

# Managing Age-Related Hearing Loss: How to Use Hearing Aids Efficiently – A Mini-Review

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## Key Words

Hearing impairment · Hearing loss · Hearing aid · Successful aging · Everyday activity · Self-regulation · SOC model

## Abstract

Using hearing aids may contribute to better functioning in the everyday lives of hearing-impaired older individuals. We introduce an integrative concept for the efficient use of hearing aids that involves both satisfaction with, and behaviour towards, hearing aids. We review theoretical and empirical work on the predictors of the efficient use of hearing aids in everyday life. Furthermore, we contend that the use of hearing aids requires improved understanding of the variability of hearing demands within specific contexts of everyday life (e.g. conversation with family members, listening to music). The efficiency of hearing aid use thus depends on the fit of situational demands, personal resources, and the specific configuration of the hearing aid device. We propose an integrative person-environment-fit model that advances concepts of selection, optimisation, and compensation to hearing aid efficiency. We discuss the implications of this model for research and for practitioners in the field of gerontology.

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With regard to age-related hearing loss (ARHL), auditory health care often focuses on audiometric examination and on the fitting of hearing aids. However, a considerable proportion of hearing-impaired individuals neither own nor use a hearing aid [1, 2]. Consequently, audiological and psychological research has addressed the potential predictors and mechanisms associated with increased and improved hearing aid use [3]. Some studies have focused on the prediction of behavioural indicators of hearing aid use, such as the duration or frequency of use, while other studies have predicted evaluative indicators, such as satisfaction with the hearing aid. For example, hearing aids have been found to be used more frequently when there is greater social control [4] and greater cognitive capacity [5], and satisfaction with hearing aids is stronger when individuals hold more positive attitudes [6]. Following these lines of research, we review the literature on predictors of improved use and satisfaction with hearing aids. In which circumstances do older adults benefit from using a hearing aid in everyday life? How and when is it helpful to use a hearing aid in various daily-life contexts? How does the use of hearing aids depend on the resources of the hearing-impaired older adults?

We introduce an integrative concept of the efficiency of hearing aid use. The concept refers to a function of using the device while maximising its subjective utility, for example, with regard to feeling satisfied. We argue that hearing aid use is not exclusively related to benefits and may also have costs, such as personal stigma or problems in handling. In line with successful aging theories, our concept of the efficiency of hearing aid use implies that perceived benefits of hearing aid use should outweigh the costs of using it [7]. We discuss efficient hearing aid use from a resource-oriented perspective and apply the model of selection, optimisation, and compensation (SOC). The consideration of such strategies may improve the understanding of efficient hearing aid use in later adulthood.

We begin by providing an overview of ARHL, its impact on quality of life and the prevalence of hearing aid use in later adulthood. Next, we introduce the concept of the efficient use of hearing aids in the everyday lives of older adults, and review the theoretical and empirical work on predictors of efficient hearing aid use. In accordance with such results, we propose an integrated model of dynamic adaptation for hearing aid use in old age. This model advances the principles of SOC and suggests that situational demands, personal resources, and the configuration of the hearing aid device interact in predicting the efficient use of hearing aids in old age. We conclude with a discussion of implications of this model for improved understanding of hearing aid use in old age.

### Prevalence and Aetiology of ARHL

Hearing loss is the second most common chronic disease in old age. In the USA, 27% of individuals in their 60s, and 55% of 70- to 79-year-olds have bilateral hearing loss [8]. In Europe, the prevalence of hearing loss is slightly lower. In the British Medical Research Council (MRC) trial, 30% of women and 40% of men aged 75–79 years reported hearing difficulty. Sex differences were no longer apparent among individuals older than 85 years [9]. The WHO defines hearing loss as speech frequency (0.5, 1, 2, and 4 kHz) pure-tone average thresholds of 25 dB or greater in both ears. At this level, hearing loss begins to impair everyday life and communication abilities. Disabling hearing impairment that requires tertiary prevention (e.g. hearing aids) is defined as a permanent unaided average hearing threshold of at least 41 dB for the better ear [10].

Although there is no clear aetiology for ARHL, it is characterised by a bilateral, symmetrical hearing impairment that begins with higher frequencies and subsequently affects the main frequencies of everyday speech [11]. Consequently, older hearing-impaired individuals typically complain about problems understanding speech in the early stages of loss. Although ARHL may often be associated with other causes, general aging of the auditory system seems to be the predominant factor. The relevant aging processes include damage to hair cells, loss of blood supply in the cochlea, and loss of nerve fibres and neural elements in the central auditory system. Additionally, chronic exposure to noise over the life span, specific auditory stress events (e.g. trauma), and otological disease might result in hearing loss [12].

Empirical studies suggest that ARHL has detrimental effects on quality of life in later adulthood [13]. Nevertheless, there are few alternative means to counteract ARHL (e.g. auditory training and cochlear or middle ear implants). In most cases, coping with disabling hearing impairment requires the use of hearing aids. In the following sections we will provide an overview of the prevalence of hearing aid use in later adulthood and the predictors of efficient hearing aid use.

### Hearing Aid Use in Later Adulthood

There is evidence that the use of hearing aids may serve to alleviate, or even neutralise, the negative consequences of ARHL [14]. Nevertheless, a high proportion of hearing-impaired individuals neither own nor use a hearing aid. In the USA, the prevalence of hearing aid ownership ranges from 12% of individuals aged 50–59 years to 48% of individuals in their 70s [1]. These age differences are mainly related to the progressive severity of ARHL. Due to differences in the health insurance reimbursement for hearing aids, European data have revealed varying patterns, especially among younger cohorts. According to the EuroTrak survey, 23% (France) to 31% (UK) of hearing-impaired individuals aged 55–64 years own a hearing aid. For individuals older than 74 years, this prevalence ranges from 39% in France to 56% in the UK, which is comparable to the USA [2]. However, the European data may have overestimated the prevalence of hearing aid ownership due to mild to moderate ARHL, as hearing loss was assessed via self-report.

Of those individuals who own a hearing aid, the proportion of owners that do not use the device at all varies between 4.7% in the German sample of the EuroTrak

Study [2] and 24.9% in the Epidemiology of Hearing Loss Study [15]. Hearing aid use is highly stable over time, as individuals decide in the first weeks whether and how long to use the devices [16]. There are significant interindividual differences in the duration of hearing aid use in everyday life. Tesch-Römer [16] observed that daily hearing aid use ranges from 26 to 960 min. Data from the Blue Mountains Study [17] indicate that 15% of hearing aid users wear the hearing device less than 1 h/day, most individuals (60%) wear the device 1–8 h/day, and 25% of all hearing aid owners, especially those with moderate to severe hearing loss, report using a hearing aid for more than 8 h/day.

However, whether hearing-impaired individuals who wear a hearing aid for only a few minutes per day are less efficiently using than those who wear it all day remains an open question. While the frequent and persistent use of hearing aids may alleviate the negative consequence of ARHL, it is not possible to conclude that greater durations of hearing aid use necessarily indicate that users are satisfied with the hearing aid. This issue comprises the question of what constitutes the best criteria for efficient hearing aid use.

### Defining Efficiency of Hearing Aid Use

The findings of earlier studies suggest that very satisfied hearing aid owners may seldom use their device, while dissatisfied individuals may use their hearing aids more than 8 h/day [18]. We argue that hearing aid use is not exclusively related to benefits and may have costs, such as personal stigma or problems in handling. Therefore, hearing aid efficiency depends both on behavioural (e.g. frequency and duration of use) and subjective indicators (e.g. satisfaction).

Herein, we discuss efficient hearing aid use in the context of a resource-oriented perspective that is applied to research on adaptation to aging losses [19]. Accordingly, individuals with higher resources better adapt to age-related losses and report more positive adaptational outcomes, like everyday functioning or quality of life [20]. Lindenberger et al. [7] applied this perspective to technology use in later adulthood. They argued that the use of technical devices needs to require fewer resources than those gained through using the device. In other words, the perceived benefits of hearing aid use should outweigh the perceived costs. Thus, the benefits of hearing aid use are not restricted to improved hearing but are also related to positive affect, reduced stress, social participation, and

more distal evaluation criteria, such as quality of life or everyday competence.

However, positive outcomes of hearing aid use are subject of inter- as well as intraindividual differences as they highly depend on specific auditory demands within different everyday life contexts. Hearing aid efficiency may vary greatly across contexts within an individual's daily life. For example, individuals with moderate to severe hearing loss are hardly able to carry on a conversation at normal volume. They will benefit most by using a hearing aid device, as the devices are optimised for this listening situation. However, hearing aid technology is not always processing music in such ways that hearing-impaired individuals are able to listen to it without difficulty. Consequently, users may experience situation-specific dissatisfaction with the hearing aid.

We refer to efficient hearing aid use as an individual's response to environmental demands that result from the listening situation as well as the hearing aid device. Consistent with the perceived benefits and costs, individuals actively decide on whether to use their hearing aids or not. There are empirical studies that have suggested that hearing-impaired individuals are able to manage everyday life demands without using a hearing aid. In an interview study with 71 individuals aged 40–60 years, Hallberg and Carlsson [21] extracted ten strategies to manage ARHL that include changing the environment and alternative communication strategies; wearing a hearing aid to improve hearing was only one item on this list.

### What Predicts Efficient Hearing Aid Use?

What are the preconditions and characteristics that are associated with efficient use of hearing aids? In this section, we review the theoretical and empirical findings on predictors of hearing aid use. The research cited refers either to behaviourally observable indicators (e.g. ownership, duration, frequency) or to subjective evaluative indicators (e.g. satisfaction) of hearing aid use. We distinguish three separate sources of influences that may relate to improved hearing aid use: personal resources defined as sensory and cognitive capacities and personality characteristics, the demands of the listening situation that result from social, spatial, and auditory contexts, as well as the demands of the hearing aid device. The currently available studies have mainly accounted for the personal resources of the hearing-impaired individual. Although there is little empirical data on the role of context, we also consider the demands of the listening environment and the configura-

tion of the hearing aid in the following sections, as these factors may facilitate or hamper hearing aid use.

### *Personal Resources*

Theoretical models applied to hearing aid use widely focus on attitudes. For example, Wiesner and Tesch-Römer [4] found, in accordance with the theory of planned behaviour, that hearing aid use was best predicted by an individual's intention to use a hearing aid and strong beliefs in social norms (e.g. advice from spouses, doctors, and audiologists). Other studies have found that negative attitudes towards hearing loss, such as denial or trivialisation, are associated with less frequent use of hearing aids [22]. The 'big five personality dimensions', such as agreeableness and neuroticism, have been found to predict hearing aid use [6]. In addition, efficient hearing aid use related to ownership, frequency, and duration of use may also depend on potential losses or declines in sensory and cognitive functioning. Subjective awareness of deteriorating hearing and high self-reported hearing handicaps are among the most often self-reported reasons for purchasing a hearing aid [2]. Furthermore, general health [23], visual and fine motor skills [24] and cognitive resources in terms of working memory capacity [25] and inhibitory capacity have been found to be positively related to hearing aid use in older adulthood. For example, inhibitory capacity, equivalent to conscious or unconscious restraint of behavioural processes (e.g. listening to background noise while talking), differentiates full-time from part-time and non-users of hearing aids [5]. Sociodemographic factors, such as marital status, education, and income, do not seem to differ between hearing-impaired individuals with or without hearing aids [26].

### *Listening Situations*

Listening situations describe the auditory, social, and spatial contexts that an individual experiences throughout everyday life. Older adults have been found to spend 80% of each day at home and about two thirds of their waking hours alone. Nevertheless, the hours spent in the company of partners, family members, friends, or professionals have a particularly positive influence on quality of life [27]. With respect to auditory contexts, there are a number of abstract situations that are assessed within the fitting process, including quiet situations, speech in quiet situations, speech in noisy situations, and noisy situations. The listening situations differ with respect to auditory demands. Quiet situations, such as self-care activities, require little auditory information. In contrast, speech in noisy situations, such as communication in a small group,

is highly dependent on speech understanding. To our knowledge, there are no empirical studies on the prevalence of hearing aid use in different listening situations.

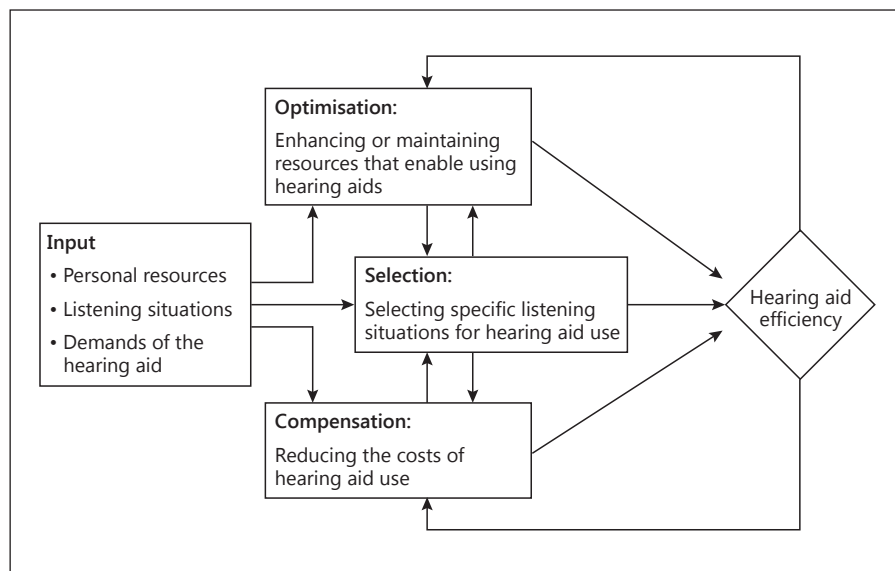
### *Demands of the Hearing Aid*

Unlike visual aids, hearing aids are not capable of restoring sensory acuity to normal. Rather, the use of hearing aids is associated with a significant number of demands, such as difficulties in handling, sound quality, and communication in groups. Even the most advanced hearing aids basically amplify the loudest and closest sounds, which produces detrimental effects in situations with multiple speakers and noisy and echo-filled environments. In line with this argument, Hartley et al. [17] as well as Kochkin [28] reported that, among hearing aid owners, the main reasons for not using a hearing aid were insufficient effectiveness, problems with amplification, and discomfort. In a recent review on predictors of non-use of hearing aids among hearing aid owners, handling problems in using and maintaining the devices (e.g. inserting, changing batteries, volume control) were identified in most of the studies cited [29]. Handling problems gain in importance among the oldest old. A study with nursing home residents revealed that the 86% of the participants needed help taking care of their hearing aids [30]. Based on assumptions of the health belief model, Saunders et al. [31] found empirical evidence that individuals that regularly use their hearing aids perceived more benefits and fewer barriers in device use. Finally, data from a Swiss survey revealed that hearing aid use is related to the configuration of the hearing aid. In this survey, hearing aid use was more frequent among individuals with binaural amplification and more complex signal processing [32].

In the following section, we propose an integrative model of the efficiency of hearing aid use that summarises the findings cited thus far and explicates the prerequisites for, and circumstances in which, older adults benefit from the use of a hearing aid. In the model, benefits are not restricted to improved hearing but are also related to subjective evaluation criteria of hearing aid use, such as positive affect or social participation.

### **Efficiency of Hearing Aid Use: An Integrative Model**

As we stated before, we suggest that positive outcomes of hearing aid use highly depend on contextual factors such as auditory demands within different everyday life contexts. This is consistent with ecological gerontology



**Fig. 1.** Model of the efficiency of hearing aid use.

that suggests that those outcomes may not only depend on personal resources. Rather, resources may have improved outcomes if they converge with contextual demands [33]. Regarding hearing aid use, this perspective implies that the demands of the hearing aid and the listening situations need to fit the specific sensory, cognitive, and personality resources of the hearing-impaired individual.

We suggest that the adaptive functions of efficient hearing aid use may be best understood with the SOC model [34, 35]. The model describes strategies of how individuals make use of their resources to maximise gains and minimise losses over the life span [34]. The model was applied to research on adaptation to chronic disease, like osteoarthritis [36] or multiple sclerosis [37], as well as general aging [38]. Strategy use was found to positively relate to indicators of successful aging [35] and everyday competence [38].

We argue that individuals make use of the strategies of SOC in response to personal and environmental preconditions [39–41]. As the latter may change over time, we stress a dynamic perspective in the model. Also, strategy use may differ from person to person, as the model accommodates wide interindividual differences. Even behaviours that appear initially maladaptive (e.g. not using a hearing aid) are adaptive as soon as their function is examined, such as higher satisfaction or more positive emotional outcomes [42]. Figure 1 illustrates the interplay between personal and contextual resources (input), adaptive strategy use, and hearing aid efficiency as an

adaptational outcome. In the following section, we apply the three principles of SOC to the efficiency of hearing aid use in later adulthood.

### Selection

Hearing-impaired individuals actively decide whether to use a hearing aid in different listening situations (e.g. choosing when to acquire or use the device). For example, older adults with ARHL have been found to disengage from social contexts in which they have trouble hearing [43]. The same may be true when selecting listening situations for device use. The individual might choose not to use the hearing aid in very demanding listening situations, such as group conversations or watching TV in the presence of others. Also, a selective focus on a limited number of activities may help to preserve personal resources.

### Optimisation

Our review of the empirical findings revealed that the use of a hearing aid requires personal resources such as cognitive capacities and fine motor skills. Clearly, the enhancement or training of one's personal resources may result in more efficient use of the hearing aid, that is, optimisation. For example, over the past 20 years, a number of audiologic rehabilitation training programs have emerged that advise hearing-impaired individuals on living with hearing aids and provide knowledge about hearing aids and communication strategies (e.g. choosing the right seat at a table). Some of these training programs

have been evaluated and have shown positive effects on the perceived handicap [for an overview, see 44]. Also, the fitting of the hearing aid device is subject to optimisation. Hearing aid fitting is a process that requires several assessments at the audiologists'. Thereby, hearing-impaired individuals seek to gradually adapt the configuration of their device to the needs and discomforts they are confronted with in everyday life.

### *Compensation*

Clearly, the use of a hearing aid per se involves compensation of ARHL. Additionally, individuals seek to reduce or balance for the specific costs of using a hearing aid; these costs include problems in handling, undesirable background noise, or stigmatisation. Social support positively influences the adoption of hearing aid use; for example, significant others might provide knowledge about hearing aid technology and effective coping strategies [44]. Furthermore, there are an increasing number of alternative hearing-assistive technologies available that either support listening (e.g. FM systems, telecoils, and headphones) or alert the user (e.g. light signals). In a US survey of hearing aid owners, 84% of the participants reported having used at least one of these technologies within the last 2 years. The technologies are mainly used in difficult listening situations in which hearing aid performance is poor, such as being part of an audience or being in a group conversation with background noise [45].

In sum, we argue that the efficiency of hearing aid use may be increased by choosing those situations of everyday life for hearing aid use that best fit the hearing aid configuration (selection) in combination with enhancement of and training in the resources and skills needed to handle the device (optimisation) and balancing or compensating for the inevitable costs that accompany the use of hearing aids.

### **Implications for Future Research**

Here, we reviewed the theoretical and empirical work on hearing aid use in the everyday lives of older adults and introduced the concept of the efficiency of hearing aid use. Thus, we contend that hearing aid efficiency is a function of both actional (frequency and duration of use) and evaluative indicators (satisfaction). We advanced the principles of SOC to determine the prerequisites and circumstances under which older adults benefit from using a hearing aid. In reviewing the literature, we extracted

personal and environmental resources that predict hearing aid use in later adulthood, such as sensory and cognitive abilities, attitudes, personality characteristics, listening situations defined by social, spatial, and auditory contexts, and the configuration of the hearing aid device. We proposed exemplary behavioural correlates of how hearing-impaired individuals orchestrate these resources to maximise hearing aid efficiency. Selection processes mainly pertain to the selection of listening situations for device use; hearing-impaired individuals actively decide whether to use a hearing aid in different social, spatial, and auditory contexts. Optimisation manifests itself in the enhancement or maintenance of resources that enable hearing aid use through fine motor or speech comprehension trainings, as well as in the fitting and fine-tuning of the hearing aid device. Compensatory processes aim to reduce the costs of hearing aid use and are evident in social support from significant others or additional hearing-assistive technologies.

Future research should translate the three strategies into behavioural correlates and verify these correlates empirically and functionally with regard to their relationships with hearing aid efficiency. Respective studies may use biographical interviews as source of information on how the strategies become apparent in hearing aid use in everyday life (see Gignac et al. [36] as a reference for osteoarthritis patients). Also, experimental studies that systematically vary environmental demands of hearing aid use (e.g. different configurations of the hearing aid device, different listening situations) may gain new insights into behavioural correlates of the three strategies (see John and Lang [37] as a reference for a vignette study).

There are a number of theoretical models that aim to explain self-regulatory strategies for dealing with chronic disease. Research on the management of sensory loss is founded on the theory of control, the theory of accommodation and assimilation, or the stress and coping model [e.g. 46]. We chose the SOC model as it highlights the proactive role of the individual in managing losses over the life span. Our perspective is not limited to the use of personal resources (e.g. attitudes, expectations, sensory and cognitive abilities) in response to hearing loss. Rather, we focus on the environmental demands and resources (e.g. demands of the hearing aid device, listening situations) that may interact with personal competence in hearing aid use. The strategies of SOC embrace a dynamic perspective, which is important as ARHL is progressive and there is high variability in the contextual demands of hearing aid use. The model also allows for predictions about how the three strategies relate to adaptational out-

comes. For the review, we chose hearing aid efficiency as a proxy outcome for hearing aid use because we sought to understand the individual and situational circumstances under which hearing aids are actually helpful.

Future research should also account for more distal evaluation criteria and consider the protective effects of efficient hearing aid use on the quality of life of hearing-impaired individuals. Empirical data confirming the positive effects of hearing aid use on physical states in terms of perceived hearing handicaps and cognitive functioning are currently available [14]. Nevertheless, a significant number of empirical studies do not support these preserving effects [16]. We argue that these studies operationalised hearing aid use with behavioural or evaluative indicators and did not account for the high inter- and intraindividual variability in hearing aid efficiency. Therefore, future research may have to consider hearing aid use on a daily or weekly basis for ensuring improved understanding of older adults' everyday lives with hearing aids. The gradual processes of hearing loss and the adoption of hearing aids call for more longitudinal designs with repeated measurement occasions. The findings presented in this review combine research from psychology and audiology. Future studies should apply standardised measures from both disciplines to strengthen the validity and reliability of the findings.

### Implications for Practice

Now that we have pointed out a number of open questions for future research, we will address the implications of this review for practitioners in the field. Maximising the frequency and duration of hearing aid use and the customers' satisfaction is part of the fitting process. The former has been verified via a battery of measures of pure-tone and speech audiometry testing amplification at different frequencies. For the subjective evaluations of hearing aids, there are a number of questionnaires (e.g. SADL, IOI-HA) that quantify the individual's satisfaction in different listening conditions. The results presented underline that those evaluation criteria are highly dependent on the interplay of personal resources, listening situations, and the demands of the hearing aid. Furthermore, hearing-impaired individuals make use of adaptive strategies in response to these resources. Audiologists should therefore precisely account for their clients' individual prerequisites and conditions throughout counselling and hearing aid fitting.

With regard to selection processes, there are a number of standardised instruments that ask the individual to determine the situations in which the hearing aid is most needed (e.g. GHABP, COSI). The better the individuals specify these situations, the better the devices are configured according to their personal resources and most important listening situations. Respective questionnaires should be further optimised for the most important listening situations and should be included in the fitting process. For practitioners in the field, optimisation is not only related to the resources of the hearing-impaired individual but is also related to the configuration of the hearing aid. For example, there are adaptive signal-processing algorithms that account for differences in working memory capacity and adjust directional microphones or noise reduction accordingly [44]. To compensate for the costs of using a hearing aid, practitioners should include significant others in the fitting process or inform patients about alternative hearing-assistive technologies that might facilitate hearing aid use in everyday life.

In conclusion, we reviewed the literature on the predictors of hearing aid use. Based on theoretical and empirical findings, we proposed an integrative model for the efficiency of hearing aid use that involves strategies of SOC. We contend that investigation of such strategies promises to improve understanding of the adaptive use of hearing aids in old age. Future research should account for the inter- and intraindividual differences in efficient hearing aid use in everyday life as a starting point for new intervention concepts in hearing aid fitting and training.

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