Literature Review

https://doi.org/10.1590/2317-6431-2022-2768en

Audiology Communication Research
ISSN 2317-6431

Training for perceptive-auditory voice analysis: scope review

Treinamento para análise perceptivo-auditiva da voz: revisão de escopo

Karoline Evangelista da Silva Paz[1], *Maxsuel Alves Avelino de Paiva*[1], *Daviany Oliveira Lima*[2], *Vanessa Veis Ribeiro*[3], *Ronei Marcos de Moraes*[1], *Leonardo Wanderley Lopes*[1]

ABSTRACT

Purpose: To synthesize the state of scientific knowledge about training for auditory-perceptual voice analysis. **Research strategy:** Question, Concept and Context and combinations of descriptors were formulated for searching in PubMed/Medline, LILACS and SciELO databases. **Selection criteria:** Studies were included with a population composed of listeners with or without experience in auditory-perceptual analysis, which included auditory-perceptual voice analysis, in the context of vocal clinic, using human and/or synthesized voices, with individual or group training. Training method, voices used, training time and whether there was training in central auditory skills were observed. **Results:** It is common to use auditory anchors, feedback, breathy and rough natural voices and training time with a maximum duration of two hours. No study applied the training of central auditory processing skills in training for auditory-perceptual voice assessment. **Conclusion:** There is still no consensus on what is the best training program for auditory-perceptual voice analysis.

Keywords: Voice; Voice disorders; Auditory perceptual; Voice quality; Dysphonia

RESUMO

Objetivo: sintetizar o estado do conhecimento científico sobre treinamento para análise perceptivo-auditiva da voz. **Estratégias de pesquisa:** a estratégia PCC (População, Conceito e Contexto) e combinações de descritores foram utilizadas para busca nas bases de dados PubMed/MEDLINE, LILACS e SciELO. **Critérios de seleção:** foram incluídos estudos com população composta por ouvintes com ou sem experiência na análise perceptivo-auditiva, que incluíssem a análise perceptivo-auditiva da voz, no contexto da clínica vocal, utilizando vozes humanas e/ou sintetizadas, com treinamento individual ou em grupo. Foram observados método de treinamento, vozes utilizadas, tempo de treinamento e se houve treino de habilidades auditivas centrais. **Resultados:** A literatura consultada mostrou ser comum o uso de âncoras auditivas, *feedback*, vozes naturais soprosas e rugosas e tempo de treinamento com duração máxima de duas horas. Nenhum estudo aplicou o treino de habilidades de processamento auditivo central no treinamento para avaliação perceptivo-auditiva da voz. **Conclusão:** ainda não há consenso sobre qual é o melhor programa de treinamento para análise perceptivo-auditiva da voz.

Palavras-chave: Voz; Distúrbios da voz; Percepção auditiva; Qualidade vocal; Disfonia

Study carried out at Pós-Graduação in Modelos de Decisão e Saúde, Universidade Federal da Paraíba – UFPB – João Pessoa (PB), Brasil.
[1]Programa de Pós-graduação em Modelos de Decisão e Saúde, Universidade Federal da Paraíba – UFPB – João Pessoa (PB), Brasil.
[2]Programa de Pós-graduação em Neurociência Cognitiva e Comportamento – PPGNeC, Universidade Federal da Paraíba – UFPB –João Pessoa (PB), Brasil.
[3]Departamento de Fonoaudiologia, Universidade de Brasília – UnB – Brasília (DF), Brasil.
Conflict of interests: No.
Authors' contributions: KESP participated in study idealization, selection of studies, data analysis, and manuscript writing; MAAP participated in the selection of studies and data analysis; DOL participated in manuscript writing and review; VVR participated in study idealization, analysis, and manuscript review; RMM participated in method analysis and manuscript review; LWL participated in the idealization, analysis, and manuscript review.
Funding: None.
Corresponding author: Karoline Evangelista da Silva Paz. E-mail: fonok.evangelista@gmail.com
Received: December 29, 2022; **Accepted:** May 12, 2023

INTRODUCTION

Voice quality is essentially a perceptive phenomenon in response to acoustic stimuli, and voice production is also a physical property, whose analysis requires auditory perception. Hence, auditory-perceptual analysis (APA) of the voice is understandably the reference speech-language-hearing standard for voice assessment – an indispensable prerequisite to assess and monitor dysphonic patients. However, it is a subjective procedure that depends on factors inherent to the listener, such as their individual experiences and skills. Auditory-perceptual training can minimize the high intrarater and interrater agreement variability in voice APA[1].

There are various reasons why greater consensus in voice APA is necessary. These include the need for more precise professional assessments and the difficulty obtaining consistent references to serve as the basis of speech-language-hearing students' training, validate acoustic assessments and automatic tools, and implement new techniques[2].

Besides conventional auditory-perceptual training, central auditory skills can be also improved with training[3]. Such skills should be considered in voice assessment, as APA involves biological mechanisms that correspond to specific auditory skills: the brain decodes soundwaves from the external ear to the cortex in a process that enables detailed sound analysis through the auditory pathways of the central nervous system and auditory cortex[4]. Thus, adequate sound signal analysis requires precise auditory processing[5].

The literature available on APA auditory training has some variables that must be observed, such as training method, voices used, training time, and whether central auditory skill training has been considered. Knowing such variables makes it possible to analyze which training strategies are most used and whether any aspect has not yet been explored, thus directing the development of new training programs.

PURPOSE

To synthesize the state of the scientific knowledge on voice quality APA training.

RESEARCH STRATEGY

This review was conducted based on the recommendations of the international guide of Preferred Items for Systematic Reviews and Meta-Analyses – extension for Scoping Reviews (PRISMA-ScR)[6]. The research question and eligibility criteria were developed according to the PCC strategy (Population, Concept, and Context)[7], using the following key topics:

- Population: listeners with or without experience in APA.
- Concept: voice APA training.
- Context: voice clinical practice.

The following research question was developed, conciliating the PCC key topics and the study objective: "How is voice APA training carried out?".

The electronic search was conducted in May 2022 in the PubMed/MEDLINE, LILACS, and SciELO databases, also searching the citations in the selected articles. The search strategies were developed based on free index terms related to the PCC, using combinations of the following descriptors: PubMed – ((("*speech-language pathology*") OR ("*speech therapy*")) AND (("*auditory perception*") OR ("*auditory perceptual assessment*") OR ("*auditory perception judgment*") OR ("*auditory-perceptual evaluation*") OR ("*auditory-perceptual analysis*") OR ("*auditory-perceptual measures*")) AND (("*dysphonia*") OR ("*perceptual evaluation of dysphonia*") OR ("*voice quality*") OR ("*vocal quality*"))); SciELO – ((("*speech therapy*")) OR (("*speech-language pathology*")) AND (("*auditory perception*")) OR (("*auditory perceptual assessment*")) OR (("*auditory perception judgment*")) OR (("*auditory-perceptual evaluation*")) OR (("*auditory-perceptual measures*"))); LILACS – ((("*vocal quality*")) OR (("*voice quality*")) AND (("*speech therapy*")) OR (("*auditory perceptual assessment*")) OR (("*auditory perception judgment*")) OR (("*auditory-perceptual evaluation*")) OR (("*auditory-perceptual meas*ures"))). All databases were searched in English, using no publication language or date filter.

SELECTION CRITERIA

Articles were selected based on eligibility criteria. Thus, the review included studies whose populations comprised listeners with or without experience in APA in the context of voice clinical practice and that included voice APA training, either individually or in groups, using human and/or synthesized voices. The exclusion criteria were secondary studies, training using only artistic voices, and studies that did not describe the APA training.

Firstly, studies were selected by identifying them in the PubMed/MEDLINE, SciELO, and LILACS databases. Then, the inclusion criteria were applied with title and abstract reading. Afterward, duplicates were removed, and the exclusion criteria were applied with full-text reading. Two reviewers selected the articles independently. In case of divergence between them, another two reviewers were available to reach a consensus decision.

DATA ANALYSIS

The following data were extracted from the eligible articles to make up the analysis matrix: authors, training method, voices used, training time, and whether central auditory skills were trained.

RESULTS

The search initially screened 124 articles, of which 14 were selected for analysis after applying the eligibility criteria. There were no divergences between the reviewers who searched and screened the articles; therefore, a third reviewer was unnecessary. Based on these articles, new ones were included by searching their bibliographical references, totaling 23 studies in this review (Figure 1).

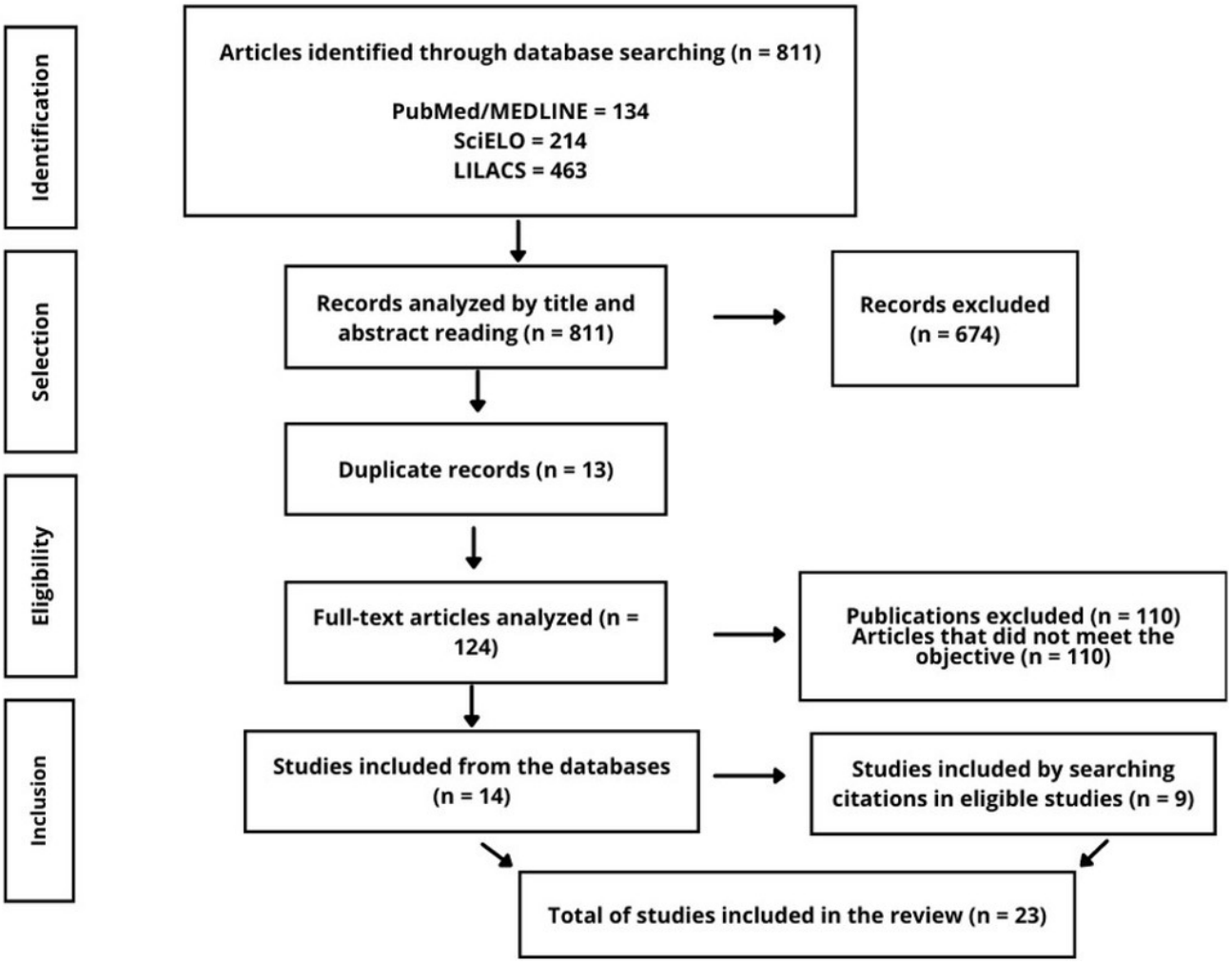

Figure 1. Flowchart with data collection and study selection to comprise the sample
Subtitle: n = number of publications

The literature consulted for this review shows that studies commonly use auditory anchors (69.56%) – which are natural or synthesized vocal emissions defined as representative of a certain type and/or degree of deviation, working as an external reference during APA; feedback (i.e., being informed of correct and wrong answers during training) (78.26%); and breathiness and/or roughness as the most assessed vocal parameters (82.60%). There was no fixed training time parameter in the literature, as some studies (34.78%) did not even specify the training duration. Most of those who mentioned this information (86.6%) used 2-hour training at the most.

Moreover, there was a gap in the literature regarding central auditory skill training during voice-quality APA training. None of the analyzed studies included central auditory processing skill training as a learning strategy (Chart 1).

DISCUSSION

This study synthesized the state of scientific knowledge on voice APA training. It identified in the consulted literature the most used training methods and voices (synthesized, natural, or both), the most studied voice-quality parameters during APA training, the training time, and whether central auditory skills training has been considered.

Various authors have invested in training APA raters, using anchor voices[1,2,8-20], which are voice models that match parameters addressed in the study and work as a reference to assess other voices. This use has proved to be useful to increase APA reliability by reducing its variability and subjectivity[1]. Even though professionals commonly need many years of experience to reach reliable APA standards, it is currently known that using anchors helps stabilize internal standards even in inexperienced listeners, making them achieve a considerable precision level in APA in a short time, as long as they are adequately trained[8,11,19].

Some studies used synthesized voices[2,8,9,13], which are combinations of different biomechanical parameters to generate signals with different degrees, types, and combinations of vocal deviations. Given the multidimensionality of human voice characteristics, obtaining objective assessments is difficult, which hinders just standardization. As for synthesized voices, it is possible to know exactly their acoustic properties and even manipulate acoustic parameters as wished or needed[2]. Using synthesized voices favors APA reliability, thus greatly contributing to scientific research and APA training among young clinicians[2].

Chart 1. Analysis matrix of studies that approached training for the auditory-perceptual analysis of the voice

PAPER	MÉTODO DE TREINAMENTO	VOZES UTILIZADAS	TEMPO DE TREINAMENTO	TREINO DE HABILIDADES AUDITIVAS CENTRAIS
(1)	Anchors and feedback Information on the case (interview, imaging examination, and clinical history)	56 natural voices Parameters: roughness, breathiness, asthenia, strain, and instability	58.33 minutes (mean)	Not performed
(2)	Anchors and feedback	12 synthesized and 12 natural voices Parameters: pitch, timbre, loudness, roughness, breathiness, asthenia, tremor, and instability	Not reported	Not performed
(3)	Feedback	10 deviated natural voices. Parameter: overall degree	Not reported	Not performed
(8)	Anchors and feedback	20 duplicated voices, natural and synthesized, normal and deviated Parameters: roughness and breathiness	30 minutes	Not performed
(9)	Anchors and feedback	57 synthesized voices Parameters: Breathiness	4 hours	Not performed
(10)	Anchors and feedback	30 natural voices: 15 samples of anchor voices and 15 used as training stimuli Parameters: overall degree, roughness, and breathiness	2 hours	Not performed
(11)	Auditory anchors and auditory and textual cues	36 natural voices Parameters: degree of deviation, roughness, and breathiness	15-20 minutes	Not performed
(12)	Lectures, anchors, and feedback.	23 natural voices in 82 presentations Parameter: resonance	2 hours	Not performed
(13)	Anchors and feedback	6 synthesized voices in 36 presentations Parameter: breathiness	15 minutes	Not performed
(14)	Visual anchors (spectrogram)	107 deviated natural voices Parameters: overall degree, roughness, breathiness, asthenia, and strain	Four 20-minute sessions	Not performed
(15)	Classes, anchors, proprioception, group discussion, feedback	14 deviated natural voices + two repetitions Parameters: degree of deviation, diplophonia, pitch, strain, instability, breathiness	50 minutes	Not performed
(16)	Anchors and feedback	84 natural voices, normal and deviated. Parameter: overall degree	Not reported	Not performed
(17)	Textual and auditory anchors and feedback	30 natural voices Parameters: overall degree, roughness, a nd breathiness	Not reported	Not performed
(18)	Anchors and feedback	40 natural voices Parameters: overall degree, roughness, breathiness, strain, asthenia, pitch, and loudness	Not reported	Not performed
(19)	Anchors and feedback	Natural voices (unspecified number of voices used in training) Parameter: resonance	Not reported	Not performed
(20)	APA with and without repetition of anchor stimuli	220 natural voices Parameters: roughness, breathiness, and strain	Two sessions: 1st: 1 hour and 10 minutes 2nd: 42 minutes	Not performed
(21)	Feedback. Information on the case (interview, imaging examination, and clinical history)	20 natural voices in increasing order of deviation Parameters: degree of deviation, pitch, loudness, breathiness, roughness, frequency, strain, instability	Not reported	Not performed
(22)	Feedback	20 natural voices: two normal and 18 deviated ones Parameters: roughness and breathiness	50 minutes	Not performed
(23)	Feedback	32 natural voices + extra voices chosen by the students (unspecified number) Parameters: overall degree, roughness, breathiness, asthenia, and strain	Nine 15-minute sessions	Not performed
(24)	Auditory- and/or visual-perceptual feedback (spectrogram)	24 natural voices Parameters: overall degree, roughness, and breathiness	2 hours divided into four 20-minute sessions	Not performed
(25)	Feedback	20 natural voices Parameters: degree of deviation, roughness, breathiness, asthenia, and strain	5 hours	Not performed
(26)	Review with samples of voices with different qualities	25 natural voices Parameters: degree of deviation, roughness, breathiness, strain, pitch, and loudness	10-15 minutes	Not performed
(27)	APA with consensus	Natural voices (unspecified number of voices used in training) Parameter: resonance	Not reported	Not performed

Source: Developed by the authors, 2022
Subtitle: APA = auditory-perceptual analysis

Feedback is used quite commonly in training[1,2,5,8-10,12,13,15-19,21-25] because it is useful to develop internal standards to guide voice APA. In this strategy, the rater hears a stimulus and receives immediate feedback on whether they were right or wrong. The task helps develop calibrated prototypes between raters, increasing APA reliability[12,13,19].

Concerning voice quality parameters, breathiness and roughness have the highest interrater agreement indices and are the most used in clinical practice[16]. Therefore, training these parameters helps develop representative mental prototypes that contribute to better APA[8].

Interrater agreement tends to be higher regarding the overall degree of deviation but lower regarding voice quality parameters (e.g., breathiness, roughness and resonance)[3]. This shows the need for auditory training to practice separate voice parameters[27]. Such training should be mandatory for undergraduate speech-language-hearing students[5]. Auditory APA training should be progressive, beginning with easier tasks and then gradually increasing to harder challenges. For instance, they should practice on more deviated voices before other ones with a lower degree of deviation[3].

Concerning training time, shorter sessions are known to teach more effectively than longer ones, especially among inexperienced raters[3]. This is particularly due to the use of anchors, as their effect stabilizes internal standards, making raters achieve a considerable precision level in APA[9,11]. Two training hours are enough to perceive significant differences in APA precision among inexperienced listeners[10].

The brain can only pay attention to and consciously process the most relevant stimulus at a given moment, which is only possible when the attention span is not exceeded. Neural circuit activation tends to deviate attentional focus to other stimuli, whether internal or environmental[28]. Dividing training into various sessions favors learning because it avoids fatigue and inattention, also contributing to learning with repeated exposure to emissions. Hence, some studies used 20-minute training moments at the most, taking longer intervals or dividing training into various sessions[1,15,23,26].

In summary, there are many similarities in the training provided in the various studies analyzed in this review. However, no specific training program was systematically followed, which requires further research on the various training approaches to establish a reference standard. This may guide the APA teaching method in subjects that address the voice in undergraduate speech-language-hearing programs and train clinicians and/or scientific researchers.

The literature is scarce on training central auditory processing skills during voice APA training. Nevertheless, voice-quality APA involves skills to recognize and discriminate time and frequency patterns[4]. Therefore, understanding the relationship between central auditory processing and voice APA can help develop more effective auditory APA training programs.

APA requires the ability to identify and discriminate the degree and type of voice-quality deviation and analyze aspects such as pitch, loudness, and resonance. Voice-quality deviations involve changes in the acoustic signal in the time and/or frequency domains. Hence, raters must have a skillful auditory perception to process, decompose, integrate, and interpret acoustic information[3].

Because the voice is analyzed through the auditory pathway, auditory processing assessment is important to both voice patients (who need to monitor it) and speech-language-hearing therapists (who perform voice APA). As for dysphonic patients, there is evidence that voice changes may be related to auditory processing difficulties, especially in ordering and temporal resolution skills. Thus, results in auditory processing assessment are proportional to performance in auditory perception of the voice[29]. There are indications that central auditory processing assessments and central auditory skills training could be included in APA training programs. However, further studies with central auditory processing training are needed to demonstrate its effectiveness.

CONCLUSION

There are various similarities in the training provided in the studies analyzed in this review. However, there is no consensus on a specific APA training program to be considered the reference standard. The most used strategies include the use of auditory anchors, feedback, natural voices with different degrees of deviation (mainly using breathiness and/or roughness as parameters), and short training duration. The literature is scarce on training central auditory processing skills during voice APA training.

REFERENCES

1. Santos PCM, Vieira MN, Sansão JPH, Gama ACC. Effect of auditory-perceptual training with natural voice anchors on vocal quality evaluation. J Voice. 2019;33(2):220-5. http://dx.doi.org/10.1016/j.jvoice.2017.10.020. PMid:29331406.
2. Gurlekian JA, Torres HM, Cediel MR. A perceptual method to rate dysphonic voices. J Voice. 2019;33(4):453-64. http://dx.doi.org/10.1016/j.jvoice.2018.01.007. PMid:29731380.
3. Schaeffer N. Student training to perceptually assess severity of dysphonia using the dysphonic severity percentage scale. J Voice. 2013;27(5):611-6. http://dx.doi.org/10.1016/j.jvoice.2013.03.016. PMid:23876942.
4. Paiva MAA, Rosa MRD, Gielow I, Silva IM, Silva Sousa ES, Silva ACF, et al. Auditory skills as a predictor of rater reliability in the evaluation of vocal quality. J Voice. 2021;35(4):559-69. http://dx.doi.org/10.1016/j.jvoice.2019.11.020.
5. Paoliello KBG, Pereira LD, Behlau M. Voice quality and auditory processing in subjects with and without musical experience. J Voice. 2021;35(1):9-17. http://dx.doi.org/10.1016/j.jvoice.2019.07.006. PMid:31377024.
6. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73. http://dx.doi.org/10.7326/M18-0850. PMid:30178033.
7. Peters M, Godfrey C, McInerney P, Munn Z, Trico A, Khalil H. Chapter 11: scoping reviews. In: Aromataris E, Munn Z, editors. JBI manual for evidence synthesis. Australia: JBI; 2020.
8. Chan KMK, Yiu M-LE. The effect of anchors and training on the reliability of perceptual voice evaluation. J Speech Lang Hear Res. 2002;45(1):111-26. http://dx.doi.org/10.1044/1092-4388(2002/009). PMid:14748643.
9. Chan KM, Yiu EM. A comparison of two perceptual voice evaluation training programs for naive listeners. J Voice. 2006;20(2):229-41. http://dx.doi.org/10.1016/j.jvoice.2005.03.007. PMid:16139475.

10. Eadie TL, Baylor CR. The effect of perceptual training on inexperienced listeners' judgments of dysphonic voice. J Voice. 2006;20(4):527-44. http://dx.doi.org/10.1016/j.jvoice.2005.08.007. PMid:16324823.

11. Awan SN, Lawson LL. O efeito da modalidade âncora na confiabilidade das classificações de gravidade vocal. J Voice. 2009;23(3):341-52. http://dx.doi.org/10.1016/j.jvoice.2007.10.006. PMid:18346869.

12. Lee A, Whitehill TL, Ciocca V. Effect of listener training on perceptual judgement of hypernasality. Clin Linguist Phon. 2009;23(5):319-34. http://dx.doi.org/10.1080/02699200802688596. PMid:19399664.

13. Chan KM, Li M, Law TY, Yiu EM. Effects of immediate feedback on learning auditory perceptual voice quality evaluation. Int J Speech Lang Pathol. 2012 Ago;14(4):363-9. http://dx.doi.org/10.3109/17549507.2012.679746. PMid:22646315.

14. Núñez-Batalla F, Díaz-Molina JP, García-López I, Moreno-Méndez A, Costales-Marcos M, Moreno-Galindo C, et al. El espectrograma de banda estrecha como ayuda para el aprendizaje del método GRABS de análisis perceptual de la disfonía. Acta Otorrinolaringol Esp. 2012 May-Jun;63(3):173-9. http://dx.doi.org/10.1016/j.otorri.2011.10.002. PMid:22153964.

15. Iwarsson J, Reinholt Petersen N. Effects of consensus training on the reliability of auditory perceptual ratings of voice quality. J Voice. 2012 Maio;26(3):304-12. http://dx.doi.org/10.1016/j.jvoice.2011.06.003. PMid:21840170.

16. Ghio A, Dufour S, Wengler A, Pouchoulin G, Revis J, Giovanni A. Perceptual evaluation of dysphonic voices: can a training protocol lead to the development of perceptual categories? J Voice. 2015;29(3):304-11. http://dx.doi.org/10.1016/j.jvoice.2014.07.006. PMid:25516201.

17. Brinca L, Batista AP, Tavares AI, Pinto PN, Araújo L. The effect of anchors and training on the reliability of voice quality ratings for different types of speech stimuli. J Voice. 2015 Nov;29(6):776.e7-14. http://dx.doi.org/10.1016/j.jvoice.2015.01.007. PMid:25795348.

18. Ehrlich B, Lin L, Jiang J. Concatenation of the moving window technique for auditory-perceptual analysis of voice quality. Am J Speech Lang Pathol. 2018 Nov 21;27(4):1426-33. http://dx.doi.org/10.1044/2018_AJSLP-17-0103. PMid:30304342.

19. Wong DW, Chan RW, Wu CH. Effect of training with anchors on auditory-perceptual evaluation of dysphonia in speech-language pathology students. J Speech Lang Hear Res. 2021 Abr 14;64(4):1136-56. http://dx.doi.org/10.1044/2020_JSLHR-20-00214. PMid:33769849.

20. Bispo NO, Yamasaki R, Padovani MMP, Behlau M. Repetition of anchor stimuli and nature of vocal samples in the perceptual auditory judgment performed by speech-language pathology students. CoDAS. 2022;34(4):e20210064. http://dx.doi.org/10.1590/2317-1782/20212021064. PMid:35081197.

21. Oates J, Russell A. Learning voice analysis using an interactive multi-media package: development and preliminary evaluation. J Voice. 1998;12(4):500-12. http://dx.doi.org/10.1016/S0892-1997(98)80059-3. PMid:9988037.

22. Misono S, Merati AL, Eadie TL. Developing auditory-perceptual judgment reliability in otolaryngology residents. J Voice. 2012 Maio;26(3):358-64. http://dx.doi.org/10.1016/j.jvoice.2011.07.006. PMid:22019147.

23. Silva RS, Simões-Zenari M, Nemr NK. Impact of auditory training for perceptual assessment of voice executed by undergraduate students in Speech-Language Pathology. J Soc Bras Fonoaudiol. 2012;24(1):19-25. http://dx.doi.org/10.1590/S2179-64912012000100005. PMid:22460368.

24. Barsties B, Beers M, Ten Cate L, Van Ballegooijen K, Braam L, De Groot M, et al. The effect of visual feedback and training in auditory-perceptual judgment of voice quality. Logoped Phoniatr Vocol. 2017 Abr;42(1):1-8. http://dx.doi.org/10.3109/14015439.2015.1091036. PMid:26525078.

25. Hosseinifar S, Torabinezhad F, Ghelichi L, Roudbari M, Silverman EP, Faham M. How do voice perceptual changes predict acoustic parameters in persian voice patients? J Voice. 2018 Nov;32(6):705-9. http://dx.doi.org/10.1016/j.jvoice.2017.08.015. PMid:29033255.

26. Solomon NP, Helou LB, Stojadinovic A. Clinical versus laboratory ratings of voice using the CAPE-V. J Voice. 2011 Jan;25(1):e7-14. http://dx.doi.org/10.1016/j.jvoice.2009.10.007. PMid:20430573.

27. Oliveira AC, Scarmagnani RH, Fukushiro AP, Yamashita RP. The influence of listener training on the perceptual assessment of hypernasality. CoDAS. 2016;28(2):141-8. http://dx.doi.org/10.1590/2317-1782/20162015163. PMid:27191877.

28. Lima CF, Soares AJC. Estresse, atenção e efeitos na aprendizagem de adultos: dados da literatura. Revista Contemporânea de Educação. 2019 Sep/Dec;14(31):235-53. http://dx.doi.org/10.20500/rce.v14i31.24007.

29. Ramos JS, Feniman MR, Gielow I, Silverio KCA. Correlation between voice and auditory processing. J Voice. 2018 Nov;32(6):771.e25. http://dx.doi.org/10.1016/j.jvoice.2017.08.011. PMid:28967586.