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Benefits of hearing training for elderly users of individual sound amplification devices (ISAD): Integrative literature review

Benefícios do treinamento auditivo para idosos usuários de aparelhos de amplificação sonora individual (AASI): Revisão integrativa da literatura

Beneficios del entrenamiento auditivo para personas mayores usuarios de dispositivos de amplificación de sonido individuales (DASI): Revisión integradora de la literatura

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Abstract

Introduction: Individual Sound Amplification Devices (ISAD) are considered an external help and do not solve all communication obstacles. Many elderly people do not present good use of the sound amplification, as hearing aids do not provide communication skills and are not equivalent to the natural function of the auditory system. The principle of Auditory Training is to develop neuroplasticity, promoting changes in auditory skills and auditory performance through stimulation, allowing the elderly to learn to experience sounds in a significant way. **Objective:** To verify the benefits of auditory training in elderly hearing aid users. **Methodology:** This is an integrative review. Articles were searched in the CAPES, SciELO and LILACS databases, and those that met the inclusion criteria were selected. The guiding question that composed the study was the following: "What are the benefits that auditory training provides to elderly users of hearing aids?" **Results:** From the combinations of Health Descriptors, a

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NM: Study design and manuscript writing.
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set of 318 articles was obtained. After the analysis process, 6 articles remained to answer the proposed question. **Conclusion:** Hearing Training improved figure-ground skills, binaural integration, ordering and temporal resolution in elderly hearing aid users. The association between the use of hearing aids and auditory training, in addition to providing audibility of acoustic information, enhances the skills involved in auditory processing, regardless of age.

Keywords: Acoustic Stimulation; Hearing Aids; Auditory Perception; Hearing Disorders; Elderly.

Resumo

Introdução: Os Aparelhos de Amplificação Sonora Individual (AASI) são considerados como uma ajuda externa e não solucionam todos os obstáculos de comunicação. Muitos idosos não apresentam bom aproveitamento da amplificação sonora, pois as próteses auditivas não fornecem as habilidades comunicativas ou equivalem à função natural do sistema auditivo. O Treinamento Auditivo tem como princípio desenvolver a neuroplasticidade, promovendo mudanças nas habilidades auditivas e desempenho auditivo mediante estimulação, permitindo que o idoso aprenda a vivenciar os sons de maneira significante. **Objetivo:** Verificar os benefícios do treinamento auditivo em idosos usuários de AASI. **Metodologia:** Trata-se de uma revisão integrativa. Foram pesquisados artigos nas bases de dados CAPES, SciELO e LILACS, e selecionados aqueles que atendiam aos critérios de inclusão. A questão norteadora que compôs o estudo foi a seguinte: "Quais os benefícios que o treinamento auditivo proporciona aos idosos usuários de próteses auditivas?" **Resultados:** A partir das combinações dos Descritores em Saúde (DeCS), obteve-se uma amostra de 318 artigos. Após o processo de análise, restaram 6 artigos para responder à questão proposta. **Conclusão:** O Treinamento Auditivo ocasionou melhora das habilidades de figura-fundo, integração binaural, ordenação e resolução temporal, em idosos usuários de AASI. A associação entre o uso das próteses auditivas e o treinamento auditivo, além de proporcionar audibilidade das informações acústicas, potencializa as habilidades envolvidas no processamento auditivo, independentemente da idade.

Palavras-chave: Estimulação Acústica; Auxiliares de Audição; Percepção Auditiva; Transtornos da Audição; Idoso.

Resumen

Introducción: Los dispositivos de amplificación de sonido individuales se consideran una ayuda externa y no resuelven todos los obstáculos de comunicación. Muchas personas mayores no hacen un buen uso de la amplificación del sonido, ya que los audífonos no brindan habilidades de comunicación o son equivalentes a la función natural del sistema auditivo. El principio del Entrenamiento Auditivo es desarrollar la neuroplasticidad, promoviendo cambios en las habilidades auditivas y el desempeño auditivo a través de la estimulación, permitiendo que las personas mayores aprendan a experimentar los sonidos de manera significativa. **Objetivo:** Verificar los beneficios del entrenamiento auditivo en usuarios de audífonos de edad avanzada. **Metodología:** Esta es una revisión integradora. Se realizaron búsquedas de artículos en las bases de datos CAPES, SciELO y LILACS y se seleccionaron aquellos que cumplieron con los criterios de inclusión. La pregunta orientadora que compuso el estudio fue la siguiente: "¿Cuáles son los beneficios que brinda el entrenamiento auditivo a los usuarios mayores de audífonos?" **Resultados:** De las combinaciones de Descriptores de Salud (DeCS) se obtuvo una muestra de 318 artículos. Tras el proceso de análisis, quedaron 6 artículos para dar respuesta a la pregunta propuesta. **Conclusión:** El entrenamiento auditivo mejoró las habilidades de figura-fondo, integración binaural, ordenamiento y resolución temporal en usuarios de audífonos de edad avanzada. La asociación entre el uso de audífonos y el entrenamiento auditivo, además de proporcionar audibilidad de la información acústica, mejora las habilidades involucradas en el procesamiento auditivo, independientemente de la edad.

Palabras clave: Estimulación acústica; Audífonos; Percepción auditiva; Trastornos de la audición; Anciano.

Introduction

Aging refers to a set of changes that the human being undergoes through the passage of time; these changes are irreversible and result in consequences for the general health of individuals, compromising biological, physiological, psychological and sensory functions. Among the sensory alterations that manifest in senescence is the decrease in auditory acuity. Considered as one of the most disabling, it negatively influences the ability of communication and interaction of the elderly.[1]

The decline in auditory skills begins around the age of 50, and approximately 25% of the population aged between 60 and 75 years already has hearing impairments due to age. Hearing loss resulting from the aging process is called Presbycusis. Regarding the etiology, it is considered a multifactorial disease, influenced by extrinsic conditions together with genetically established aging. Some aggravating factors are: exposure to occupational and non-occupational noise, use of ototoxic drugs, diseases in general such as diabetes, hypertension or vascular diseases, infections and family history. [2, 3]

Elderly patients with presbycusis present hearing loss with specific characteristics: It is of the sensorineural type, bilateral, symmetrical, progressive, from mild to severe and descending configuration, with preservation in low frequencies and more accentuated deficits in high frequencies, impedance and tympanogram without alterations , and there may be presence or absence of stapedial acoustic reflexes.[2]

The process by which hearing impairments and their negative influences can be minimized is audiological rehabilitation, which is a problem-solving process designed to meet the particular needs of the hearing impaired, focusing on the difficulties of each one's hearing skills and also on the impact of disability regarding psychosocial and communication aspects, seeking to adjust them to families and society. [4, 5]

Hearing rehabilitation includes the indication, selection and adaptation of Individual Sound Amplification Devices (AASI), commonly called hearing aids. They are electronic equipment that capture sound, speech or environmental signals, which are modified, amplified at frequencies where hearing is compromised, and delivered to the user, providing audibility.[4]

Although they have evolved technologically, the use of hearing aids alone is not capable of restoring normal hearing. Hearing aids are intended to provide as much acoustic information as possible, but familiarity with the device and the sounds that will be heard must be created, which are often different from what the auditory system was previously used to dealing with. Therefore, even though hearing aids are adapted to the user's hearing needs, they are considered an external aid and partially compensate the difficulties resulting from hearing loss, not solving all communication obstacles. In many cases, the elderly do not make good use of amplification and do not feel satisfied, as these technologies do not provide the auditory skills, the understanding necessary for the natural function of the auditory system.[4, 6, 7]

Central Auditory Processing (CAP) refers to the efficiency with which the Auditory Nervous System manipulates acoustic information, that is, how it interprets, recognizes and organizes sound stimuli, verbal or not, from the environment. The PAC is related to a series of skills which are necessary for the individual to decode and understand what he hears, among them:

Location and lateralization of the sound source, recognition of similarities and differences between acoustic patterns, understanding of speech or other sounds in the presence of competing signals, processing of acoustic stimuli presented simultaneously in both ears and storage of auditory information. Thus, hearing and communication encompass central mechanisms of understanding, information processing and the elaboration of a response to the acoustic stimulus received. Over time, as a function of age, there are changes that make the process of perception of auditory information in the central system difficult, causing a decline in one or more auditory processing skills.[8, 9]

Auditory Training (AT) refers to a set of acoustic tasks indicated for the activation of the auditory system and others associated with it, so that its neural basis and auditory behaviors are positively modified. AT strategies include listening tasks, in which the individual will perform functions such as detection, discrimination, recognition and understanding of sound information, in order to enable or rehabilitate auditory skills, minimizing the functional deficits presented and providing better performance of hearing. The AT used in the process of fitting hearing aids has as its principle

the development of plasticity of the Central Nervous System, promoting changes in nerve cells and auditory performance through hearing stimulation, allowing the elderly to learn to experience different sounds in significant ways. [8, 10]

Objective and justification

this study is justified by the relevance of verifying, through scientific evidence, the beneficial outcomes that auditory training produces for elderly users of hearing aids, since it is not a usual practice in the audiological rehabilitation of this public. Furthermore, it is an opportunity to demonstrate to Speech-Language Pathologists the importance of adding training to clinical practice, to promote user satisfaction with sound amplification and their quality of life. Thus, the objective of this research is to verify the benefits of auditory training in elderly users of hearing aids.

METHOD

This is an integrative literature review in order to answer the following guiding question: What are the benefits that auditory training provides to elderly users of hearing aids?

After formulating this question, the terms to be used in the research were surveyed through the Health Sciences Descriptors (DeCS), and the electronic databases to be accessed. The descriptors chosen were: Acoustic Stimulation; Hearing Aids; Auditory Perception; Training; Elderly; Hearing Disorders; Adaptation; Rehabilitation. For the scientific search, the databases CAPES (Coordination for the Improvement of Higher Education Personnel), SciELO (Online Scientific Electronic Library) and LILACS (Latin American and Caribbean Literature in Health Sciences) databases were selected.

The article search process included: combinations between descriptors, analysis of titles and abstracts, full readings of articles that were not enlightening by titles or abstracts, use of the "AND" search operator, and choices based on pre-established criteria. The following criteria for inclusion of articles were adopted: Publications from the last 10 years and with full texts; studies carried out with individuals of both sexes; target audience aged 60 years and over and hearing aid users who have experienced some auditory training. The following exclusion criteria were established: articles published more than 10 years ago; studies with a population under 60 years of age; articles that referred to individuals with normal auditory thresholds who underwent auditory processing therapy; publications with incomplete texts; literature reviews; researches that did not contemplate the theme of this research and duplicate studies.

From the selected descriptors, an initial sample of 318 articles was obtained. After careful analysis, 4 articles from the CAPES platform, 5 articles from the SciELO platform and 4 articles from the LILACS platform were included, totaling 13 articles. Of this total, it was observed that 7 articles from the SciELO and LILACS platforms were duplicates and were excluded. However, the search resulted in 6 articles that met the inclusion criteria for the study, as shown in Figure 1.

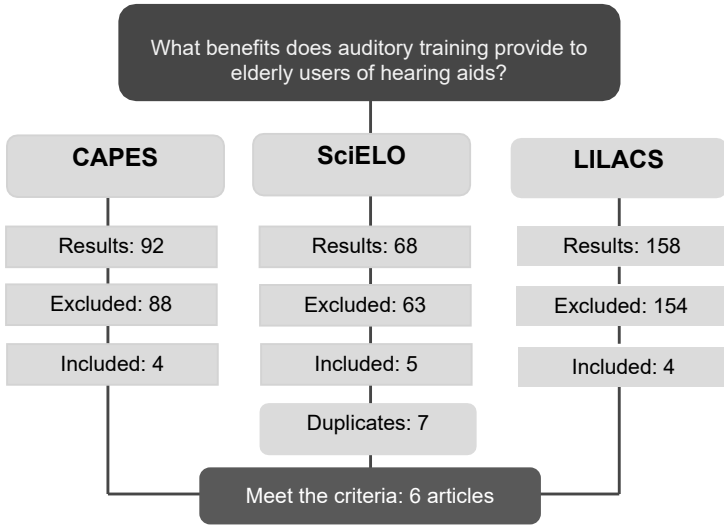

Figure 1. Process of inclusion and exclusion of articles, prepared by the author.

Results

Chart 1 presents the scientific articles included in the integrative review. In this, information regarding the authors, year of publication, type of research, title and general objective are described. It was observed that the period of publication varied between 2012 and 2019 and that the studies mostly included an auditory rehabilitation program.

Chart 1. Presentation of studies included in the integrative review.

Articles	Authors/Year/ Magazine	Search Type	Study Title	General objective
Article 1	Teixeira et al. 2018 Audiol Commun Res.	Longitudinal, interventional, retrospective and prospective, observational, contemporary and individual study.	Computerized auditory training in elderly people with hearing aids by the Unified Health System.	To verify the effectiveness of a computerized auditory training program in elderly people with hearing aids through the SUS, through measures of auditory processing and a participation restriction questionnaire.
Article 2	Hennig et al. 2012 J Soc Bras Fonoaudiol.	Quantitative, longitudinal, descriptive and experimental study.	Effects of auditory rehabilitation on temporal ordering ability in elderly users of hearing aids.	To analyze the effects of an auditory rehabilitation program on the ability to temporally order patterns of duration and frequency of sounds in elderly people who use hearing aids.
Article 3	Lessa et al. 2013 CoDAS	Descriptive, longitudinal, quantitative and experimental study.	Results of auditory rehabilitation in elderly users of hearing aids evaluated with a dichotic test.	To verify the effects of auditory rehabilitation, through the analysis of the quantitative and qualitative aspects of the SSW test, in elderly new users of hearing aids.
Article 4	Bertuol et al. 2019 Disturb. Comunn.	Quantitative, qualitative and longitudinal study.	Auditory Training: tinnitus and auditory skills in elderly people with hearing loss.	To estimate the effects of Computerized Acoustically Controlled Auditory Training (TAAC-C) in the reduction of tinnitus annoyance and changes in auditory abilities in elderly people with hearing loss who wear hearing aids.

Articles	Authors/Year/ Magazine	Search Type	Study Title	General objective
Article 5	Fonseca et al. 2015 CEFAC.	Prospective, longitudinal and contemporary study.	The performance of elderly with sensorineural hearing loss in auditory processing tests: a longitudinal study.	To verify the performance of elderly people in auditory processing tests at the delivery of the Individual Sound Amplification Device, after one month of using this device and after auditory training.
Article 6	Melo et al. 2016 Stud. interdiscipl. aging.	Study descriptive qualitative.	Hearing rehabilitation program: changes in the self-perception of participation restriction in the elderly.	To present a Hearing Rehabilitation Program aimed at the elderly public who use hearing aids, and to evaluate changes in the self-perception of participation restriction after such therapeutic intervention.

Chart 2 presents the characteristics of the samples that make up the studies, the tests used for evaluation, the conduct of auditory training and the main results.

Chart 2. Description of samples, interventions and main results of the studies.

Articles	Sample	Evaluation	Training A.	Results
Article 1	72 elderly: SG= 48, CG =24; Ages between 60 and 89 years; Sensorineural, bilateral and symmetrical hearing loss; Mild to Moderately Severe Grade; No experience with hearing aids.	HHIE-S: Handicap Inventory for the Elderly; Speak in Noise; RGDT: Random Range Detection Test; Digit Dichotic.	4 sessions; 1 weekly session, duration of 1 hour; Active Listening, Duo Training, Memo Training, Pedro no Camp and CD Listening with Interferes.	The SG improved superiorly in the RGDT, DD and Speech-in-Noise tests compared to the CG. It was observed in both groups that, as the age increases, the performance in the RGDT test decreases. As for the HHIE-S, the results indicated the absence of severe restriction in 87.5% of the SG after TA, and 100% of the CG after adaptation. Still, the test that showed the highest performance after intervention was the Speech in Noise.
Article 2	117 elderly: SG =9, CG=8; Ages between 60 and 84 years; Bilateral and symmetrical sensorineural hearing loss; Grade Mild to Moderately Severe; No experience with hearing aids.	DSP: Duration Sequential Patterns; SFP: Sequential Frequency Patterns.	7 sessions; 1 weekly session, duration of 1 hour and 15 minutes; MAT: Musical Auditory Training; In an acoustic booth and with AASI.	The SG showed evolution after the TA in the DSP and SFP tests, both for the murmured and named response patterns, indicating improvement in recognition, temporal ordering and naming skills. The GC did not show changes for any response pattern. It is important to note that 15 individuals were fitted with powerful hearing aids (BTE), however, the time of hearing loss in the CG is longer than in the SG, reaching 10 and 20 years in 4 participants.
Article 3	17 elderly: G1= 8, G2= 9; Ages between 60 and 84 years; Bilateral and symmetrical sensorineural hearing loss; Grade Mild to Moderately Severe; No experience with hearing aids.	SSW: Test of Alternate and Overlapping Disyllables.	7 sessions; 1 weekly session, duration of 1 hour and 15 minutes each; MAT: Musical Auditory Training.	Both groups showed improvements in the quantitative aspects, however, the evolution of G2 was significant in the variables DC, ENC and total hits, which evaluated the left hemisphere, demonstrating benefits of auditory training for the HE, involved in rhythm, semantic identification, temporal and sequential processing of sounds. In terms of organization, memory, integration and decoding deficits, it was observed that the elderly in both groups suggested improvements and others worsened.

Articles	Sample	Evaluation	Training A.	Results
Article 4	5 elderly; Ages between 67 and 84 years; Sensorineural hearing loss; Mild to Moderate Grade; Complaint of tinnitus for 6 months or more; Change in auditory skills; Time of fitting with an average of 3 years; Sensory deprivation with a mean of 6 years.	TSQ: Tinnitus Severity Questionna re; RGDT: Random Range Detection Test; Speak in Noise; Digit Dichotic; PEALL: Long Latency Auditory Evoked Potentials.	16 sessions; 2 times a week, 30 minutes each session; TAAC-C: Acoustically Controlled Auditory Training – Computerized; Active Listening Program.	Regarding the TSQ, there was a marked reduction in the degree of tinnitus annoyance. The scores showed changes from severe and moderate to mild and negligible in all subjects. In the DD and Speech-in-Noise tests, most participants scored within the normal range after intervention. The benefits of auditory skills and tinnitus were not evidenced in the electrophysiological assessment. As for the RGDT, all the elderly had pre-intervention normality.
Article 5	11 individuals; Ages between 61 and 78 years; Bilateral and symmetrical sensorineural hearing loss; Mild to Moderate Grade; Sensory deprivation between 2 and 20 years (mean 5.82 years); Daily use time between 7 and 16 hours (average 10, 18 hours).	Speak in Noise; RGDT: Random Range Detection Test; Digit Dichotic.	Total of 5 sessions; Tasks to stimulate detection, discrimination, recognition and comprehension skills; Gradual difficulty levels.	There was a significant improvement in the results after the use of hearing aids and AT, in all tests. It is noteworthy that between the first and second assessment, the individuals were going through the acclimatization period, which was 4 weeks in this study. Despite the evolution at each evaluation, it was observed that the longer the sensory deprivation time, the lower the results in the Speech in Noise test, in both ears, however, obtaining higher values for the right ear.
Article 6	10 elderly; Ages between 62 and 92 years; Sensorineural hearing loss; Grade Mild to Severe; Prosthetics on average for 3.2 years; Changes in listening skills.	HHIE-S: Handicap Inventory for the Elderly; Quality of Life Assessment Instrument (WHO); MMSE: Mini Mental State Examination.	8 sessions lasting 45min; AT informal and computerized; Figure-ground tasks for verbal and non-verbal sounds; Stimulation of the specific altered skills in each case.	Most individuals had incomplete elementary education and had a significant restriction on participation. After the therapeutic sessions, it was observed that this decreased considerably. The elderly went through the acclimatization period and sought the service from 7 months to 9 years after fitting the hearing aid.

Discussion

This research exposes the studies included from the databases, which used formal tests to verify the benefits of auditory training programs for elderly users of hearing aids. The results were discussed and compared with the literature, correlating the tests applied and the beneficial outcomes of auditory training from the auditory skills evaluated before and after the interventions, in order to answer the proposed guiding question.

It was observed in articles 2 and 5 that the time of sensory deprivation had a negative influence on auditory training, as some individuals did not achieve good performance and others did not obtain changes in response patterns. These results are explained by another study[11], in which it was evidenced that elderly people with acquired hearing loss had a significant worsening in their auditory abilities after a period of deprivation, stating that the functioning of hearing is related to the quantity and quality of acoustic information, the lack of auditory input causes cognitive decline in the elderly and the use of sound amplification would be able to help improve audibility and maintain communicative skills.

From the monotic task Speech in Noise, applied in studies 1, 4 and 5, the figure-ground skill was evaluated, in which the elderly were asked to recognize the messages heard in the presence of a noise, presented in an ear of each time. All participants improved significantly in this task

after the intervention. This finding is in agreement with those found by Sales[12] in a survey composed predominantly of elderly people with acquired sensorineural hearing loss, who participated in approximately 8 training sessions lasting 1 hour. In the end, the results showed considerable benefits of this ability, with a marked difference bilaterally, thus, auditory training was an alternative to improve auditory performance in the presence of noise.

Despite technological advances, it is stated that the exclusive use of hearing aids does not satisfactorily compensate for the sensory impairments and one of the main complaints of the hearing impaired is the understanding of speech in noise, with this, auditory training becomes an alternative to improve this ability and make users feel satisfied with the devices.[13]

The Dichotic Digits Behavioral Test, also used by Teixeira (2018), Bertuol (2019) and Fonseca (2015), evaluated the skills of binaural integration and figure-ground, which correspond to the ability to integrate and recognize different stimuli presented in both the ears and understanding of speech sounds in the presence of competitive others. It was found that, despite the time of sound deprivation, changes in auditory functions present, bilateral hearing loss and age, the performance of the elderly evolved significantly, and some reached normal scores after formal training. These results are similar to those found in elderly people who participated in a computerized auditory training program, with a similar average frequency, having the same audiological settings, which obtained satisfactory differences, inferring that this type of training promotes improvement in hearing function transfer of information between the hemispheres, an ability often impaired in these individuals, due to the lag of the fibers of the corpus callosum, and also in the ability to understand speech.[14]

The Alternate and Overlapped Disyllables Test, mentioned in study 3, evaluated the ability of binaural integration and temporal ordering, which involves the perception and processing of various auditory stimuli in their order of occurrence in time. It was observed that the group of elderly people who participated in training sessions obtained better results in the quantitative aspects and showed greater benefits for the left hemisphere, however, in the qualitative aspects, the opposite occurred for individuals from both groups. The benefits obtained are also found in an experimental study[12], in which the elderly were initially below the normal range, and after the intervention there was a reasonable improvement, comparing the results with the final evaluation. Given the relevance of temporal aspects to auditory processing skills, it can be said that this difference is important for maximizing communication among elderly hearing aid users, especially in adverse listening environments.

The predominance of the left hemisphere and the unsatisfactory results can be explained by the literature[15], which justifies that aging has effects on the peripheral and central auditory system. Thus, the advantage of one ear over the other in dichotic tests is due to the decrease in cognitive abilities and the decline in the ease of transferring interhemispheric information, in addition, the inefficiencies of central auditory functions are reflections of senility, even in the elderly no hearing complaints.

In studies 1, 4 and 5, the Random Range Detection Test (RGDT) was used to assess the temporal resolution ability, which refers to the shortest time interval for an individual to perceive rapid changes between acoustic signals, being necessary to discriminate and understand speech sounds. It was evident that, even with the benefits provided to some elderly people, the performance was lower with increasing age. This variation is similar to the literature[16], which clarifies that over the years, temporal skills deteriorate, regardless of the degree of hearing loss.

Another occurrence observed in article 4 was that all the elderly presented normality in the pre-intervention RGDT test. This is explained by another research[17], in which elderly people with the same audiological conditions participated and the benefits provided by hearing aids were evaluated from the possibility of reorganization of the central auditory system. It was found that only the use of hearing aids produced positive effects in the stimulation of neural plasticity, promoting an improvement in the performance of the temporal resolution ability, inferring that acoustic stimulation from sound amplification is capable of reorganizing and rescuing auditory functions.

In the articles presented in this review, the auditory training varied between 4 and 16 sessions, with durations between 30 minutes and 1 hour and 15 minutes and a weekly frequency of a maximum of 2 times. In some, it was evident that the levels of difficulty with each training changed gradually

and the stimulation of skills occurred according to the changes found in each case. According to the literature[18], the skills to be worked must be determined so that they are performed by individuals with the existing facilities and at the same time promote the learning of others. As for the level of difficulty, it should be adjusted according to individual performance. In addition, the time of each session, the amount, the interval between them and the intervention period are crucial for the change in neural synchrony to occur.

Conclusion

The results presented in this study showed that auditory training in elderly hearing aid users caused a significant improvement in the auditory skills of figure-ground, binaural integration and temporal ordering and resolution. Therefore, it can be concluded that the association between the use of hearing aids and auditory training, in addition to providing audibility of acoustic information, enhances the skills involved in auditory processing, regardless of age.

Thus, it can be said that, with a global audiological rehabilitation, these individuals feel motivated and safe to act in the various communicative situations of everyday life, receiving sound signals efficiently and overcoming the limitations imposed by hearing loss.

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