Speech Mapping and Probe Microphone Measurements

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Essentials of Modern Hearing Aids: Selection, Fitting, and Verification
(coming fall 2017)

Speech Mapping and Probe Microphone Measurements

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Typeset in 10.5/13 Minion Pro by Flanagan's Publishing Services, Inc.
Printed in the United States of America by McNaughton & Gunn, Inc.

Library of Congress Cataloging-in-Publication Data:
Names: Mueller, H. Gustav, author. | Ricketts, Todd, author. | Bentler, Ruth A., author.
Title: Speech mapping and probe microphone measurements / H. Gustav Mueller, Todd A. Ricketts, Ruth Bentler.
Description: San Diego, CA : Plural Publishing, [2017] | Includes bibliographical references and index.
Identifiers: LCCN 2017009204| ISBN 9781944883942 (alk. paper) | ISBN 1944883940 (alk. paper) | ISBN 9781944883942 (e-ISBN) | ISBN 1944883940 (e-ISBN)
Subjects: | MESH: Hearing Aids | Correction of Hearing Impairment--instrumentation | Audiometry, Speech--instrumentation
Classification: LCC RF290 | NLM WV 274 | DDC 617.8--dc23
LC record available at https://lccn.loc.gov/2017009204

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Preface

Although the notion of measuring the output of a hearing aid in the real ear had been tossed around since the 1940s, it was not until the late 1970s that a "dispenser friendly" system was available. In this case, the term "dispenser friendly," is used somewhat loosely. The late 1970s equipment that we are referring to was first described in a paper that was presented by Earl Harford, Ph.D. in September of 1979 at the International Ear Clinics' Symposium in Minneapolis, Minnesota. At this meeting, Earl reported on his clinical experiences of testing hearing aids in the real ear using a miniature (by 1979 standards) Knowles microphone. The microphone was coupled to an interfacing impedance-matching system (developed by David Preves, Ph.D., who at the time worked at Starkey Laboratories), which could be used with existing hearing aid analyzer systems. Unlike today's *probe tube* microphone systems, this early method of clinical real-ear measurement involved putting the entire microphone (about 4 mm by 5 mm by 2 mm) in the ear canal down by the eardrum of the patient. If you think cerumen is a problem with probe microphone measurements today, you should have seen the condition of this microphone after a day's work!

While this early instrumentation was a bit cumbersome, we quickly learned the advantages that probe microphone measures provided in the fitting of hearing aids. We frequently ran into calibration and equalization problems, not to mention a yelp or two from the patient, but the resulting information was worth the trouble. Word of this new testing technique traveled fast, and a study of the clinical applications was soon underway at Walter Reed Medical Center in Washington, D.C. In the fall of 1980, at the ASHA convention in Detroit, Michigan, the first paper on this topic at a national meeting was presented, authored by Walter Reed audiologists Dan Schwartz, Brian Walden, Gus Mueller, and Rauna Surr.

In the early 1980s, the first computerized *probe tube* microphone system, the Rastronics CCI-10 (developed in Denmark by Steen Rasmussen), entered the U.S. market. This system had a silicone tube attached to the microphone (the transmission of sound through this tube was part of the calibration process), which (thankfully) eliminated the need to place the microphone itself in the ear canal. The Rastronics real-ear analyzer (in prototype form) was first demonstrated at the 1982 ASHA convention in Toronto, Canada. At the time, there was a distribution link with Bernafon hearing aids, and the demonstration was at the Bernafon booth. In October of 1983, the first clinical model, the CCI-10, was shown at the national hearing aid meeting in Denver. The product was bundled with Bernafon hearing aid sales, deals were struck, and within a few months, clinical probe microphone testing was occurring at offices across the United States.

We soon saw several other companies introduce equipment to enter into the probe microphone market. One of the first to join Rastronics in the marketplace was the product line Acoustimed from South Africa, which operated using an Acorn Computer, and unlike other products that used swept tones, the Acoustimed used a click as in the input stimulus. The Bosch company introduced a probe microphone product with the perhaps the most intriguing name—the "Invivo." One product that gained popularity quickly, and provided the most competition for Rastronics was the "IGO" (insertion gain optimizer) from Madsen. And finally, maybe the most over-engineered product of the day was the "Aurora," which was part of Nicolet's Project Phoenix, and was used to fit the digital hearing aid from this project. The probe placement device of the Aurora scared away most clinical audiologists, as it was a large metal apparatus, fitted to the head containing various nobs to adjust the probe up or down, right or left, in or out. The preciseness probably pleased a handful of researchers, but the process was too cumbersome for clinical use, and the appearance was something associated more with brain surgery than assessing the performance of a hearing aid.

A bigger issue than the equipment itself was developing standard terminology and procedures for all the new measures that were now being conducted with hearing aids on the real ear. In 1986, Dave Preves was quoted in the *Hearing Journal*, as stating: "An Acoustical Society of America study group will meet this month [May 1986] to begin discussing the standardization of real-ear measurement terminology." It was a decade later before the first ANSI standard on probe microphone measures, S3.46-1997, was published. Like good wine, standards take time to reach maturity.

While waiting for the phantom standard to emerge, audiologists published papers using the terminology that was rumored to be part of the standard, and was already being tossed around by clinicians. The first complete summary of all these terms, however, was in a 1992 book written by Gus Mueller, David Hawkins, and Jerry Northern, titled *Probe Microphone Measurements*. Two hearing aid companies, Starkey and Siemens, bought thousands of these books, and distributed them widely, free-of-charge among audiologists. The word was finally out to the masses describing what probe microphone measurements were all about.

So, 25 years have passed since that first book on probe microphone measurements—it is now out of print, although some pristine collector's copies can be found on eBay. Interestingly, it was never revised, and no other book dedicated to probe microphone measurements has been published since—until now! There are a few things that haven't changed much in 25 years, but there are a lot more things that have. We have tried to include all of them in our current text.

The three of us are pretty confident, and we think we have the answers to most things (at least regarding to hearing aids), but the one thing we can't explain is why the verification of hearing aid gain and output using real-ear measures has not become routine practice—estimates for the U.S. place the adoption of this testing at no more than 20 to 25%. The equipment is readily available, the procedures are easy to learn, and the time commitment is minimal. The penalty (to the patient) if the audiologist does not do the testing can be huge. For the audiologist, failure to verify is bordering on malpractice. Moreover, there isn't an alternative fitting method. We talk about all this in Chapter 1, hoping to get some of you who are on the fence to become *believers*.

Fitting hearing aids using speech mapping procedures indeed does require more time than simply asking the patient "So how does that sound?" Clinicians often ask—is

all that work really worth it? The answer is a resounding "yes." Forgetting for a moment the ethical and possible medical-legal ramifications of fitting hearing aids and *not* providing patients with appropriate audibility, considerable data show that as verification and validation measures increase, so do patient benefit and satisfaction. Research findings also show that in general, patients fitted to a validated prescriptive approach have improved speech understanding, real-world outcomes, and a preference for the prescriptive gain and output. Moreover, large studies such as MarkeTrak VIII clearly indicate that as audiologists add various verification and validation components of Best Practice to their fitting protocol, satisfaction increases accordingly, patient loyalty increases significantly, and follow-up visits for hearing aid adjustments are reduced.

The primary use of speech mapping and probe microphone measures is to verify gain and output on the day of the fitting. To state the obvious, if something is verified, there must be a reference standard. We believe an excellent starting point is the use of a validated prescriptive fitting approach. Today, we have two, well-researched methods, the NAL-NL2 and the DSL v5.0. We provide you with a review of both of these well-established and validated methods.

The core of this book is dedicated to the nuts and bolts of conducting the probe microphone measures. This could be speech mapping for determining a match to target, or it could be an RESR85 measure to assure that the MPO is okay, or it could be the use of special speech signals for programming frequency lowering. For each test and procedure, we provide background information, a clinical step-by-step protocol, and case examples, all geared toward the day-to-day fitting of hearing aids. Just in case we forgot to mention something in these core chapters, we also included a special FAQ chapter, which provides the answers to just about every question that we could think of—most of which, are questions that we have gotten at one of our workshops. Finally, because fitting hearing aids is not only just about real-ear verification, we provide a final chapter on "putting it all together." Here we provide a brief outline of other procedures that supplement probe microphone measures before and after the fitting—the details of which you can find in our other three books.

For those of us who use probe microphone measures routinely, it is difficult to imagine how hearing aids could be fitted without this testing. Certainly, using either the REAR or the REIG is essential for verification of prescriptive targets and determining appropriate audibility of the amplified signals—there is no alternative choice. Along with being critical verification measures, these procedures are also helpful in assessing and adjusting several hearing aid features, and in troubleshooting post-fitting problems. Moreover, conducting these measures can be fascinating and educational, and sharing the results with the patient is a very effective counseling procedure. Clearly, the routine use of probe microphone assessment and making reasoned decisions based on the findings is one of the most important components in the overall fitting of hearing aids. Without this information, we are forced to make choices based on guesses, hunches, or clinical intuition, instead of data. This is certainly not something we want to do if we are truly interested in providing evidence-based services.

The authors wish to acknowledge the generous support of Otometrics during the writing and production of this book.

1 The Underlying Rationale

Wrong does not cease to be wrong because the majority share in it.

—Leo Tolstoy

Every university professor who teaches hearing aid classes knows the story. Five years after her graduation, you run into one of your prized AuD students at a conference. She was, of course, trained to follow Best Practice Documents and always conduct probe microphone verification back at the university. But now she says, "I probably shouldn't tell you this, but I never do probe microphone verification anymore. No one else at my clinic is doing it, so I don't either." The Tolstoy quote above says it best.

We want all of our hearing aid patients to be happy, right, and leave our offices with a smile on their face? Although it is nice to see them smile, this *verification* approach doesn't quite follow evidence-based practice. It has been shown time and time again that a *validated* prescriptive fitting method should be used as a starting point for *verification*. As we discuss later, when we have verification of a validated prescriptive method, we have a good understanding of the trade-offs between audibility, speech understanding, sound quality, comfort, and other factors involved in the fitting of the typical patient. This may not be the end point for all patients, and gain adjustments may be necessary. However, if we start with ear canal sound pressure level (SPL) reference information relative to the individual patient's dynamic range, we then know what effect we are having on audibility when we make changes from a validated method, and the potential impact of those changes. Perhaps it's obvious, but we'll say it anyway, the only way you know if you are fitting to a specific fitting method, is to observe SPL in the ear canal.

We all know of cases in which a patient was fitted without real-ear verification, and several patient-driven adjustments had to be made, and the patient ended up with little or no gain. For instance, we recall one case of a hearing aid wearer—who interestingly also happened to be an audiologist—using new instruments he had fitted to himself through careful listening. After volunteering to be a demonstration patient at one of our probe microphone workshops, he and the rest of the audience discovered that he had simply programmed his hearing aids to match his unaided open-ear canal resonance—the hearing aids had no real-ear gain above 1500 Hz.

Although behavioral measures can be helpful, they are complementary and not a substitute for the objective assessment of hearing aid output in the ear canal. It is important to understand that a *prescriptive fitting* is ultimately based on the desired amplified signal level in the ear canal, not a 2cc-coupler measure (at least not without correcting for differences between the ear and the coupler), a KEMAR measure, or a

computer simulation in the fitting software. Therefore, *probe microphone measures* of hearing aid performance *(or individual real-ear corrections to the coupler these provide)* are needed for verification of our chosen prescriptive method.

The importance of these procedures has been emphasized and recommended in every hearing aid-fitting guideline published in the past 20 years. As an example, the following excerpt is taken from the 2006 fitting guidelines of the American Academy of Audiology (AAA) (p. 25):

> The objective of this segment of the fitting process is to ensure that the fitting and verification procedure is viewed as a process rather than an event, which culminates in the optimal fitting for the patient. Verification procedures also serve as a benchmark against which future hearing aid changes can be compared. Specific goals and rationales underlie all hearing aid fittings. Verification procedures should be based on validated hearing aid fitting rationales.

As mentioned earlier, you are using a validated method only when that method's prescribed gain and/or output are referenced to what is required in the ear canal. We mention this again as this concept doesn't seem to be obvious to all clinicians. For example, Mueller (2005b) reported that in a survey of audiologists fitting hearing aids, 78% stated that they routinely were using a validated prescriptive fitting approach (i.e., either the NAL or the DSL). Interestingly, however, of this 78%, only 44% reported routinely using probe microphone measures. Question of the day: How do the remaining 56% know what method they are using, or if they are using any method at all? This is like saying that you drove exactly 60 mph all the way to work, only to admit that the speedometer in your car never moves off zero! You need a speedometer, and you have it—it's your probe microphone equipment.

Mueller and Picou (2010) identified a similar disconnect in their survey findings. From their sample, 79% of audiologists reported using a validated prescriptive fitting approach, and yet only 59% of this group routinely used probe microphone verification. Another peculiar finding from this survey was, that of the respondents who said they used prescriptive methods routinely *and* also reported conducting probe microphone testing routinely, only 37% said that their primary reason for using probe microphone testing was to verify these targets.

Real Ear Versus Probe Microphone Versus Speech Mapping

There are a few different terms that refer to the act of putting a tube in the ear canal and measuring the output from the hearing aid in the real ear. An early term that was used for this was *in situ* measurement, meaning "in position"—a reasonable term, as indeed the hearing aid is measured in the *use position*. In early marketing efforts of probe microphone equipment, however, it was important to make the distinction that the testing was conducted on the *real ear* and not in a 2cc coupler. *In situ* did not have much meaning to most audiologists, so it made more sense to refer to the testing as *real-ear measurements* (REM). The term REM (pronounced *rhem*) is sometimes used today by manufacturers and audiologists.

Whereas testing during the first 20 years of probe microphone assessment mostly involved swept pure tones and composite noise as the input signal, in the past decade, speech shaped signals, or real-speech inputs, have become routine. The use of these signals in combination with plotting the patient's

CLINICAL CONCEPT: You Don't Fit Hearing Aids by PROBE

We often overhear at audiology meetings, perhaps around a cocktail table, one audiologist asking another, "So do you fit your aids by probe?" There seems to be a common belief that probe microphone measures are a way to fit hearing aids. They are not. They are simply a way to *verify* your way of fitting hearing aids. We know of large clinics where the audiologists are required by their supervisor to do probe microphone measures. What audiologists may do is push the magic button that provides a fit to the manufacturer's default fitting, then conduct probe microphone testing for inputs of 55, 65, and 75 dB SPL, and put the results in the patient's chart. Not one hearing aid adjustment involved! Did they *fit by probe*? Some might say they do. Are they fitting by a validated rationale? Not likely, as we describe in detail later in this chapter. Again, the act of conducting probe microphone testing is not a way of fitting hearing aids—the validated rationale is the way—which needs to be verified.

To reiterate this point in another way, we use a weekend construction project as an analogy to the fitting of a hearing aid. Let's say you are going to build a doghouse. You start with a general design (type of roof, door size, etc.—just as you start with selection of a validated fitting rationale). You then go online and find a blueprint for building the doghouse that fits your design (exact dimensions for all the pieces that will need to be assembled—just as you obtain desired gain and output values for your fitting method). Now, while cutting the pieces for this doghouse you might use a tape measure to *verify* that all the pieces fit your blueprint. (Remember the adage, "Measure twice, cut once.") Would you tell your woodworking colleagues that a tape measure is a way to build a doghouse? Not likely. But could you build a sturdy and nice-looking doghouse without using a tape measure? Probably not!

dynamic range in SPL has prompted audiologists to refer to the testing as *speech mapping*. This term was first used in the early 1990s when Bill Cole and his colleagues introduced this feature, trademarked as Speechmap™ on the Audioscan coupler/probe microphone unit from his company, Etymonic Design Incorporated. This equipment did not produce a shaped speech signal all at once, but rather a series of tone pips/bursts whose levels reflected the frequency-specific long-term average speech spectrum (LTASS) levels. Most audiologists today use a speech-shaped/shaped-speech input signal, and if different input levels are used and they are plotted relative to the patient's residual range of hearing, they are conducting speech mapping. That is, if it's not plotted for different input levels, it's not really a "map" of the ear canal output. Of course, you can't do REM or speech mapping without a probe microphone, so that too is a reasonable term, particularly because many probe microphone measurements to not involve using a speech signal.

Which term is correct? Or better, which term will cause the least confusion? We believe there is a clear choice, and that choice is probe microphone measures, for several reasons. First, consider the procedures for conducting aided sound-field testing and functional gain. The last time

we checked, these are *real-ear measures* of hearing aid performance. There are government forms that very specifically require the "real-ear measure of hearing aid performance" with the patient wearing one versus two hearing aids. They are referring to aided sound-field testing. If you believe that the term *real ear* relates only to probe microphone measures, this request would be quite puzzling, as there is no probe microphone measure that would assess the summation effects of two instruments.

On a recent audiology Listserv we saw this posting: "I'm going to buy some real-ear equipment, but I can't decide if I should purchase probe microphone or speech mapping?" This posting highlights our second point. Probe microphone testing nearly always *is* speech mapping; speech mapping nearly always *is* a component of the probe microphone assessment of a hearing aid. They are not two different things. Therefore, it is much simpler to call the entire process *probe microphone measures*, as, although it is likely that this will include speech mapping, it is also very possible that some of the testing will not be speech mapping; for example, a swept-tone MPO measure, the measure of the occlusion effect, and so forth.

So, with all that said, in this book we use the term *probe microphone measures* to describe all types of real-ear testing of hearing aid performance.

Compliance with Best Practice Guidelines

The use of probe microphone measures for hearing aid verification has always been assumed when Best Practice guidelines were written. Going back to the recommendations of the 1990 Vanderbilt Report II (see Hawkins et al., 1991), probe microphone assessment has been mentioned as either the preferred method or one of the preferred methods for verification. Over the years, published guidelines from the Independent Hearing Aid Fitting Forum (IHAFF), the ASHA, and the AAA have recommended the use of probe microphone verification. The statement on this topic from the 2006 AAA document is unambiguous: "Prescribed gain (output) from a validated prescriptive method should be verified using a probe microphone approach that is referenced to ear canal SPL."

In case you think this is only a United States recommendation, this International Society of Audiology (2005) excerpt from their document "Good Practice Guidance for Adult Hearing Aid Fittings and Services" states the fitting tolerances that are acceptable internationally.

> Where a fitting rationale contains an acoustical target, each hearing aid fitting should be verified by real-ear measurement using an input stimulus appropriate for the hearing aid under test prior to any fine-tuning. Tolerances to the prescription rationale of ±5 dB at frequencies of 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz and of ±8 dB at 3000 and 4000 Hz should be achieved in all cases. In addition, the slope in each octave should be within ±5 dB/octave of the target. Where it is not desirable or possible to achieve a prescriptive target (e.g., because of feedback issues) or where the measurement is not technically feasible, the clinical record should contain an explicit statement to this effect. (p. 5)

We know, however, that what is supported by research evidence, recommended by opinion leaders, and published in Best

Practice Documents, does not always find its way into routine clinical audiology use. The best example of this might be the persistent use of live-voice speech recognition testing, despite the abundance of literature showing the many shortcomings of this practice (see Hornsby & Mueller, 2013; Mueller, Ricketts, & Bentler, 2014). But what about probe microphone measures? The clinically friendly equipment for this testing has been available for more than 30 years. Are these measures a routine part of the hearing aid fitting protocol for all or most audiologists? This topic has generated a number of surveys, so we do have a pretty good idea of compliance. In the following four surveys, the audiologists responding were actively engaged in the fitting of hearing aids, and *routine use* was defined as using probe microphone measures with at least 50% of adult patients:

- In 1995, Mueller and Strouse reported that the routine use of probe microphone measures was 54% for audiologists (n = 134) and 18% for hearing instrument specialists (HISs; n = 108), with an overall average use rate of 39%.
- In 1999, Mueller again examined use rates for both audiologists and HISs, but this time limited the survey to those who owned or had access to the equipment. When the two professional groups were combined, 42% reported routine use.
- In 2003, a Mueller survey of primarily audiologists (n = 558 audiologists, 49 HISs) showed an overall routine use rate of 37%.
- A few years later, Mueller (2005b) again examined the popularity of these measures, this time among audiologists only. The overall use rate was 34%. It was slightly higher (~40%) for recent graduates (either masters level or AuDs) and for experienced audiologists who had obtained their AuD through distance learning.

The results of these surveys are surprisingly similar, showing, in general, routine use of probe microphone verification of about 35% to 40%. This takes us to the most recent and extensive survey on the topic by Mueller and Picou (2010). This online survey used data only from U.S. practitioners who dispense hearing aids, and included a total of 420 respondents, of which 309 were audiologists (74%) and 111 (26%) were HISs. One of the questions related to the routine use of the equipment on the day of the fitting. The results are shown in Figure 1–1.

If we first look at the left portion of Figure 1–1, we see use rates that are quite similar to what has been found in other surveys: about 45% for audiologists, 36% for HISs, with an overall use rate of 41%. These data are for the total sample, which includes individuals who do not have the equipment. The data on the right portion of the chart are only for those respondents who stated that they have the equipment available. As we would predict, this increases the use of this testing (more so for HISs), but not by nearly the amount that would be expected. Consider that for both groups, about 45% of the audiologists and HISs who have the equipment don't use it routinely. These data are nearly as low as surveys regarding use rates for people who own treadmills! Of course, people completing this survey knew what the correct answer was. Using the findings from some lie detector questions embedded in the survey, Mueller and Picou (2010) concluded that the actual use rate is not even as high as their results indicated—as many as 25% of respondents said that they were doing probe microphone measures that don't even exist.

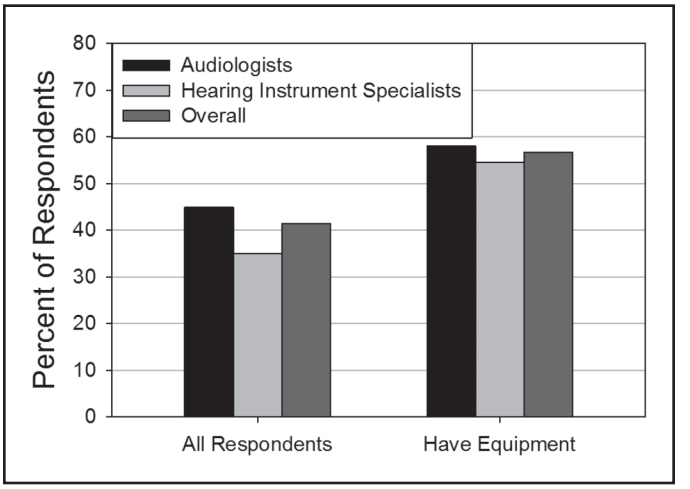

Figure 1–1. Survey results comparing "routine use of probe microphone measures" indicating across all respondents, about 41% use, and across practitioners who have the equipment, about 55% use. Adapted from Mueller and Picou, 2010.

One finding we find interesting is that in 1995, probe microphone use for audiologists, versus hearing instrument specialists (HISs), was 54 to 18%. Today, or at least in the 2010 survey, the use rate is essentially the same between these two groups, due to a considerable uptake by the HISs. Why is this? Although we have little data on the topic, we do have some opinions formed from discussions with individuals from both groups, as well as manufacturer's sales reps, who probably know the straight scoop the best. Here are our thoughts:

- There are fewer "mom and pop" HISs today than there were 20 years ago. Currently, HISs are younger and more tech savvy.
- Many HISs in private practice are no longer with a franchise company, but are now selling the same hearing aids as the audiology practice down the street. This places a greater emphasis on the quality of the fitting, using the right equipment, and a contemporary fitting protocol.
- More and more, the fitting is driven by consumers, as they become better educated regarding the right and wrong way to fit a hearing aid. In July 2009, *Consumer Reports* reported that in their sample, about two-thirds of hearing aids sold were fitted incorrectly. The article concluded: "The provider should do several tests to verify that they (hearing aids) are working optimally. Of that battery of tests, one stands out as a must-have: the real-ear test."
- Finally, in recent years the hearing aid distribution system has changed, with many chains and big-box stores dispensing hearing aids. These are common employment sites for HISs, and many, if not most of these stores, make an *effort* to follow Best Practice guidelines; sadly, perhaps more so than some audiology practices. Individuals

> working at these sites are strongly encouraged to follow the established Best Practice protocols.

Much of the MarkeTrak VIII report focused on verification, including the administration of tests such as probe microphone measurements (e.g., Kochkin et al., 2010; Kochkin, 2011). The approach taken by MarkeTrak VIII was different from that used in the other surveys we have reported. Rather than asking audiologists and HISs if they conducted the testing, individuals purchasing hearing aids were queried if they had received testing using a probe tube inserted in the ear. Survey findings reported that 42% of the respondents stated that they received this testing, and there was not a significant difference in the frequency if the patient had been fitted by an audiologist or an HIS—findings which more or less agree with the Mueller and Picou (2010) survey.

Possible Ethics Violation?

Ever since it became obvious that audiologists were not adopting the use of probe microphone measures at the rate that everyone expected, many of us have publicly commented that not doing probe microphone assessment when hearing aids are fitted is clearly *poor clinical practice*. In a 2009 article in *Audiology Today* titled, "It's a Matter of Ethics," Catherine Palmer took it to a different level. She questioned if not doing probe microphone testing is a violation of the code of ethics of our major audiology professional organizations. She specifically stated, "If we talk about ethical practice, then we have to be comfortable saying that there are hearing health care providers (audiologists) who are not practicing ethically" (p. 32).

Most of us think of unethical practice related to the fitting of hearing aids as things such as free trips to Hawaii or giving kickbacks to referral sources. But the Code of Ethics for professional organizations also includes items related to how we perform clinical audiology. For example, Principle 2 of the AAA Code of Ethics states, "Members shall maintain high standards of professional competence in rendering services." Principle 4 states, "Members shall provide only services and products that are in the best interest of those served." Principle of Ethics II from the ASHA *Code of Ethics* states that "Individuals shall honor their responsibility to achieve and maintain the highest level of professional competence."

Consider this example: If you don't use probe microphone measures, how would you know if you had even made soft sounds audible—one of the most basic components of the hearing aid fitting? If you actually sold a pair of hearing aids and *didn't* make soft sounds audible (simply because the necessary software adjustments were not made), would this be a "high standard of professional competence?" Would it be "providing services that are in the best interests of those served?" Not really.

Palmer (2009) concludes her article with the following.

> I hope we can continue to discuss the reasons that hearing aid acceptance is not higher in the hearing-impaired population. The fact that a doctoral profession is arguing about whether or not to individually verify the gain and output of a hearing aid in a patient's ear that takes less than 5 minutes might just be a good place to start. If you are wondering if providing this level of verification will establish you as an expert and set you apart from other providers, keep

in mind that it does not require any particular expertise to attach cords to a HI-PRO Box, double click on NOAH, enter a patient name, click hearing thresholds on a graph, double click on a manufacturer icon, and click "first fit." This level of "expertise" does not require a doctoral degree. As a profession, it is time to be an expert. An expert knows exactly what levels of sound are being produced in an individual's ear canal and how those levels correspond to the listener's residual dynamic range of hearing. (*Audiology Today*, p. 34)

Reasons for Not Conducting Probe Microphone Measures

More important than the recommendations of best fitting practices and experts, is that the research evidence that we detail in the following discussion clearly demonstrates the importance of completing probe microphone measurements. Despite being the intuitive thing to do, the right thing to do, and therefore, we think the ethical thing to do, as surveys reveal, probe microphone testing is *not* conducted by most audiologists when they fit hearing aids. Over the years, there have been many reasons postulated regarding why this is true, as well as articles written on the topic (Mueller, 2005b). We review several of those reasons here.

Equipment Isn't Available

Why would one choose to set up a practice without the necessary equipment? Certainly, the overall cost of essential equipment must be considered, but used systems, in good working condition are available for a few thousand dollars, and the more basic new systems sell for only a little more. Lease-to-buy deals are available for around $100.00 per month. Given that many clinics and offices will have gross annual hearing aid sales of $300,000 to $500,000, a $5000 equipment purchase that leads to improved patient satisfaction and benefit does not seem very unreasonable. Would an audiologist decide to whistle pure tones, and open a clinical practice without an audiometer?

Not Enough Time

If you unbundle your products and services, what percentage of the total cost of a pair of hearing aids is for the hearing aids themselves, and what portion is for our services? Even when the price of hearing aids is bundled (e.g., average cost of $6000. for a pair of premier hearing aids), we know that a good share of the money paid by the patient is for our professional services. Isn't the patient paying for our time? How much time does $6000.00 buy? 5 hours? 10 hours? 20 hours?

These professional services include optimizing gain to provide as much hearing aid benefit as possible, while ensuring satisfaction and comfort. This is the very goal of many of the validated prescriptive gain and output procedures we are verifying through probe microphone testing. As professionals, we take as much time as necessary to get the job done right.

Not Valid with Today's Technology

Those of us fitting hearing aids for several years have heard a lot of "what you can't do." It started with you can't do probe microphone testing with wide dynamic range compression (WDRC) hearing aids. Then we heard, you can't do probe micro-

SOAPBOX: Let's Just Do It Right!

Several years back, we transitioned to a doctoral profession because we realized that being an audiologist involved a lot more than what could be learned in Master's program. Along with being a "Doctor" comes responsibility—it's "okay" to be the one who does things right. You're the only student who refuses to go to a placement because they don't use probe microphone verification for fitting hearing aids? Good for you. You're a practicing audiologist and you're the only one in the clinic doing probe microphone? Good for you. The place where you work doesn't have probe microphone equipment? Buy it yourself. Your employer tells you that there isn't time to do probe microphone testing for your hearing aid fittings? Find a new job!

There is considerable evidence to show that the use of hearing aids will improve individual's lives. There is also evidence to show that well-fitted hearing aids will have an even greater impact.

phone testing with programmable hearing aids, which then led to you can't do probe microphone testing with digital processing hearing aids (Mueller, 2001a). Even today we often hear a clinician say, "I was told by my rep that probe microphone testing really doesn't tell you much with their product." All this simply is not true. In fact, in many cases, the more sophisticated the processing, the more things that you can verify, and the more important it is to verify. With today's real-speech inputs, the probe microphone findings provide a very reasonable estimate of real-world audibility for speech. Sure, there are a few caveats to this, but they are easy to overcome. We will discuss those in Chapter 5. The bottom line is, if one of our primary goals is achieving the right amount of audibility for speech, it seems to make good sense to measure it in the real ear.

Poor Training?

Could it be that AuD students simply are not trained properly regarding the importance and use of probe microphone measures? This has been suggested by some. We find it unlikely that an accredited AuD program would *not* teach the verification procedures recommended in best practices guidelines. However, there is sometimes a disconnect between academic training and clinical practice and mentoring. Here is a comment on the topic from professor Mike Valente, certainly one of the strongest advocates of probe microphone testing that you will find in an AuD training program.

> According to the clinic coordinator at one graduate program, in 16 of 20 external clinical sites where she sends her students for clinical experience, probe microphone equipment is never used or used only in "special cases." Therefore, some students wonder if probe microphone verification really is necessary if seasoned audiologists with successful practices do not use it. Also, I believe a majority of students graduate understanding the need for probe microphone measures to implement a "best practice," but the facility in which they are then employed either does not