The Aging Hand and Handling of Hearing Aids: A Review

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Introduction

A Century of Miniaturization

Over the past 100 years, hearing aids and hearing instrument technologies have undergone a number of technological developments, and perhaps the most obvious of these changes for the general population concern miniaturization. For example, in the first quarter of the 1900s, a typical carbon-based hearing aid, such as the Siemens M22, measured 7.5 x 5.75 x 3.25 inches in size, or approximately the size of a car battery. Today, not only are there hearing devices that are small enough to be entirely positioned in the outer one third of the cartilaginous portion of the ear canal (i.e., completely-in-the-canal hearing aids), but technological developments have reached a point where there now exist "deep canal" devices that are completely situated in the bony portion of the ear canal. This raises the possibility that the trend for miniaturization may have consequences for a person's ability to manipulate and manually operate increasingly smaller hearing aids and hearing instrument technologies (e.g., FM receivers, boots, remotes, etc).

Does Miniaturization Matter?

Although the exact number differs according the definition used for any particular study, population-based studies generally estimate that 31.5 million Americans, or approximately 1 in 10 individuals report hearing difficulty (Kochkin, 2005). Over several decades, hearing aid adoption rates have tended to linger on the order of approximately 20–23% (Kochkin, 2007). Hence, one of the challenges facing the hearing health care profession is to better understand why adoption rates remain so low.

There are a number of obstacles that potentially explain the observed non-adoption rate. Such factors include lack of perceived benefit from hearing instruments, financial barriers, negative attitudes, discouraging past experiences, perceived handicap, comfort and familiarity with using information and communication technologies (Czaja et al., 2006; Gonsalves & Pichora-Fuller, 2008), and/or lack of awareness of the rehabilitation options available for people who are hard of hearing (Kochkin, 2007). Given the miniaturization of hearing aids and hearing instrument technologies, are there also perceived difficulties associated with operating and handling modern hearing instruments? In order to better understand why non-adopters fail to make use of hearing instruments, a recent MarkeTrak study was conducted in which surveys were mailed to 3000 hearing-impaired adults who had not yet decided to pursue hearing aids (Kochkin, 2007). Interestingly, 23% of respondents reported that handling difficulties were one of the reasons why participants did not take action to pursue hearing aids as a possible solution for their hearing difficulties.

There are a number of difficulties associated with manipulating hearing aids and hearing instrument technologies. Difficult tasks include inserting and removing the devices, operating different hearing aid controls such as pressing buttons and toggles, adjusting volume controls, changing accessories such as batteries, wax guard baskets, springs, and receiver tips, coupling different components to a hearing aid (e.g., an FM boot), and general cleaning and maintenance requirements such as the removal of wax. Several of these tasks (e.g.,

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inserting or removing the hearing aids and manipulating the controls) present unusual challenges because they are typically performed when they are worn in or behind the ears such that the person must perform the task without the benefit of visual cues and often when using the non-dominant hand.

In addition to the challenges associated with hearing aids and controls that are becoming increasingly smaller in size, a further complicating issue is that the users of hearing aids may find manipulating hearing aids even more difficult because of age-related decreases in relevant abilities. In addition to auditory deficits observed with aging, older adults also demonstrate well-defined and characteristic age-related deficits in other sensory-perceptual systems. For example, age-related in vision may result in difficulties reading instructions or finding, inspecting, and/or positioning a hearing aid (Erber, 2003). Similarly, age-related changes in cognition may result in difficulties understanding or remembering information necessary for the successful use of hearing aids (Brooks, 1985; Pichora-Fuller & Singh, 2006). Finally, difficulties in manipulating hearing aids may result from "normal" age-related changes in haptics (i.e., the sense of touch) and motor abilities (Erber, 2003; Manchester, Woollacott, Zederbauer-Hylton, & Marin, 1989). In the absence of hand-pathology, diminished hand function manifests after the age of 60 (Carmeli, Patish, & Coleman, 2003), and this may potentially result in greater difficulty operating a hearing aid. Accordingly, anatomical and functional changes of the aging hand should also be considered in the design of hearing instruments and in selecting models for older individuals (for a review, see Erber, 2003).

The Aging Population

Demographic estimates suggest that the proportion of the population aged 65 years and older is growing considerably faster than any other age group (Wong, 1988; Davis, this issue). Although a comparable demographic shift is observed in most developed countries (Siegel, 1988), we consider population changes occurring in Canada as an example. In 2006, census data indicated that seniors represent 13.7% of the population; however, this number is projected to increase to 26.4% by the year 2051. Furthermore, the largest growth is projected to occur in the segment of the population age 85 years and older (Statistics Canada, 2007). As the population ages, greater demands will be placed on hearing health care systems, and in order to deliver effective rehabilitation services for older adults, audiologists must have a greater understanding of the sensory-perceptual changes that accompany aging, and how these changes influence successful rehabilitation. Whereas companion chapters in these proceedings focus on the role on the epidemiology of aging (Davis, this issue) and sensory, cognitive, socio-emotional and health changes in old age (Lemke, this issue), the current paper will focus on how sensory-perceptual changes contribute to the successful manipulation and handling of hearing aids and hearing instrument technologies.

The Aging Hand

Although audiologists are quite familiar with age-related changes in auditory processing and communication function, many practitioners have limited formal training and exposure to information about the anatomical and functional changes that occur in the aging hand. The hands are the most complex and important parts of the upper extremity, and hand function declines with age in both older women and men, particularly after the age of 65 (Carmeli, Patish, & Coleman, 2003). There are reports of declining hand function when older adults perform a number of everyday tasks requiring fine and gross motor control, including tying shoelaces, fastening buttons, and changing earrings (Shiffman, 1992).

It is important to note that diminished hand function arises from interactions among impairments in multiple systems such as the muscular and skeletal systems (e.g., decreased muscle mass and hand dexterity), sensory systems (e.g., declines in visual, haptic, and auditory modalities, particularly insofar as they provide feedback during motor activities), degeneration of the central nervous system (e.g., diminished executive function processes that coordinate complex motor movement) and the peripheral nervous system (e.g., impairments at the level of motor neurons) (Hackel et al., 1992; Hunter, White, & Thompson, 1998).

Age-Related Anatomical and Functional Change

Although it is beyond the scope of the current paper to provide a more comprehensive review of the effect of aging on hand function, we will briefly describe a few of the major changes that are observed in aging hands. With aging, a number of changes occur at the level of bones and joints, with decreases in bone mass starting as early as the third decade in both men and women (Kart, Metress, & Metress, 1978). Perhaps the most common conditions that audiologists are likely to encounter in the course of clinical practice are osteoporosis and arthritis. Osteoporosis is four times more common in women than men, and it affects 30% of women over the age of 65 years. Although osteoporosis is a risk factor for fractures, in and of itself, osteoporosis does not directly result in disability; however, the picture is quite different in the case of arthritis. In the United States, arthritis is one of the leading causes of disability among older adults, with the most common form of arthritis being osteoarthritis (Lawrence et al., 1998). When manipulating a hearing aid, there are several forms of the disease that can negatively affect successful performance of tasks that are required to handle hearing aids, such as osteoarthritis of the hand, wrist, or shoulder and rheumatoid arthritis.

Osteoarthritis

Hand osteoarthritis, or age-related wear and tear, affects more women than men, with prevalence rates of 26.2% in women and 13.4% in men aged 71 to 100 years in the Framingham Study of Aging (Dillon, Hirsch, Rasch, & Gu, 2006). The disease actually comprises more than 100 different disorders of the hand, and the exact cause of osteoarthritis is unknown. Osteoarthritis is a degenerative disease process in which moving parts of the joints deteriorate, and the symptoms may include pain, swelling, stiffness, bone spur formation, joint deformities, restricted range of motion in the fingers and/or wrist, and difficulties in tasks of dexterity that require grip and pinch (Estes, Bochenek, Fassler, & Fasler, 2000). Conventional treatment options include the use of heat to keep hands limber, application of ice to minimize bouts of inflammation, the use of over-the-counter or prescription-strength non-steroidal anti-inflammatory medications such as aspirin, hand splints, cortisone shots, fusion surgery to force bones on each side of a joint to grow together, and joint reconstruction surgery in more extreme cases (Towheed, 2005).

Rheumatoid Arthritis

Rheumatoid arthritis is a progressive autoimmune disease process that results in chronic inflammation of the joints. Like osteoarthritis, the disease also affects more women than men. The estimated prevalence for rheumatoid arthritis is approximately 1% (Lawrence et al., 1998); however, prevalence levels differ based on geographic location, suggesting that environmental factors may contribute to the expression of the disease (Alamanos, Voulgari, & Drosos, 2006). The etiology of rheumatoid arthritis is currently unknown, but research suggests that the disease arises from a complex interaction of genetic and environmental factors (Firestein, 2005); risk factors include a family history of rheumatoid arthritis and smoking. Rheumatoid arthritis can affect a number of joints throughout the body, including the fingers, wrists, knees, feet, and ankles. One of the classic indicators of rheumatoid arthritis is that the hands exhibit a deformity whereby fingers tend to deviate toward the pinkie finger (Rizio & Belsky, 1996). Symptoms vary, but often consist of pain, stiffness with greater rigidity observed when first waking up, swelling of joints, weakness, fatigue, a restricted range of motion for the affected areas, and difficulties for tasks of dexterity that require grip and pinch (Grassi, De Angelis, Lamanna, & Cervini, 1998; Majithia & Geraci, 2007). Typically, the symptoms associated with rheumatoid arthritis are more severe than those observed with hand osteoarthritis (Affleck et al., 1999). Although there is no cure for rheumatoid arthritis, treatments strategies tend to focus on medical, social, and emotional support for the patient by managing pain, minimizing joint damage, and enhancing functional capabilities (Grassi, De Angelis, Lamanna, & Cervini, 1998; Tugwell, Idzerda, & Wells, 2008).

Hand Muscles

Older adults, especially after the age of 60, experience considerable loss in muscle mass as they age, although decreased muscle mass is less prominent in older hands as compared to age-related declines in other muscle groups. Muscle mass decline can range from 25 to 45% and hearing health care professionals may encounter the term "sarcopenia of old age" for patients experiencing such loss (Carmeli, Coleman, & Reznick, 2002). Decreases in muscle mass are highly correlated with decreased muscle strength. After the age of 60, older adults exhibit as much as 20 to 25% decline in hand-grip strength (Rantanen et al., 1998), with significantly accelerated loss of hand strength observed in very old age (Werle, Goldhahn, Dreup, Simmen, Sprott, & Herren, 2009). In general, a 15% loss in strength per decade is observed for older adults aged 50 to 70 years (Grabiner & Enoka, 1995). Prehension refers to the ability to seize, grasp, and manipulate objects, and one prehension behavior of particular relevance for tasks required to manipulating a hearing aid is *precision thumb-finger pinch grip*. On such tasks, older compared with younger adults also experience age-related deficits in the ability to exert finger-pinch strength and maintain steady finger pinch forces (Enoka et al., 2003; Ranganathan, Siemionow, Sahgal, & Yuu, 2001).

The Nervous System

In addition to the loss of strength associated from decreasing muscle mass, older adults experience impaired hand muscle control due to changes in both the central and peripheral nervous system. Particularly after the age of 60, older adults typically have fewer motor neurons, less branching per neuron, a reduction in the number of myelinated nerve fibers, and diminished nerve fiber diameters (Carmeli, Patish, & Coleman, 2003; Galea, 1996; Hesselmann et al., 2001; Mittal & Logmani, 1987). Less is known about the role of central mechanisms in hand function; however, impairment of neurotransmitters (i.e., neuropeptide Y) has also been implicated in the functional declines observed in the aging hand (Lambert, Callow, Feng, & Arnold, 1999).

Tactile Sensitivity, Skin, Vascular System, and Fingernails

For seniors, there are also a number of changes that affect tactile sensitivity, the skin, vascular system, and fingernails. Tactile sensitivity is particularly important for successful operation of a hearing instrument. Compared to younger adults, older adults demonstrate reduced tactile sensitivity in the fingers (Kenshalo, 1986). Research suggests that diminished tactile sensitivity is not attributable to changes in the mechanical properties of the skin, but from a loss of sensory mechanoreceptors (Ulfhak, Bergman, & Fundin, 2002; Woodward, 1993). The skin also becomes drier, slipperier, less elastic, and undergoes a number of cosmetic changes such as wrinkling, veining, and age spots (Cole, Rotella, & Harper, 1999). Skin regenerative processes are also significantly slower in older adults than younger adults, resulting in longer recovery periods following skin trauma (Gilchrest, 2008; Kurban & Bhawan, 1990; Montagna & Carlisle, 1979). In older adults, there is also poorer vascularization resulting in poorer blood flow, and the consequences include less available muscle bioenergy (Kutsuzawa, Shioya, Kurita, Haida, & Yamabayshi, 2001) and poorer thermal adaptation to environmental temperature variation; this may explain why older adults often report that their hands are cold (Evans et al., 1993; Ikeda, Umeda, Tsuda, & Ohta, 1991). For many users of hearing instrument technologies, manipulation is often achieved by using the fingernails, and aging nails undergo change as well. Specifically, the fingernails of older adults are more likely to be thicker, darker, grow more slowly, be more brittle, and become more prone to fungal infections (Carmeli, Patish, & Coleman, 2003; Cohen & Scher, 1992; Gilchrest, 2008).

Hand Tremor

The issue of tremor is another concern that has consequences for audiological rehabilitation, particular as the condition can have severe implications on the ability to perform tasks involving fine motor control. Interestingly, although there is a common belief that older hands exhibit more tremor than younger hands, research findings have been somewhat inconclusive. Although a few studies have observed that older compared with younger hands exhibit greater physiological tremor (Marsden, Meadows, Lange, & Watson, 1969; Morrison, Mills, & Barrett, 2006), other studies have failed to observe more tremor in older adults (Birmingham, Wharrad, & Williams, 1985; Elble, 2003; Raethjen, Pawlas, Lindemann, Wenzelburger, & Deuschl, 2000; Sturman, Vaillancourt, & Corcos, 2000).

Conclusion

Diminished hand function arises from a combination of age-related decline in a number of physical systems that include the muscles, bones, joints, tendons, skin, and the central and peripheral nervous system. One of the principle issues in research exploring the aging auditory system is the need to understand the complex interactions of the auditory pathway starting at the pinna and extending to auditory cortex, and a similar problem faces researchers trying to understand the aging hand. For both areas of investigation, the remaining challenge is to try and tease apart the contributions to performance that arise from age-related degeneration of neural mechanisms from decline observed from either the auditory or upper extremity periphery.

Manual Dexterity and Hearing Aid Use: A Literature Review

Does Dexterity Matter?

Although an audiological assessment tends to focus on the peripheral auditory system by quantifying and qualifying hearing in terms of the degree (e.g., mild, moderate, severe, etc), type (e.g., conductive, sensorineural, CAPD, etc), and configuration (e.g., high-frequency, symmetrical, fluctuating, etc), the recent past strongly suggests that successful hearing aid use also relies on a consideration of non-auditory factors such as cognition and manual dexterity. Importantly, "success" with hearing aids has been demonstrated along a number of different dimensions that can be used to describe how patients benefit from the services provided by hearing health care professionals. For example, the inability to insert an ear mold as a result of reduced manual dexterity has been associated with less hearing aid use (Brooks, 1985). Similarly, several studies have observed that individuals with better handling abilities tend to wear their hearing aids more than individuals who are less able to manipulate hearing aids and hearing aid accessories (e.g., Hickson, 1986; Kumar, Hickey, & Shaw, 2000; Wilson & Stephens, 2003). For example, in a sample of 135 older adult participants who were being fitted with hearing aids for the first time, Hickson (1986) found that manual dexterity predicted who would continue to wear their hearing aids three months post-fitting. Interestingly, dexterity was more important than predictor variables such as age, degree and type of hearing loss, motivation for attendance, and sex, all of which failed to predict who would continue to wear their hearing aids. There is also evidence that manual dexterity predicts who ultimately decides to keep rather than return their hearing aids. In an attempt to differentiate between older adults who are hearing aid adopters or rejecters, Humes, Wilson, and Humes (2003) measured more than 21 audiological and non-audiological predictor variables in a sample of 76 older adults, and found that only the ability to tolerate loud inputs and finger dexterity predicted hearing aid retention (although Mulrow, Tuley, and Aguilar (1992) failed to observe a relationship between manual dexterity and successful hearing aid use in a sample of 194 older adults. In addition to keeping their hearing aids, and choosing to wear them more often, hearing impaired listeners with better manual dexterity also report experiencing more benefit and being more satisfied with their hearing aids (Baumfield & Dillon, 2001; Kumar et al., 2000). Finally, in a study identifying important hearing aid attributes, older hearing-impaired participants rated speech understanding in noise and speech understanding in quiet as the only two hearing aid features more important than handling issues (Meister, Lausberg, Kiessling, von Wedel, & Walger, 2002). Thus, it appears that manual dexterity and hearing aid ergonomics are important consideration in the minds of patients who wear hearing aids, and they are extremely important factors that determine successful hearing aid use in terms of who keeps, wears, benefits, and experiences satisfaction from their hearing aids.

Which Tasks Required for Hearing Aid Use are Affected by Dexterity Issues?

Wearing and caring for a hearing aid involve a number of different motor tasks such as inserting a hearing aid and/or ear mold, various manipulative tasks such as pressing buttons, rotating wheels, flipping toggles, adjusting their fit, coupling boots and wires, changing wax guard baskets and springs, changing receiver tips and batteries, and maintenance behaviors such as removing wax. For example, Singh, Pichora-Fuller, Hayes, and Carnahan (2007) found a positive correlation between manual dexterity and button pressing speed on behind-the-ear (BTE) hearing aids. Although there has been limited focus on the relationship between manual dexterity and successful hearing aid use, research has shown that these motor tasks appear to place different demands on a patient's manual dexterity. For example, more difficulty is observed when patients either try to insert their hearing aid(s) or when they try to make adjustments to a volume control than when performing a number of other tasks such as inserting or removing a battery, turning a hearing aid on (by either closing the door or flipping a switch), or manually adjusting to a telecoil setting (Upfold, May, & Battaglia, 1990). Similarly, Parving and Phillip (1991) also found that the ability to make a volume control adjustment was considered the most difficult task when older hearing aid wearers handled their hearing aids. Hence, these findings would suggest that clinicians need to provide additional counselling for patients when first instructing them on how to insert their hearing aids and if applicable, on how to adjust the volume control.

Is it Easier to Manipulate an ITC, ITE or a BTE?

One of the most common questions that hearing health care practitioners ask in regards to manual dexterity and successful hearing aid use is what kind of hearing aid is easiest to manipulate? Although this question is seemingly quite straightforward, unfortunately, the answer is not as clear-cut. The literature provides several suggestions for dealing with manual dexterity issues. First, it is generally accepted that the BTE style of hearing aids with ear molds are more difficult to insert and remove than custom products (Skinner, 1988; Upfold, May, & Battaglia, 1990; Baumfield & Dillon, 1991), possibly because of the fact that despite their larger size, BTEs with custom ear molds require manipulating three (the hearing aid, ear mold, and tubing), rather than one object. Second, it is also generally accepted that the smaller accessories and controls found on in-the-ear (ITE) and in-the-canal (ITC) products are harder to manipulate than those located on BTE products (Skinner, 1988), especially when making volume control adjustments (Upfold, May, & Bataglia, 1990). Third, the most systematic investigation of manipulative success comparing different hearing aid styles is that by Upfold, May and Bataglia (1990) who compared 244 participants randomly assigned either an ITE, ITC, or BTE plus ear mold style of hearing aid fitting. In general, greater manipulative success was observed for participants fit with ITE than with either ITC or BTE hearing aids. Furthermore, this pattern of performance is consistent with research from Murphy (1980) who found that older adults reported that ITE hearing aids are easier to use than BTEs. All of these findings, however, should be qualified in that studies comparing the ability to manipulate a hearing aid were conducted in an era that did not benefit from the widespread proliferation of open-ear BTE products that we currently see today. Thus, it remains unclear how open-fit products compare with custom products and the extent to which positioning tactics differ for open-fit hearing aids.

How Much Instruction is Necessary?

One point that cannot be overemphasized is that regardless of which style of hearing aid a patient decides to wear, there is good evidence to suggest that hearing aid wearers benefit from aural rehabilitation efforts that provide patients with instruction on the effective use and management of the device (e.g., Brooks, 1979; Abrams, Hnath-Chisolm, Guerreiro, & Ritterman, 1992; Northern, & Beyer, 1999; Chisolm, Abrams, & McArdle, 2004). Furthermore, as suggested by Boothroyd (2007), it is also important to distinguish between "instruction" and "telling", whereby instruction assumes that a client learns how to perform a prescribed behavior through repeated demonstrations and coaching. For example, it may be beneficial if audiologists observe patients operate and handle their hearing aids while performing tasks necessary for their successful use (Alberti, Pichora-Fuller, Corbin, & Riko, 1984). However, even if a patient is able to successfully manipulate a hearing aid in the clinic, this does not preclude the possibility of handling problems developing over time. In one study, a significant number of participants who could successfully handle their hearing aids during an initial hearing aid fitting, demonstrated an inability or considerable difficulty performing the same tasks just one month later (Upfold, May, & Battaglia, 1990). Thus, it appears that detailed and repeated instruction on the use and care of hearing aids may be necessary for some users of the devices, and quite possibly for significant others as well (Pichora-Fuller & Schow, 2006; Preminger, 2003).

What is the Relationship Between Age and the Ability to Operate a Hearing Aid?

Although the effects of aging on hand function and functional performance are poorly understood, there have been several investigations of the influence of age the importance of hearing aid ergonomics and on ability to manipulate a hearing aid. As previously mentioned, whereas older adults (e.g., greater than 73 years of age) consider handling issues to be an important feature to be considered in the design of hearing aids, a different pattern is observed for adults less than 55 years of age for whom hearing aid ergonomics appear to be relatively unimportant (Meister, Lausberg, Kiessling, von Wedel, & Walger, 2002). Interestingly, and perhaps not surprisingly, this age-related difference in the perceived importance of hearing aid ergonomics seems to mirrors the reduced ability of older adults to handle hearing aids that has so often been reported. Although most studies have suggested that the majority of problems handling hearing aids occur for participants over the age of 71 years (Turk, 1986), compared with adults in their 20s, reduced abilities to handle hearing aids have been observed for adults age 60 to 70 when they are initially learning to operate hearing aid controls (Singh, Pichora-Fuller, Hayes, & Carnahan, 2007).

Given that problems in handling hearing aids become more prevalent in adults greater than 70 years of age, issues of manual dexterity may be prevalent for a large percentage of hearing aid wearers, given that the average age of first-time hearing aid wearers is approximately 70–72 years of age (Brunenberg, Chenault, & Anteunis, 2004; Kochkin, 2005). Furthermore, for adults over the age of 70 years, several studies have observed a positive correlation between age and difficulty operating a hearing aid. For example, Henricksen, Noring, Christensen, Pedersen, and Parving (1988) found that participants over the age of 80 have more difficulty handling their hearing aids than participants 70 to 80 years of age. Such difficulties are especially prevalent for patients over the age of 85 (Stephens & Meredith, 1991). In a study of 185 hearing aid wearers who were at least 90 years of age, Parving and Philip (1991) found that roughly 1 in 5 hearing aid wearers were unable to switch their hearing aid on and off, 1 in 4 were unable to insert their hearing aids properly, 1 in 3 were unable to either clean the ear mold or change the battery, and that 40% of the sample were unable to adjust the volume control.

What is the Relationship Between Age, Dexterity, and Type of Hearing Aid?

Consistent with research finding greater success in manipulating hearing aids for participants fit with ITE compared to BTE hearing aids (May, Upfold, & Battaglia, 1990), there is evidence suggesting that middle-aged adults (e.g., individuals in their 50s and 60s) exhibit a preference for manipulating ITE rather than BTE hearing aids (Jerlvall, Almquist, Overgård, & Arlinger, 1983). In contrast, however, it appears that there is a different pattern of performance for patients over the age of 75 years. Compared with patients less than 75 years of age, older patients tend to have more difficulty inserting ITE hearing aids and they find it easier to handle BTE compared with ITE hearing aids (Stephens & Meredith, 1991). Furthermore, first-time hearing aid wearers over the age of 75 years tend to experience more difficulty handling ITE compared with BTE hearing aids (Meredith & Stephens, 1993).

What is the Relationship Between Objective Tests of Manual Dexterity and the Ability to Successfully Operate a Hearing Aid?

Although this literature review has focused on exploring the relationship between age and the ability to successfully manipulate a hearing aid, it is not age per se that is the cause of difficulties in handling hearing aids, but rather the assumed poorer manual dexterity of older adults. To explore this possibility, several studies have examined the relationship between successful handling of a hearing aid and manual dexterity based on performance using well-established objective tests of dexterity. Typically, manual dexterity is assessed using a pegboard test, such as the Purdue (Tiffin & Asher, 1948), Grooved, or 9-hole (Mathiowetz, Weber, Kashman, & Volland, 1984) pegboard tests, whereby participants attempt to place pegs in holes as quickly as possible. In such studies, individuals with better pegboard test scores tend to be better able to manipulate hearing aids (Singh, Pichora-Fuller, Hayes, & Carnahan, 2007), and they are more likely to keep rather than return their hearing aids (Humes, Wilson, & Humes, 2003) and to report wearing hearing aids more often (Kumar, Hickey, & Shaw, 2000); however, mixed findings have been reported with respect to satisfaction. Whereas Kumar, Hickey, Shaw observed a positive correlation between manual dexterity and satisfaction with hearing aids, others have failed to observe this relationship (e.g., Mulrow, Tuley, & Aguilar, 1992). Is there a relationship between sex and the ability to manipulate a hearing aid?

Despite the fact that women perform better than men on measures of manual dexterity that require moving small objects (e.g., fine pegs) (Peters & Campagnaro, 1996), there is some evidence to suggest that older women perform worse than men on tasks that require manipulating hearing aids (Upfold, May, & Battaglia, 1990; Meredith & Stephens, 1993). This sex-related difference in performance may arise from the increased prevalence of hand impairments (e.g., hand osteoarthritis) observed in women previously mentioned (Dillon, Hirsch, Rasch, & Gu, 2006). In contrast to the poorer performance observed in older women, it also appears that men, more so than women, exhibit more age-related difficulty, particularly after the age of 80 years, in learning how to manipulate a hearing aid (Upfold, May, & Battaglia, 1990). It is unknown to what extent this difference in older men arises from possible differences in cognition rather than manual dexterity (Gerstorf, Herlitz, & Smith, 2006).

Should Adults Over the Age of 75 wear ITCs?

At this point, it may be prudent to provide a word of caution. Clearly, hearing health care practitioners are motivated to improve the quality of patients' lives, and in attempting to do so, it may be tempting to conclude that patients younger/older than a particular age cut-off should be prescribed a specific type of hearing instrument, that advanced age necessarily suggests manual dexterity issues, or that an 84-year old man will likely have difficulty learning how to manipulate his new hearing aid. Clearly, there are perils in trying to apply research findings observed across large samples when decisions are made regarding any given patient. Rather, clinical decision-making for a particular individual must take into consideration a conscientious evaluation of the available research evidence and the individual capabilities of each patient. Research by Tonning, Warland, and Tonning (1992) highlights the risks of not considering the appropriateness of ITC hearing aids for older hearing-impaired listeners. Patients' for whom manual dexterity did not preclude the fitting of an ITC hearing aid were found to wear their hearing aids more and to have fewer difficulties operating them when wearing ITC compared with BTE hearing aids.

Do Clinical Impressions of Ability to Manipulate a Hearing Aid also Predict Success with a Hearing Aid?

Interpersonal communication is shaped by contributions from a number of systems including how we talk, our facial expressions, eye gaze, body position and gestures. Recently, and highlighted in popular culture by the best-selling book *Blink: The Power of Thinking Without Thinking* (Gladwell, 2005), there has been a resurgence of interest in gaining a better understanding of the accuracy of information that we gather over short intervals, such as first impressions. People, as it turns out, are capable of forming relatively accurate judgments and evaluations based on minutes-long and even seconds-long glimpses (aka "thin slices") of expressive behavior (for a review, consult Ambady & Rosenthal, 1992). There are, of course, dangers associated with solely relying on thin slices of behavior, but given that time is a limited resource, especially for the busy practitioner, is it possible to rely on information collected over brief time intervals within a clinical context?

Although no research has directly explored such first impressions in an audiological setting, work has been done in other health care contexts, including clinical psychology. Based on brief observation periods, in some cases less than 5 minutes in duration, judgments of interaction quality made by independent raters have been found to accurately predict patient outcomes at levels better than chance (Rogers, Gendlin, Kiesler, & Truax, 1967; Truax, Wittmer, & Wargo, 1971). Moreover, ratings based on brief glimpses of behavior have been demonstrated to not differ significantly from ratings based on longer exposure times (Mintz & Luborsky, 1971). Similarly, Bernieri and Gillis (2001) compared judgment accuracy for periods varying from 5 seconds to 60 minutes and found minimal accuracy improvement with longer periods. Amazingly, in their review of 38 studies of accuracy based on exposure times ranging from 3.5 seconds to periods as long as 5 minutes, Ambady and Rosenthal (1992) found that accuracy did not increase with longer exposure times. Thus, it appears that social-behavioral judgments can be relatively accurate even when made relatively quickly.

Perhaps one of the more interesting findings to emerge from the literature on manual dexterity and successful hearing aid use is the predictive power of the clinician's first impressions about a patient's ability to handle hearing aids. Two papers highlight the possible relationship between clinician judgments of a patient's ability to handle and manipulate hearing aids and successful outcomes associated with the use of hearing aids. Wilson and Stephens (2003) examined 140 first-time hearing aid wearers, and after an initial consultation, patients returned three months later. During the second consultation, clinicians rated each patient's ability to handle their hearing aid and recorded the reported use of the aid, and found that patients who were judged to be better in handling their hearing aids were also those individuals who reported wearing their hearing aids often. Regardless of whether the relationship between a clinician's first impressions and the ability to manipulate a hearing aid arises from pre-existing differences in dexterity or from repeated use of the hearing aid (i.e., practice), it appears that trained clinicians can use their observations of patient dexterity to predict successful use of hearing aid with some degree of accuracy.

There is also evidence to suggest that a clinician's first impressions about a patient's ability to manage their hearing aid can predict how much a patient wears their hearing aid *three months later* (Hickson, 1986). What makes these findings even more astounding is that in this study, each audiologist's impressions were collected while the patient was being fit with hearing aids for the first time. There is, of course, the possibility that the audiologists who provided these judgments may have been particularly skillful clinicians. For example, it is unclear to what extent a clinician's ability to assess a patient's manual dexterity develops from specific training they received, years of practice and experience, or from observing participants while they perform specific tasks of dexterity necessary for long-term success. Hence, there appears to be stronger evidence to suggest that objective tests of dexterity predict successful use of a hearing aid, and preliminary evidence to suggest that trained clinicians can assess a patient's manual dexterity. Furthermore, it appears that such assessments have implications for short and possibly long-term hearing aid use and benefit. Clearly, these findings are exciting, and more research is necessary to explore the relationship between a clinician's first impressions and the ability to successfully manipulate a hearing aid.

Conclusions and Clinical Implications

A number of anatomical and physiological changes occur in the aging hand. These include changes to muscles in and serving the hand, joints, tendons, skin, and central and peripheral nervous system. As a result of these changes, older adults, particularly after the age of 60 years, report experiencing gradual declines in hand function. Of particular relevance for hearing aid use is that behaviors affected by age-related changes to the hand are those that require fine motor control. These difficulties are likely to be exacerbated by technological developments in the hearing aid industry that result in manufacturing increasingly smaller hearings instruments and hearing aid controls. The combined effects of diminished hand function and hearing aid miniaturization translate into a potential crisis in handling difficulties, which may explain in part, why hearing aid adoption rates remain low. The difficulties include most, if not all, motor tasks associated with wearing and caring for hearing aids.

Manual dexterity and ergonomic design are important to a large segment of the population wearing or thinking about wearing hearing aids, and they impact a patient's decision to keep rather than return, wear, benefit from, and experience satisfaction with their hearing aids. Different problems in handling hearing aids emerge for ITC, ITE, and BTE hearing aids, and thus, the prescription of any particular type of hearing aid will depend on the visual, cognitive, haptic, and motor abilities of the individual. There is strong evidence to suggest that patients experience more positive outcomes after they are trained to properly use and handle their hearing aids. In general, there should be more consideration of dexterity and potential problems in handling hearing aids for older compared with younger patients. Finally, given that most hearing health care clinics lack formal tests of manual dexterity, there is preliminary evidence to suggest that some clinicians are capable of judging a patient's ability to manipulate hearing aids, even in patients wearing hearing aids for the first time.

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