocal projection" does not necessarily have a specific and clear definition and it usually creates confusion about the exact meaning (Lessac, 1967; Linklater, 1976; Michel, & Willis, 1983; Stanislavski, 1986; Acker, 1987; Raphael, & Scherer, 1987; Munro, Leino, & Wissing, 1996).

Despite the term vocal projection seems to be subjective and inaccurate, a previous study determined acoustic and perceptual differences between comfortably projected voices and the voices with maximum projection in a group of professional actors (Pinczower, & Oates; 2005). Results showed that spectral energy differences between stronger and weaker regions (alpha ratio) decreased and the perception of projection increased with as sound pressure level increased. The authors concluded that LTAS can be a useful tool to evaluate voice quality. Based on this finding, it is possible that the AF would be helpful in producing effective vocal projection during acting. This is essential for performers, making it possible for their voices to be heard by listeners with maximum intelligibility and minimum vocal effort.

Besides vocal projection, a large terminology base has been created to perceptually describe both normal and pathological voices. Moreover, different systems to perceptually assess the quality of voice have been developed. However, most perceptual evaluation systems are mainly focused in the evaluation of pathological voices. Bele (2005; 2007) conducted a study to develop a valid method for evaluation of normal to good voice quality. This study investigated both normal and supranormal voices in two groups of professional voice users: teachers and actors. The results indicated a high inter-rater reliability for most perceptual characteristics, specifically for connected speech tasks at habitual loudness levels. The perceptual assessment carried out in the present study is based on Bele's protocol (Bele, 2005).

Since theater actors spend several years training their voices, it would be expected that they would have a proper performing voice technique, which should be reflected in both acoustic and perceptual parameters. In addition, most studies have only used male actors to assess the AF while few have focused on female actors. The present study aimed to compare actresses' voices and non-actresses' voices through auditory perceptual and acoustic analysis in order to see whether there are differences between groups and to establish correlations between variable. Special attention was also paid to the region of the AF to determine differences among the groups. This study is the continuation of an earlier investigation which used Brazilian actresses (Master, De Biase, & Madureira, 2012).

METHODOS

Participants

Thirty actresses and thirty non-actresses were included in this study. To be included in the study, participants had to be a native Brazilian Portuguese speaker in the age range of 18-50 years with no current or past history of voice disorder. The actress group had to have at least five years of theater acting experience along with at least one year of formal vocal training. The non-actress group could not be a professional voice user or have had any formal singing or speech training.

Recordings

Audio recordings of both groups were taken during a reading task of a 200-word text (approximately 1.5 minutes in duration). All participants read at their habitual loudness level. The participants were recorded in an acoustically treated booth, with an ambient noise level below 30 dB. For the recording, a Marantz PMD-671 Solid State Recorder (Marantz, USA) and microphone headset AKH C420L (AKG, AUT), positioned at a distance of 8 cm from the mouth was used. The calibration of sound pressure measures was performed by means of a sound level meter Minipa MSL 1351C (Minipa, Brazil) and a sound generator Korg GA-30 (Korg, Brazil). At the end of each recording, a 220 Hz reference sound was emitted at a distance of 8 cm from the recorder.

Acoustic analysis

In the LTAS window, the acoustical variables measured were the equivalent sound level (Leq), the speaking fundamental frequency (SFF), the alpha ratio (the level difference between 50-1000 Hz and 1–5 kHz), the level difference between the F1 and F0 regions (L1 - L0 - level difference between 300–800 Hz and 50–300 Hz), and the energy level of 30 spectral points separated by 160 Hz. Special attention was given to the amplitude of the harmonics lying in the AF region ranging from 2.8kHz to 3.5kHz. All acoustic variables were obtained using the software Praat (v.5.1.12). The analyzed spectral frequency had an extension of 0–5kHz and a 160Hz bandwidth. Hanning window with time resolution of 25 Hz was used. LTAS analysis was performed after all pauses and voiceless sounds were excluded by the software Praat. All spectrums were normalized (i.e., the strongest component of the abscise axis, SFF and F1, were set at zero.

Auditory-perceptual assessment

Voice samples from both actresses and non actresses were recorded on a CD and perceptually assessed by five external raters using a 100 mm analogue scale. The blinded raters were speech language pathologists with more than five years of experience working with professional voice users. The order of recordings was randomized. A total of 70 voice samples were evaluated: 30 from actresses, 30 from non-actresses and 10 repeated samples in order to assess the intra-rater concordance. The auditory-perceptual analysis was carried out using an adaptation of the Bele's protocol which perceptually assessed actors' and teachers' voices (Bele, 2005, 2007).

The perceptual variables were defined as follows:

Pitch: The chief auditory correlate of fundamental frequency.

Vocal range: The range at which the fundamental frequency varies during running speech; intonation range.

Sonority: The extent to which the voice sounds resonant. A sonorous voice shows rich overtones in its spectrum.

Loudness: The chief auditory correlate of sound pressure level of speech.

Clarity of Articulation: In distinct articulation, the various speech sounds should be clearly identified. This requires that the articulators make sufficiently large movements in precise time and, if needed, strong articulatory contacts.

Breathiness: Audible noise created at the glottis due to insufficient closure at some point of the vocal folds upon phonation.

Hyperfunctional/Pressed Voice Production: The voice sounds strained as if the vocal folds are compressed during phonation; voice production with great laryngeal effort. This may be due to air pulses through the glottis having a low amplitude and the phase of minimum flow is long.

Hypofunctional/lax voice production: Opposite to hyperfunction, insufficient vocal fold adduction, produced with low laryngeal effort, resulting in a weak, slack and nonsonorous voice. The airflow pulse is rounded, and the phase of minimum flow is short.

Overall voice quality: general perception of voice quality.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS, v.13.0) (IBM SPSS Statistics, Armonk, NY). Data was compared, described, and correlated using *t*-test for unpaired samples and Pearson's correlation coefficient. Crombach's Alpha was performed to assess the inter-rater concordance for each auditory perceptual parameter and a significance level of >0.600 was used. Intra-rater concordance was performed using Pearson's correlation coefficient. A p-value < 0.05 was considered to be statistically significant for the *t*-test and Pearson's correlation coefficient.

The present study was approved by the research ethics committee of Univ Estadual Paulista (UNIFESP) process number 067/2007. Informed written consent was obtained from each participant of this study.

RESULTS

Acoustical analysis

A summary some of the acoustic measurements obtained for actresses' and non- actresses' voices are depicted in Table 1 and Figure 1. There were no significant differences between groups for L*eq*, Alpha Ratio and L1-L0. A significant difference was found for SFF with actresses presenting lower values then non-actresses.

Table 2 shows the mean, standard deviation and *p*-value for the comparison of the energy level of the thirty spectral points measured in the LTAS window. No significant differences in energy level were found across the spectral points, including the region of the AF ranging from 2.8 kHz to 3.5 kHz.

Perceptual analysis

The intra-rater concordance from the 10 repeated samples showed a high level of agreement among raters. A Pearson's correlation coefficient between 0.684-0.951 was obtained. Through Crombach's Alpha, inter-rater concordance was obtained for all perceptual parameters, except for hypertension. Therefore, this parameter was excluded from the analysis. The highest level of concordance was found for loudness, followed by overall voice quality, pitch, vocal range, clarity of articulation, sonority, hypofunction and breathiness (Table 3).

Results of the auditory-perceptual parameters for actresses and non-actresses are displayed in Table 4. Each parameter is listed in descending order of the mean. Excluding pitch in non-actresses, both groups showed the same ranking order. For both actresses and non-actresses, breathiness and hypotension obtained the lowest mean values.

Actresses showed statistically significant higher values for overall voice quality (p = 0.00), sonority (p = 0.00), loudness (p=0.012), vocal range (p=0.00), and articulation (p=0.00). Pitch demonstrated significantly lower values for actresses (p=0.028). Therefore, actresses' voices were perceived to be lower, louder, and more resonant, with more vocal extension, better articulation, and better overall quality. There were no significant differences found for the hypofunction and breathiness parameters.

Considering all participants together, positive correlations were found between voice quality and the variables of sonority (PC=0.879, p=0.00), vocal range (PC=0.793, p=0.00), articulation (PC=0.790, p=0.00) and loudness (PC=0.637, p=0.00). Moreover, loudness demonstrated a positive correlation with sonority (PC=0.735, p=0.00) and extension (PC=0.610, p=0.00). No significant correlations were found among the acoustic analysis parameters. No correlations were observed between perceptual and acoustic variables.

DISCUSSION

Acoustic analysis showed no significant differences in voice quality between actresses and non- actresses for alpha ratio. This lack of difference implies that the spectral tilt of actresses's voices does not differ from the spectral tilt of non actresses' voices. Furthermore, the energy level of the actor's formant region (3-4 kHz), obtained from the analyzed 30 spectral points, also did not show differences. Therefore, it is reasonable to assume that the actor's formant is not present in the LTAS of the actress's voice. There are few studies that provide information on female voices with conflicting results among them (Acker, 1987; Master, De Biase, & Madureira, 2012; Leino, 2009). Acoustic analysis from female American actresses' voices indicated the presence of a great concentration of energy in the frequency of 3.6 kHz during phonation with "ring" present in the voice. According to the authors, this is almost 700 Hz above the "actor's formant" in the spectrum of male voices (Acker, 1987).

Leino found a spectral peak at around 4.3 kHz in a group of Finnish actresses through LTAS analysis. Moreover, there was significant correlation between perceptual evaluation of good voice quality and the peak's amplitude (Leino, 2009). The AF in female subjects has also been found after vocal exercises. Two recent studies performed with MRI and acoustic analysis showed that the vowels recorded after vocal exercises produced a clustering of the upper formants and an increase in sound pressure level (SPL) within the range of 2 – 4 kHz (Laukkanen, Horáček, Krupa, & Švec, 2012; Laukkanen, Horáček, & Havlík; 2012). Furthermore, another study carried out using computer tomography and acoustic analysis, found similar results in a female speaker (Vampola, Laukkanen, Horáček, & Švec, 2011).

Given that no differences were found between groups for the spectral slope declination, one would also expect no differences in the perception of sonority. However, this perceptual parameter was significantly higher for trained vs. untrained female voices. Recall that sonority was defined in the present study as a resonant voice quality with rich overtones in its spectrum. A resonant voice has been described as a voice that projects well (Titze, 2001) and has greater harmonic content in the higher portion of the spectrum (Raphael, & Scherer, 1987). Resonant voice may be the result of not only resonance adjustments (i.e., vocal tract changes), but also changes in mode of phonation at the laryngeal level (i.e., amount of laryngeal adduction). A barely abducted or a barely adducted laryngeal configuration may be more favorable producing a resonant voice (Verdolini, Druker, Palmer, & Samawi, 1998). Specifically, barely abducted vocal folds have been proposed to produce maximum "vocal economy" defined as the maximized ratio between voice output (dB) and intraglottal impact stress (kPa) under constant subglottic pressure and frequency conditions (Berry, Verdolini, Montequin, Hess, Chan, & Titze, 2001; Peterson, Verdolini-Marston, Barkmeier, & Hoffman, 1994). This glottal setting has been found in healthy and vocally trained subjects Verdolini, Druker, Palmer, & Samawi, 1998; Peterson, Verdolini-Marston, Barkmeier, & Hoffman, 1994).

Despite the evidence found in previous studies on glottal adjustment (Leino, 1993; Bele, 2002; Master, De Biase, Chiari, & Laukkanen, 2008), the present study found no differences between groups for the energy level difference between 300–800 Hz and 50–300 Hz (L1-L0), which provides information on the mode of phonation (normal, flow, pressed, whisper and breathy). This level difference has been found to correlate negatively with the perception of breathiness (hypofunctional voice production). Previous works have reported that for voice spectrums with more glottal adduction, L0 (energy of F0) is weak, and for voice spectrums with less glottal adduction, L0 is stronger (Gauffin & Sundberg, 1989). Leino found that L1-L0 difference was on average positive for the good and ordinary voices and negative for the poor voices (Leino, 1993). Bele has also found a greater L1-L0 and stronger sound level in actors compared to teachers (Bele, 2002). Moreover, Guzman et al. reported that L1-L0 is low for emotions that express a breathy voice quality compared to emotions that express more a pressed voice quality (Guzman, Correa, Muñoz, & Mayerhoff, In Press). Given that L1-L0 was equal for both groups in our study, it is unlikely that a glottal adduction difference would explain the perceived more resonant voice quality in actresses. To corroborate this, an electroglottographic analysis with the same subject group was performed by (Master, Guzman, Miranda & Lloyd, 2013) Findings showed no significant differences between groups for contact quotient or closing quotient. It is important to mention that different phonatory tasks were used in the (Master et al., 2013) study compared to this study.

While the sound pressure level (SPL) was not found to be greater in the AF spectral region for actresses, a significantly higher degree of overall voice quality was found in trained vs. untrained participants. Given that voice quality and degree of voice training has been noted in previous studies to be strongly related to the SPL of the AF (Leino, 2009; Laukkanen, Järvinen, Artkoski, Waaramaa-Mäki-Kulmala, Kankare, Sippola & Salo, 2004), it is suitable to speculate that other parameters besides the AF should have contributed to our result. Leino (1993) observed that there are voices with little energy within the higher frequency region and yet still evaluated as good quality voices. Thus, it seems that neither a great alpha ratio nor a prominent actor's formant is an absolute requirement of a good voice. In the present study, actresses' voices were perceived to be lower, louder, and more resonant, with more vocal extension, better articulation, and better overall quality. Additionally, a positive correlation was found between voice quality and sonority, vocal range, articulation and loudness. Hence, vocal features other than a resonant voice containing an AF, may affect the perception of voice quality.

Another acoustic parameter that does not appear to be in line with perceptual outcomes is the equivalent sound level (L*eq*). No differences were found in L*eq* between groups. On the other hand, loudness (the chief auditory correlate of SPL for speech), demonstrated significantly higher values for trained participants. Earlier works have reported similar perceptual findings (Master, De Biase, Chiari, & Laukkanen, 2008). Acker (1987) in a study with male subjects, the degree of loudness and vocal projection were found to be higher in actors than non actors (Master, De Biase, Chiari, & Laukkanen, 2008). However, authors reported no significant differences in the overall SPL between groups for male actors. Therefore, the perceived degree of greater projection and loudness could not be attributed to an overall energy increment. Nevertheless, other factors besides SPL contributed to the perception of loudness and projection. In the same study, differences were found between the groups in terms of relative energy level of the AF with a stronger AF and a higher alpha ratio (less step spectral slope) for the actors. Since greater energy in the higher portion of the spectrum promotes the perception of a louder voice quality, these spectral differences may explain the greater degree of loudness and projection found in the trained voices. In our findings, however, the louder voice perceived in actresses could not be explained by the spectral tilt as neither the alpha ratio nor the spectral energy of the speaker's formant showed differences between groups. Nevertheless, in the perceptual analysis, loudness was positively correlated with the degree of sonority. Moreover, loudness also correlated with vocal range and articulation. Therefore, these three features may also contribute to the degree of perceived loudness.

No differences were demonstrated for the degree of breathiness between groups. Moreover, the degree of breathiness was rated low in both groups. Given that the participants (both actresses and non actresses) had not experienced voice disorders, these results are expected. Similarly, in a study that aimed to compare two projection conditions in actors, the degree of breathiness was evaluated as normal (Pinczower & Oates, 2005). A breathy voice results from incomplete closure of the vocal folds; consequently, the glottis becomes less efficient, and vocal intensity is reduced (Sataloff, 1995). Greater adduction is also necessary to achieve increased vocal power (Matz, 1994). Therefore, as the degree of breathiness showed no differences, no differences should be expected in SPL. In fact, both groups demonstrated the same overall SPL. Furthermore, as mentioned above, no differences for L1-L0 were found in the acoustic analysis which seems coincide with the absence of perceptual differences of breathiness (mode of phonation). Additionally, the hypofunctional voice quality (defined as insufficient vocal fold adduction) did not show differences between groups. Since the degree of breathiness was equal for actresses and non-actresses, the lack of difference in the perceived hypofunctional voice quality would be expected. The degree of perceived breathiness has been associated with more spectral energy between 5 and 8 kHz in previous research studies (Yanagihara, 1967). In an earlier study, L1-L0 was negatively correlated to the energy level difference between 1-5 KHz and 5-8 KHz (Guzman, Correa, Muñoz, & Mayerhoff, In Press). which provides information about noise in the glottal source (i.e., a breathy voice quality). Thus, in the present study, the lack of difference in the degree of perceived breathiness, perceived hypofunctional quality, and L1-L0 seem to be consistent with previous acoustic findings.

The only concordance between acoustic and perceptual parameters in our study was found between SFF and pitch. Both pitch (the chief auditory correlate of fundamental frequency) and SFF demonstrated significantly lower values for actresses. In an earlier study with Brazilian male actors, no differences were found for SFF when compared to non-actors' voices (Master, De Biase, Chiari, & Laukkanen, 2008). Moreover, the perceived vocal projection was negatively correlated with SFF. In the present study, no correlation between these two variables was demonstrated.

CONCLUSION

Voice quality is perceptual in nature which is one of the reasons why auditory-perceptual analysis is considered a gold standard in voice assessment. In the present study, the perceptual analysis differentiated actresses from non-actresses voices. Aside from SFF, which was significantly lower for actresses, no differences between groups were demonstrated for acoustic variables. Furthermore, acoustic parameters did not correlate with perceptual variables and no evidence of the AF in actresses' spectrums was found.

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