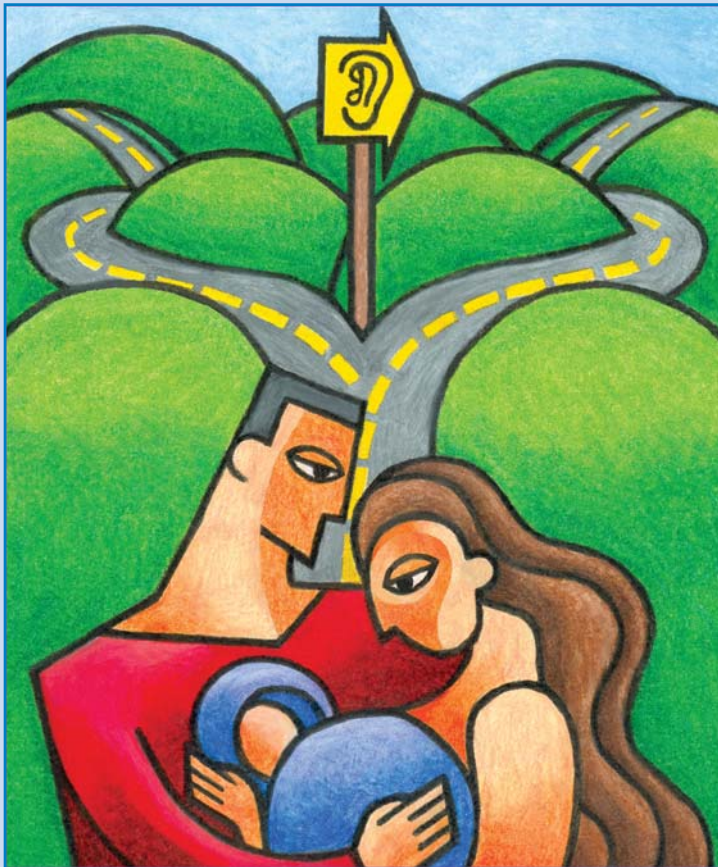


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***Revue canadienne
d'orthophonie et
d'audiologie***



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canadienne des orthophonistes et
audiologistes*

- ▶ *Comparison of Standard and Multi-Frequency Tympanometric Measures Obtained with the Virtual 310 System and the Grason-Stadler Tymptar*
Navid Shahnaz and Karin Bork
- ▶ *Phonological Awareness Tasks for French-Speaking Preschoolers*
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Purpose and Scope

The Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA) is the recognized national professional association of speech-language pathologists and audiologists in Canada. The association was founded in 1964, incorporated under federal charter in 1975 and is committed to fostering the highest quality of service to communicatively impaired individuals and members of their families. It began its periodical publications program in 1973.

The purpose of the *Canadian Journal of Speech-Language Pathology and Audiology* (CJSLPA) is to disseminate contemporary knowledge pertaining to normal human communication and related disorders of communication that influence speech, language, and hearing processes. The scope of the Journal is broadly defined so as to provide the most inclusive venue for work in human communication and its disorders. CJSLPA publishes both applied and basic research, reports of clinical and laboratory inquiry, as well as educational articles related to normal and disordered speech, language, and hearing in all age groups. Classes of manuscripts suitable for publication consideration in CJSLPA include tutorials, traditional research or review articles, clinical, field, and brief reports, research notes, and letters to the editor (see Information to Contributors). CJSLPA seeks to publish articles that reflect the broad range of interests in speech-language pathology and audiology, speech sciences, hearing science, and that of related professions. The Journal also publishes book reviews, as well as independent reviews of commercially available clinical materials and resources.

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Objet et Portée

L'Association canadienne des orthophonistes et audiologistes (ACOA) est l'association professionnelle nationale reconnue des orthophonistes et des audiologistes du Canada. L'Association a été fondée en 1964 et incorporée en vertu de la charte fédérale en 1975. L'Association s'engage à favoriser la meilleure qualité de services aux personnes atteintes de troubles de la communication et à leurs familles. Dans ce but, l'Association entend, entre autres, contribuer au corpus de connaissances dans le domaine des communications humaines et des troubles qui s'y rapportent. L'Association a mis sur pied son programme de publications en 1973.

L'objet de la *Revue canadienne d'orthophonie et d'audiologie* (RCOA) est de diffuser des connaissances relatives à la communication humaine et aux troubles de la communication qui influencent la parole, le langage et l'audition. La portée de la Revue est plutôt générale de manière à offrir un véhicule des plus compréhensifs pour la recherche effectuée sur la communication humaine et les troubles qui s'y rapportent. La RCOA publie à la fois les ouvrages de recherche appliquée et fondamentale, les comptes rendus de recherche clinique et en laboratoire, ainsi que des articles éducatifs portant sur la parole, le langage et l'audition normaux ou désordonnés pour tous les groupes d'âge. Les catégories de manuscrits susceptibles d'être publiés dans la RCOA comprennent les tutoriels, les articles de recherche conventionnelle ou de synthèse, les comptes rendus cliniques, pratiques et sommaires, les notes de recherche, et les courriers des lecteurs (voir Renseignements à l'intention des collaborateurs). La RCOA cherche à publier des articles qui reflètent une vaste gamme d'intérêts en orthophonie et en audiologie, en sciences de la parole, en science de l'audition et en diverses professions connexes. La Revue publie également des critiques de livres ainsi que des critiques indépendantes de matériel et de ressources cliniques offerts commercialement.

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From the Editor

Winter Issue



The American novelist Toni Morrison quipped: *"If there's a book that you want to read, but it hasn't been written yet, then you must write it."* The same is also true for the readers of a scientific journal, such as the *Canadian Journal of Speech-Language Pathology and Audiology*. While we are already receiving a steady number of manuscript submissions every year, we are hoping to further grow and expand the journal. We therefore encourage our readership to make maximum use of your journal, not just as a source of information but also as an outlet for your own original research. After all, *"writing is easy. You only need to stare at a blank piece of paper until your forehead bleeds"* (Douglas Adams).

The first paper in the current issue by Navid Shahnaz and Karin Bork compares the performance of two middle ear analyzer systems on a range of tympanometric parameters. The systems were tested with both normal participants and patients with otosclerotic ears.

The second paper by Pascal Lefebvre, Charlotte Girard, Karine Desrosiers, Natacha Trudeau, and Ann Sutton describes the development of a new battery of phonological awareness tasks designed for French-speaking preschoolers. The Épreuve préscolaire de conscience phonologique was developed and tested in two experiments. The appendix of this paper contains the tasks and the materials for interested clinicians and researchers.

The third paper by J. Cyne Johnston, Andrée Durieux-Smith, Elizabeth Fitzpatrick, Annette O'Connor, Karen Benzie, and Douglas Angus evaluates the decision-making needs of parents whose children have been identified as candidates for cochlear implants. The study used semi-structured interviews with parents and clinicians.

We have three book reviews in the current issue. Marie Heintzman reviews *Auditory Processing Disorders: Assessment, Management and Treatment*, Jennifer Cupit reviews *Aphasia Rehabilitation: the impairment and its consequences*, and Deryk Beal reviews *Neuroimaging in communication sciences and disorders*.

Also included in this issue are CASLPA's new scopes of practice for audiology and speech-language pathology and the recently approved vision and mission statement for the association.

Tim Bressmann
Editor
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Mot du rédacteur en chef

Numéro de l'hiver



La romancière américaine Toni Morrison a déjà lancé : « *S'il y a un livre que vous aimeriez lire, mais qu'il n'est pas encore écrit, alors vous devez l'écrire* » [trad.]. La même chose prévaut pour les lecteurs d'une revue scientifique comme la *Revue canadienne d'orthophonie et d'audiologie*. Bien que nous recevions déjà un nombre constant de manuscrits tous les ans, nous espérons augmenter ce nombre pour la revue. Par conséquent, nous encourageons nos lecteurs à faire l'usage le plus large possible de la revue, pas simplement comme source d'information, mais aussi comme endroit pour publier leurs nouvelles recherches. Après tout, « *il est facile d'écrire. Il suffit de fixer une page blanche jusqu'à ce que votre front saigne* » [trad.] (Douglas Adams).

Le premier article du présent numéro, signé par Navid Shahnaz et Karin Bork, compare la performance de deux analyseurs de l'oreille moyenne selon une série de paramètres tympanométriques. Les auteurs ont testé ces systèmes auprès de participants ayant une acuité auditive normale et de patients atteints d'otosclérose.

Le deuxième article, de Pascal Lefebvre, Charlotte Girard, Karine Desrosiers, Natacha Trudeau et Ann Sutton, décrit l'élaboration d'une nouvelle batterie de tests de conscience phonologique conçus pour les enfants francophones d'âge préscolaire. Les auteurs ont élaboré l'*Épreuve préscolaire de conscience phonologique* et l'ont soumise à deux expériences. Les cliniciens et les chercheurs intéressés trouveront les tâches et le matériel en annexe de l'article.

Le troisième article provient de J. Cyne Johnston, Andrée Durieux-Smith, Elizabeth Fitzpatrick, Annette O'Connor, Karen Benzie et Douglas Angus. Il examine le processus décisionnel des parents dont l'enfant est candidat à l'implantation cochléaire. L'étude se fonde sur des entrevues semi-structurées auprès des parents et des cliniciens.

Ce numéro présente trois comptes rendus de livre. Marie Heintzman a préparé celui du livre *Auditory Processing Disorders: Assessment, Management and Treatment*, Jennifer Cupit celui d'*Aphasia Rehabilitation: the impairment and its consequences* et Deryk Beal celui de *Neuroimaging in communication sciences and disorders*.

Ce numéro comprend aussi la nouvelle version des champs de pratique de l'audiologie et de l'orthophonie, ainsi que les énoncés de vision et de mission de l'association adoptés récemment.

Tim Bressmann
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■ Comparison of Standard and Multi-Frequency Tympanometric Measures obtained with the Virtual 310 System and the Grason-Stadler Tymptstar

■ Une comparaison entre des mesures tympanométriques standard et celles à fréquences multiples obtenues par les systèmes Virtual 310 et Grason-Stadler Tymptstar

Navid Shahnaz

Karin Bork

Abstract

The goal of this study was to compare the performance of two middle ear analyzer systems on a range of tympanometric parameters, including both the standard 226 Hz and multi-frequency tympanometric measures. 53 normal hearing adults (26 females and 27 males) were tested with two commercially available middle-ear analyzer systems, Virtual 310 middle-ear analyzer and Grason-Stadler (GSI) Tymptstar (version 2). Statistically, only the equivalent ear canal volume (EECV), the frequency corresponding to phase angle of 45 degree (F45°), and the static admittance (SA) obtained at 1 kHz were different between the two systems. The clinical significance of the norms obtained using each system was also examined in 20 cases of surgically confirmed otosclerotic ears that were either tested by the GSI or the Virtual systems. Applying the system-specific norm to a group of surgically confirmed otosclerotic ears resulted in comparable overall hit rates for the two systems for the SA, the resonance frequency (RF) and the F45°. The difference between normal and otosclerotic ears on these tympanometric variables was larger than the cut off (90% range) difference of these variables in the normal group between the two systems. The clinical significance of the differences found will have to be examined in other middle ear pathologies such as ossicular discontinuity and otitis media.

Abrégé

La présente étude visait à comparer la performance de deux analyseurs de l'oreille moyenne selon une série de paramètres tympanométriques, y compris les mesures standard à 226 Hz et les mesures à fréquences multiples. Deux analyseurs de l'oreille moyenne offerts sur le marché - Virtual 310 et Grason-Stadler (GSI) Tymptstar (version 2) - ont été testés auprès de 53 adultes ayant une acuité auditive normale (26 femmes et 27 hommes). Ces deux systèmes différaient statistiquement seulement pour le volume du conduit auditif équivalent, la fréquence correspondant à un angle de phase de (F45°) et l'admittance statique obtenue à 1 kHz. L'importance clinique des normes obtenues par chaque analyseur a été examinée auprès de 20 cas d'otosclérose confirmée par chirurgie. En utilisant la norme particulière de chaque système pour un groupe de personnes atteintes d'otosclérose confirmée par chirurgie, des taux de bon diagnostic comparables ont été obtenus pour les deux systèmes en ce qui a trait à l'admittance statique, à la fréquence de résonance et à l'angle de phase de 45°. La différence des variables tympanométriques entre une oreille normale et une atteinte d'otosclérose dépassait la différence limite (fourchette de 90 %) de ces variables pour le groupe normal entre les deux systèmes. Il faudra examiner l'importance clinique des différences relevées par rapport à d'autres pathologies de l'oreille moyenne, comme la dislocation de la chaîne ossiculaire et l'otite moyenne.

Keywords: tympanometry, multi-frequency tympanometry, otosclerosis, middle ear, Tymptstar, Virtual, resonance frequency, static admittance, tympanometric width, tympanometric peak pressure, equivalent ear canal volume, frequency corresponding to phase angle of 45 degree

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Introduction

Typanometry is a safe and quick method for assessing middle-ear function. A considerable number of studies attest to the value of multi-frequency tympanometry (MFT), especially in clinical decisions concerning infants with middle-ear problems (Balkany, Berman, & Simmons, 1978; Calandruccio, Fitzgerald, & Prieve, 2006; Holte, Margolis, & Cavanaugh, 1991; Hunter & Margolis, 1992; Kei et al., 2003; Marchant, Shurin, Turczyk, Wasikowski, Tutihasi, & Kinney, 1984; Margolis et al., 2003; Shahnaz, Miranda, & Polka, 2008) and adults with ossicular chain abnormalities (Browning, Swan, & Gatehouse, 1985; Colletti, 1975, 1976; Lilly, 1984; Shahnaz & Polka, 1997). As the application of MFT becomes more common in both paediatric and adult settings, clinicians require information about the characteristics of the instruments used to generate these measures. One particularly important question concerns comparability. Can the same set of normative data be used across all instruments?

Chicchis and Nozza (1996) have addressed this issue for standard low-frequency tympanometric parameters. They compared three tympanometric parameters of static admittance (SA), tympanometric peak pressure (TPP), and tympanometric width (TW) obtained with seven commercially available immittance systems. The authors argued that in most instances the differences were small enough that the same normative data could be applied across all systems. However, they did not determine the significance of these differences in confirmed middle-ear pathologies. Moreover, similar comparisons have not been made for MFT parameters.

Currently, there are only two commercially available MFT systems that could measure different MFT parameters, such as resonance frequencies (RF): the Grason Stadler Instruments-GSI (Viasis) Tympstar Version 2 and the Virtual 310 with the optional extended high frequency (EHF) middle ear analyzer. These two devices are the only true MF middle-ear analyzer systems as other middle-ear analyzer systems only give access to three probe tone frequencies and are not capable of measuring RF or the frequency corresponding to a phase angle of 45° (F45°), both of which have proven useful in detecting middle-ear pathologies (Shahnaz & Polka, 1997). During the past 15 years, numerous studies have reported normative data for various MFT parameters in adults (Hanks & Mortensen, 1997 [GSI]; Holte, 1996 [Virtual]; Margolis & Goycoolea, 1993 [Virtual]; Shahnaz & Polka, 1997 [Virtual]; Shahnaz & Davies, 2006 [Virtual]; Shanks, Wilson & Cambron, 1993 [Virtual]; Valvik et al., 1994 [GSI]; Wiley et al., 1999 [Virtual]). The norms reported in these studies differ somewhat due in part to the use of different measurement protocols. It has been shown that several procedural issues can affect the responses of multi-frequency tympanometric parameters. Pump speed, recording method (sweep frequency vs. sweep pressure), and compensation procedure (Margolis & Heller, 1987; Margolis & Goycoolea, 1993; Margolis & Smith, 1977;

Shahnaz & Polka, 1997) are among the variables that can affect MFT results. More recently, Shahnaz and Davies (2006) attributed some of these differences to the ethnic distribution of the participants in different studies. The authors demonstrated that MFT responses in Caucasian individuals were significantly different from Chinese individuals. Therefore, it is imperative to control for these confounding variables while comparing the normative data between the two systems.

The purpose of this study was to assess the comparability of the two middle ear analyzer systems that have been used to generate most of the published MFT norms: the GSI-Tympstar (formerly GSI-33) and the Virtual 310 middle-ear analyzers. To reach this goal, two different sets of comparisons were conducted. First, we compared the values for a range of tympanometry parameters measured on the same participants by the two different middle ear analyzer systems. Secondly, we evaluated the clinical comparability of the two systems with data obtained from 20 patients with surgically confirmed otosclerosis. Half of the patients were tested using the GSI-Tympstar and half using the Virtual 310, and the identification rates were compared between the two systems.

Methods

An institutional clinical research ethics board approved the study protocol. All participants provided their informed consent.

Participants

Fifty-three normal hearing adults (26 females and 27 males) with an average age of 23 years (range: 18-34 years) participated in this study. As Shahnaz and Davies (2006) have shown that the middle-ear characteristics are different among Caucasian and Chinese individuals, the participants were divided into two groups of Caucasian (26 participants: 14 males and 12 females) and Chinese (27 participants: 13 males and 14 females). The ethnicity of each participant was defined based on criteria set by Statistics Canada for different ethnic groups (2002). To be included in this study, the participants had to (1) achieve pure tone audiometric thresholds better than 25 dB HL at octave frequencies between 250-8000 Hz and an air-bone gap of ≤ 10 dB between 250-4000 Hz, (2) report no history of head trauma or middle-ear disease, (3) present no gross eardrum abnormalities or excessive cerumen as evidenced by otoscopic examination and (4) pass a transient evoked otoacoustic emission (TEOAE) screening. The TEOAE was performed to further verify the normal condition of the cochlea and the middle ear. A pass consisted of a greater than 6 dB emission to noise ratio in three frequency bands (2000, 3000 and 4000 Hz). The otosclerotic group consisted of 20 patients with surgically confirmed otosclerosis. Ten of these patients were tested with the GSI Tympstar system and ten of them were tested with the Virtual 310 system. The patient group included 17 females and 3 males ranging in age from 22 to 56 years (mean age = 42 years old). In the patient group, 16 were Caucasian, three were Chinese, and one was East Indian.

Instrumentation

Before the data collection, both systems were calibrated using standard cavities according to the operation manual provided by the manufacturers. Both systems were also calibrated in accordance with American National Standards Institute specifications (ANSI, 1989).

Procedure

Standard 226 Hz tympanometric parameters and multi-frequency tympanometric parameters were measured twice for each participant with normal hearing, once with the GSI system and once with the Virtual system. The order of test, and of systems, was assigned randomly.

Standard Tympanometry: The standard 226 Hz tympanometric parameters, static admittance (SA), tympanometric width (TW), equivalent ear canal volume (EECV), and tympanometric peak pressure (TPP) were calculated automatically from admittance tympanograms by both machines in the same individuals using similar pressure direction (positive to negative) and compensation procedure (positive tail). The pump speed was 200 daPa/sec for the Tymptstar and 125 daPa/sec for the Virtual system. The pressure was swept from +200 to -400 daPa in the Tymptstar and from +250 to -300 daPa in the Virtual system.

Multi-frequency tympanometric parameters: One potentially useful parameter that can be derived from the MFT is an estimate of the middle-ear resonance frequency (RF). The RF corresponds to the frequency at which mass and stiffness contribute equally to the middle ear admittance ($B_{tm} = 0$). Another potentially useful parameter is admittance phase angle of 45° (F_{45° ; Shanks & Shelton, 1991; Shahnaz & Polka, 1997). The F_{45° corresponds to the frequency at which the compensated conductance (G) becomes equal to the compensated admittance B ($G_{tm} = B_{tm}$). An additional useful parameter that can be obtained from MF tympanometry is the static admittance (SA) at higher probe tone frequencies. It has been shown that an SA obtained at higher probe tone frequencies is superior to a standard 226 Hz probe tone frequency in detecting otosclerotic ears (Shahnaz & Polka, 2002).

The SA was calculated from the compensated rectangular components, B_{tm} and G_{tm} , using sweep pressure methods at 226, 678 (630 Hz with the Virtual system) and 1000 probe tone frequencies. A similar recording method was used in the Virtual system

to calculate the SA at corresponding frequencies. It was necessary to compute these parameters differently in order to improve the mathematical accuracy of the measures. This was particularly important for the higher probe tone frequencies because the phase angles of these parameters are very different at high frequencies. Vector quantities (variables with magnitude and phase) such as admittance cannot be added or subtracted unless the phase angles of the admittance parameters are identical (Margolis & Shanks, 1991). The static admittance is usually computed by subtracting the peak from the positive or negative tail of admittance tympanogram. At 226 Hz probe tone frequency, the middle ear system is stiffness-dominated and addition or subtraction of the admittance values results in little error. However, as probe tone frequency increases, the error for the same addition or subtraction operations can become substantial. Therefore, only admittance vectors that are represented in a rectangular format (susceptance and conductance) can be added or subtracted (Shanks, Wilson, & Cambron, 1993).

This study used the numerical format calculation method by Shahnaz and Polka (2002) to derive RF and F_{45° . This method is similar to the method that is used with the GSI Tymptstar (Version 2) and the GSI-33 (Version

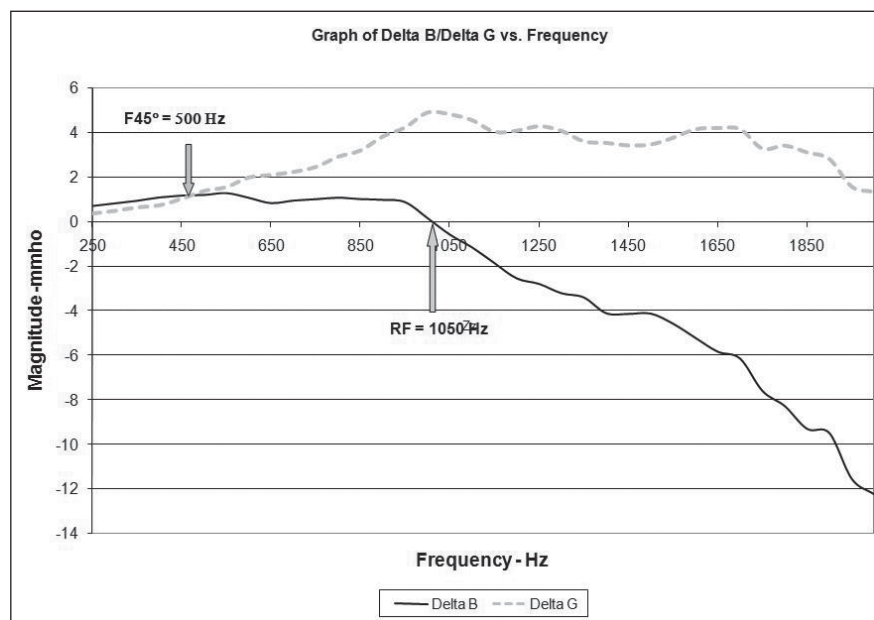


Figure 1. GSI-Tymptstar recordings of B and G (in mmho) at +200 daPa and at peak pressure while the probe tone frequency was swept from 220 to 2000 Hz in 50 Hz intervals (sweep frequency recording). The difference between B/G at +200 daPa and peak pressure (referred to as B/G) was computed at each probe tone frequency. This $\Delta B/G$ is essentially a compensated B and G measure. The ΔB and ΔG were then plotted as a function of frequency (in Hz). The frequency at which ΔB is closest to ΔG corresponds to an admittance phase angle of 45° . The frequency at which ΔB is closest to 0 dB corresponds to the resonance frequency of the middle ear system.

2) to calculate RF and F45°. The procedure developed by Funasaka, S., Funai, H., and Kumakawa, K. (1984) has been incorporated into the design of the GSI middle ear analyzer. However, with GSI-33 or Tymptstar Version 2, the user can choose to measure the admittance or its rectangular components (B and G) and admittance phase angle at extreme ear canal pressure (positive or negative, depending on the user preferences) and at the peak pressure (which is automatically derived by running a 226 Hz “Y” tympanogram or when the user manually defines the peak pressure) while the probe tone frequency is swept from 250 - 2000 Hz in 50 Hz steps (sweep frequency method). These component values (ΔY , ΔB , or ΔG) and phase angle values ($\Delta \theta$) are compensated for canal volume by computing the difference between their value at extreme pressure (positive or negative, depending on the user choice) and their value at peak pressure. The compensated values are plotted as a function of the probe tone frequency (250-2000 Hz) to determine the resonance frequency. The zero-crossing of the ΔB plot represents the resonance frequency, and the point at which ΔB and ΔG cross each other represents F45° (see Figure 1).

The measures analyzed in this study for the Virtual system were derived from numerical values that were stored in a text format when each tympanogram was run (for details of the methods used and the equations, see Shahnaz and Polka, 2002). In this format, the data are saved as uncompensated polar values (admittance - Y magnitude and corresponding phase angle - θ values) as a function of air pressure. The rectangular components, susceptance (B) and conductance (G) were derived from these polar values at different probe tone frequencies using the appropriate equations (Margolis and Hunter, 2000, p. 387). Each rectangular component, B and G, was corrected for ear canal admittance at +250 daPa, which is very close to the pressure point (+200 daPa) used with the GSI Tymptstar to calculate the B and G values. The pressure corresponding to the peak of the tympanogram was determined from the 226 Hz admittance tympanogram (which is similar to the procedure used with the GSI Tymptstar). The same peak pressure was used for all probe tone frequencies to compute the compensated B (as in B in the GSI) and G (as in ΔG in the GSI). Finally, the lowest frequency at which the compensated susceptance (or ΔB) component shifted from a positive (stiffness-dominated system) to a negative (mass-dominated system) value was determined. This frequency is essentially the same as zero susceptance (or ΔB crossing zero in Figure 1) and therefore, is the RF. The F45° was determined as the lowest probe tone frequency at which the compensated B and G became equal. Some of the procedural differences between the Virtual and the GSI systems are as follows: GSI measures the B and G only at two pressure points while the Virtual measures B and G across multiple pressure points. The interval between the multiple probe tone frequencies in the GSI system is set to 50 Hz while the Virtual is using 1/6 octave intervals.

Statistical Analysis

A mixed-model analysis of variance (ANOVA) was used to analyse the data. A 2 x 2 x 2 design was used to determine how the standard 226 Hz tympanometry parameter was influenced by the between-subject factors of ethnicity (Caucasian vs. Chinese) and gender (Male vs. Female), and the middle-ear analyzer system (GSI vs. Virtual), that served as a within subject factor. Subsequently, a 2 (Ethnicity) x 2 (Gender) x 2 (System) x 3 (probe tone frequencies of 226, 678 or 630 and 1000 Hz) design was used to determine how the MFT parameters were influenced. While a group analysis was a necessary step for the evaluation of potential differences between the two systems, it is not an adequate approach for clinical decision analysis. We often use a 90% range (5th or 95th percentiles depending on the type of disease) as a criterion for differential diagnosis. Therefore, looking at the distribution of this range between the two systems was also important.

Results

Standard 226-Tympanometry

Descriptive statistics, mean, standard deviation (SD), and a 90% range (5th to 95th percentile), for SA, TPP, EECV, and TW are shown in Table 1 for both GSI and Virtual systems.

Static Admittance (SA): The main effects of Ethnicity [$F(1, 93) = 15.49, p < 0.05$] and Gender [$F(1, 93) = 18.72, p < 0.05$] proved to be statistically significant. Inspection of the means (Table 1) indicated that the value for SA was higher in Caucasians and in males than in Chinese and females. The effect of System was not significant [$F(1, 93) = 1.6, p > 0.05$] indicating that SA value was not significantly different between the GSI and Virtual systems. This is consistent with the descriptive statistics shown for SA in Table 1. The 90% range between the two systems is quite comparable.

Tympanometric width (TW): The main effects of Ethnicity [$F(1, 93) = 9.1, p < 0.05$] and Gender [$F(1, 93) = 6.5, p < 0.05$] proved to be statistically significant. Inspection of the means (Table 1) indicated that the value for TW was wider in Chinese and females than Caucasian and males. The effect of System was not significant [$F(1, 93) = 2.2, p > 0.05$]; however, the interaction between Ethnicity and System was significant [$F(1, 93) = 2.2, p > 0.05$] indicating that TW value varies between the two systems in the Caucasian and Chinese groups. This is clearly shown in Figure 2. While the Virtual system provides a wider TW value in the Caucasian group than the GSI system, it provides a narrower value in the Chinese group than the GSI system. This is also evident in the 90% range of the TW as shown in Table 1.

Tympanometric Peak Pressure (TPP): The data for the variable TPP were explored using a mixed-model ANOVA. The main effects of Ethnicity [$F(1, 93) = 3.76, p > 0.05$] and Gender [$F(1, 93) = 0.74, p > 0.05$] were not significant. The effect of System was not significant [$F(1, 93) = 0.02,$

Table 1

Descriptive statistics for static admittance (SA), tympanometric width (TW), tympanometric peak pressure (TPP), and equivalent ear canal volume (EECV) at 226 Hz obtained using both GSI and Virtual systems. Some other published normative studies are also included for comparison. C= Caucasian; A= Chinese; M = male; F = female.

			SA mmho		TW daPa		TPP daPa		EECV mmho	
			C	A	C	A	C	A	C	A
GSI	M	Mean	0.80	0.67	79	107	0.63	-5.0	1.06	1.32
		SD	0.28	0.29	18	72	5.58	13.80	0.25	0.25
		90% Range	0.30-1.30	0.30-1.20	55-110	40-290	-10.0-5.0	-35-5.0	0.7-1.6	1.0-1.7
	F	Mean	0.66	0.37	92	128	0.65	-4.04	1.28	1.06
		SD	0.24	0.20	27	70	9.21	7.5	0.22	0.25
		90% Range	0.30-1.20	0.20-0.70	60-135	70-225	-25.0-5.0	-15-5.0	1.0-1.7	0.7-1.6
	Overall	Mean	0.73	0.51	85	118	0.64	-4.5	1.37	1.18
		SD	0.27	0.29	24	61	7.49	10.9	0.32	0.28
		90% Range	0.30-1.20	0.20-1.10	60-115	50-265	-10.0-5.0	-20-5.0	1.0-1.9	0.7-1.6
Virtual	M	Mean	0.80	0.66	97	99	-1.46	-5.33	0.90	1.18
		SD	0.26	0.42	20	29	8.12	15.40	0.28	0.29
		90% Range	0.40-1.20	0.20-1.30	66-132	47-127	-4.0-14.0	-37-14	0.5-1.5	1.0-1.6
	F	Mean	0.63	0.35	107	126	-0.91	-0.65	1.07	0.90
		SD	0.23	0.19	35	80	8.59	10.2	0.25	0.28
		90% Range	0.30-1.10	0.10-0.70	66-165	80-183	-9.0-14.0	-18-14	0.5-1.5	0.5-1.5
	Overall	Mean	0.72	0.50	102	113	-1.19	-2.9	1.21	1.04
		SD	0.26	0.36	28	33	8.26	13	0.35	0.31
		90% Range	0.30-1.20	0.10-1.10	66-146	66-165	-9.0-14.0	-18-14	0.7-1.9	0.6-1.6
Wan & Wong (2002)	M (n=50)	Mean	0.58		88.3		4.80		1.22	
		SD	0.29		34.1		20.73		0.25	
		90% Range	0.30-1.10		45.0-174.5		-24.50-29.7		0.81-1.70	
Chinese	F (n=50)	Mean	0.52		94.2		3.10		1.13	
		SD	0.28		29.2		15.81		0.31	
		90% Range	0.20-1.30		45.3-144.8		-19.75-24.7		0.70-1.60	
GSI	Overall (n=100)	Mean	0.55		91.2		3.95		1.17	
		SD	0.28		31.8		18.41		0.28	
		90% Range	0.20-1.10		45.0-159.3		-19.75-25.0		0.80-1.60	
Roup et al. (1998)	M (n=51)	Mean	0.87		59.8		-26.18		1.40	
		SD	0.46		17.3		31.66		0.32	
		90% Range	0.30-1.80		35.0-87.0		-110.00-9.0		1.00-2.10	
Caucasian	F (n=51)	Mean	0.58		73.9		-27.75		1.18	
		SD	0.27		17.2		23.50		0.22	
		90% Range	0.30-1.12		45.0-107.0		-80.0-3.0		0.80-1.60	
GSI	Overall (n=102)	Mean	0.72		66.9		-29.96		1.29	
		SD	0.40		18.6		27.76		0.29	
		90% Range	0.30-1.19		32.8-95.0		-103.50-4.2		0.90-1.80	

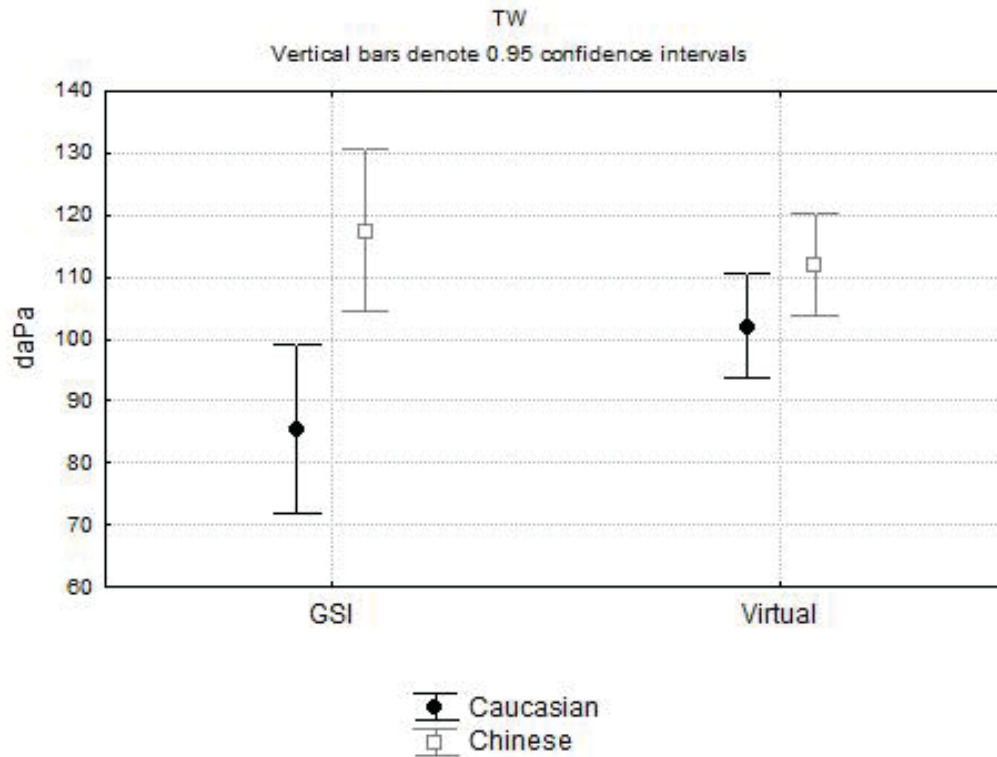


Figure 2. Mean and 0.95 confidence intervals (vertical bars) for tympanometric width (TW in daPa) between the GSI and the Virtual system in the Caucasian and the Chinese group.

Table 2

Descriptive statistics for static admittance (Y_{tm}) measured by sweep pressure (SP) recording with positive (+) compensation at three different probe tone frequencies of 226, 678, and 1000 Hz obtained using both GSI and Virtual systems. C= Caucasian; A= Chinese; M= male; F= female

Y_{tm}			226 Hz		678 Hz		1 kHz	
			C	A	C	A	C	A
GSI	M	Mean	0.94	0.72	2.50	2.18	4.31	3.01
		SD	0.45	0.32	1.29	1.18	1.55	1.60
		90% Range	0.39-1.54	0.29-1.18	1.11-4.54	0.86-4.26	1.61-6.37	1.10-6.33
	F	Mean	0.74	0.40	2.03	1.22	3.86	1.92
		SD	0.25	0.19	0.85	0.64	1.70	1.19
		90% Range	0.37-1.29	0.17-0.78	0.83-3.48	0.49-2.55	1.31-7.26	0.53-4.07
	Overall	Mean	0.84	0.56	2.26	1.69	4.08	2.45
		SD	0.37	0.30	1.10	1.05	1.63	1.49
		90% Range	0.38-1.52	0.19-1.09	0.85-4.51	0.55-3.60	1.50-7.08	0.54-3.22
Virtual	M	Mean	0.82	0.69	2.02	1.90	2.46	2.14
		SD	0.28	0.44	1.86	1.10	2.07	1.04
		90% Range	0.44-1.31	0.23-1.33	0.05-4.37	0.62-3.33	-2.00-4.41	0.61-3.57
	F	Mean	0.69	0.34	2.25	1.13	2.69	1.76
		SD	0.25	0.18	1.03	0.79	1.09	1.09
		90% Range	0.33-1.15	0.15-0.66	0.56-3.90	0.33-2.40	0.75-4.68	0.65-3.23
	Overall	Mean	0.75	0.51	2.13	1.51	2.58	1.94
		SD	0.27	0.37	1.48	1.02	1.63	1.07
		90% Range	0.35-1.25	0.15-1.19	0.56-4.37	0.48-3.30	0.73-4.68	0.61-3.57

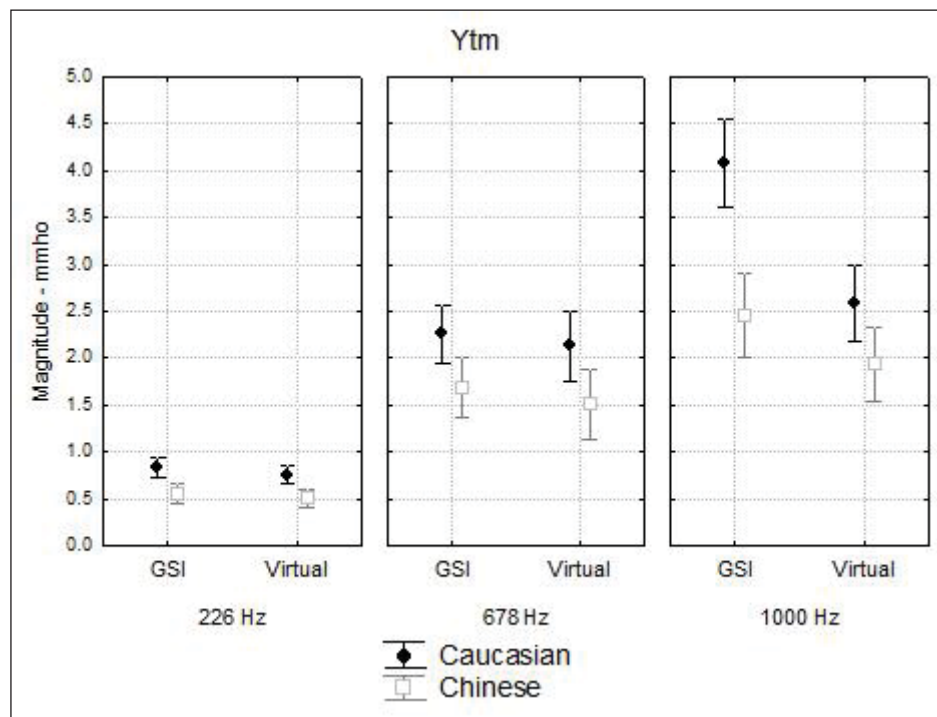


Figure 3. Mean static admittance (Ytm) and 0.95 confidence intervals (vertical bars) obtained using the GSI and the Virtual systems across three probe tone frequencies of 226, 678 (630 in the Virtual system) and 1000 Hz in Caucasian and Chinese young adults.

$p > 0.05$], indicating that the TPP value was not significantly different between the GSI and Virtual systems.

Equivalent Ear Canal Volume (EECV): The main effects of Ethnicity [$F(1, 93) = 8.75, p < 0.05$] and Gender [$F(1, 93) = 18.67, p < 0.05$] proved to be statistically significant. An inspection of the means (Table 1) indicated that the value for the EECV was higher in Caucasian and males than Chinese and females. The effect of System was significant [$F(1, 93) = 90.18, p < 0.05$] indicating that EECV value was significantly higher in the GSI system than the Virtual system. This is consistent with the descriptive statistics shown for EECV in Table 1.

Multi-frequency Tympanometry (MFT)

Static admittance (Ytm) at multiple-probe tone frequencies: Descriptive statistics for the Ytm obtained at multiple probe tone frequencies are shown in Table 2. To investigate the potential differences between the two systems, a mixed-model ANOVA was conducted with System (GSI vs. Virtual-2 levels) and probe tone frequency (226, 678, and 1000 Hz-3 levels) as the within-subject factors and Ethnicity and Gender as between-subject factors ($2 \times 2 \times 2 \times 3$ design). The main effect of Ethnicity [$F(1, 88) = 17.42, p < 0.05$] and Gender [$F(1, 88) = 6.05, p < 0.05$] proved to be statistically significant. Inspection of the means (Table 2) indicated that the value for SA was significantly higher in Caucasian and males than Chinese and females. The within subject factor of the system (GSI vs. Virtual)

was significant [$F(1, 88) = 23.93; p < 0.05$], indicating that the Ytm collapsed across the three probe tone frequencies is significantly higher in the GSI system than the Virtual system. The interaction between probe tone frequency, ethnicity, and the system was also significant [$F(2, 176) = 7.89; p < 0.05$] indicating that the Ytm varies differently between the two systems across different probe tone frequencies and the two ethnic groups. A post-hoc Tukey test revealed that the two systems were only different at the 1000 Hz probe tone frequency; however, Ytm was consistently lower in the Chinese group than in the Caucasian group in both systems across all three probe tone frequencies. This is shown in Figure 3 which compares the Ytm between the two systems across the three probe tone frequencies in both the Caucasian and Chinese groups. While at the 226-Hz probe tone frequency, the 5th percentile

is similar between the two systems at 678-Hz and 1 kHz, both the 5th and the 95th percentiles are quite different between the two systems (Table 2).

Resonance frequency (RF): The descriptive statistics for the RF obtained from the GSI and the Virtual system are shown in Table 3. The main effects of Ethnicity, Gender and System were not significant ($p > 0.05$). The interaction between Ethnicity, System and Gender was significant [$F(1, 93) = 5.45; p < 0.05$] indicating that the RF scores varied between the two systems in Caucasian and Chinese males and females. As can be seen in Figure 4 in the GSI system, Chinese female had a significantly higher RF than the Caucasian females; however, the Caucasian males had a significantly higher RF than the Chinese males. With the Virtual system, the RF was not significantly different between the two ethnic groups. However, the Chinese group had an overall higher RF frequency than the Caucasian group (see Table 3).

Frequency corresponding to a 45° phase angle (F45°): In both systems, the F45° was determined by plotting compensated B and G as a function of the probe tone frequency (see Figure 1). The descriptive statistics for the F45° obtained using the GSI and the Virtual system are shown in Table 3. The effect of System proved to be statistically significant [$F(1, 93) = 70.96; p < 0.05$]. An inspection of the means (Table 3) indicated that the value for the F45° was higher for the Virtual system than the GSI system. The interaction between the System and Ethnicity was also significant [$F(1, 93) = 4.86; p < 0.05$], indicating that the F45° value between the ethnic groups

Table 3

Descriptive statistics for resonance frequency (RF), and frequency corresponding to admittance phase angle of 45 degree (F_{45°) measured by sweep frequency (SF) recording with positive (+) compensation obtained using both GSI and Virtual systems.
C= Caucasian; A= Chinese; M = male; F = female.

			F_{45°		RF	
			C	A	C	A
GSI	M	Mean	494	406	944	827
		SD	137	123	228	201
		90% Range	350-700	250-600	600-1300	550-1150
	F	Mean	448	460	898	1013
		SD	117	98	174	225
		90% Range	250-600	250-600	700-1050	650-1450
	Overall	Mean	471	435	921	924
		SD	128	113	202	232
		90% Range	300-700 1.20	250-600	600-1300	600-1250
Virtual	M	Mean	537	517	911	927
		SD	134	91	175	258
		90% Range	400-800	400-630	630-1120	630-1250
	F	Mean	545	489	907	947
		SD	95	114	108	114
		90% Range	400-710	400-710	710-1120	710-1120
	Overall	Mean	541	555	909	937
		SD	115	109	144	195
		90% Range	400-710	400-710	710-1120	630-1250
Hanks & Mortenson (1997)	GSI-33 (age = 18-25 yr)	Mean			908	
		SD			188	
		90% Range			650-1300	

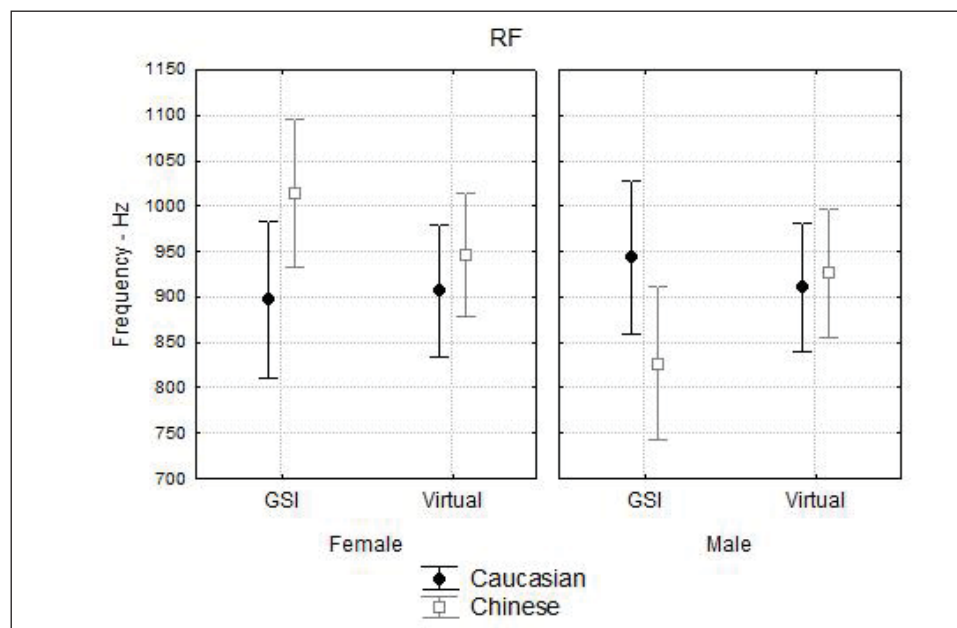


Figure 4. Mean resonance frequency (RF) and 0.95 confidence intervals (vertical bars) obtained using the GSI and the Virtual systems between males and females in Caucasian and Chinese young adults.

Table 4

Outcome of the normative data obtained using the GSI and the Virtual system in 20 cases of surgically confirmed otosclerotic ears

System	Gender	Ethnicity	Ytm 226 Hz mmho	Ytm GSI Norm	Ytm Virtual Norm	TW daPa	TW GSI Norm	TW Virtual Norm	F45° Hz	F45° GSI Norm	F45° Virtual Norm	RF Hz	RF GSI Norm	RF Virtual Norm
GSI	FM	C	0.5	-	-	90	-	-	DNT	DNT	DNT	1400	+	+
GSI	FM	C	0.4	-	-	120	-	-	DNT	DNT	DNT	1250	+	+
GSI	FM	C	0.8	-	-	185	-	-	DNT	DNT	DNT	950	-	-
GSI	FM	C	0.3	-	-	105	-	-	DNT	DNT	DNT	1500	+	+
GSI	FM	C	0.4	-	-	85	-	-	DNT	DNT	DNT	1250	+	+
GSI	M	C	0.5	-	-	105	-	-	DNT	DNT	DNT	1200	-	+
GSI	FM	C	0.3	-	-	110	-	-	DNT	DNT	DNT	1200	+	+
GSI	M	EI	1.0	-	-	60	-	+	DNT	DNT	DNT	1050	-	-
GSI	M	A	0.7	-	-	185	-	-	DNT	DNT	DNT	2000	+	+
GSI	FM	C	0.2	+	+	150	-	-	DNT	DNT	DNT	1250	+	+
Virtual	FM	C	0.09	+	+	94	-	-	1000	+	+	1800	+	+
Virtual	FM	C	0.52	-	-	61	-	+	800	+	+	1120	+	-
Virtual	FM	C	0.48	-	-	99	-	-	1120	+	+	1800	+	+
Virtual	FM	C	0.54	-	-	38	+	+	800		+	1400	+	+
Virtual	FM	C	1.43	-	-	85	-	-	560	-	-	710	-	-
Virtual	FM	A	0.2	+	+	132	-	-	1120	+	+	1400	-	+
Virtual	FM	A	0.47	-	-	75	-	-	1000	+	+	1600	+	+
Virtual	FM	C	0.8	-	-	66	-	-	630	+	-	900	-	-
Virtual	FM	C	0.14	+	+	136	-	-	1250	+	+	1800	+	+
Virtual	FM	C	0.52	-	-	38	+	+	560	-	-	800	-	-
Total+ HR				4 20%	4 20%		2 20%	4 40%		7 70%	7 70%		13 65%	14 70%

Note. Ten of these cases were tested by the GSI system and 10 of them were tested by the Virtual system. The corresponding tympanometric value for each individual otosclerotic ear is provided and is compared to gender and the ethnic specific norm (for the East Indian-EI male subject the Caucasian male norm was used). An appropriate cut-off value was selected from Tables 1 and 2 (5th percentile for the SA and the TW and 95th percentile for the RF and the F45°). This was done to explore how many otosclerotic ears were correctly identified (hit rate –HR is identified by the + sign) by the normative data obtained using the GSI and the Virtual systems. The negative (-) sign denotes misses (false negative) in the otosclerotic ears. (Ytm: static admittance; TW= tympanometric width; F45°: frequency corresponding to admittance phase angle of 45 degree; RF: resonant frequency; C= Caucasian; A= Chinese; EI= East Indian; M = male; F = female. DNT= did not test; HR: hit rate; DNT: did not test.

varies between the two systems. The F45° obtained with the GSI system was higher in the Caucasian group than the Chinese group; however, the F45° value obtained using the Virtual system was slightly higher in the Chinese group than the Caucasian group. Both the 5th and the 95th percentiles (Table 3) also differed between the two systems.

Implications of Applying System Specific Norms in Detection of Otosclerosis

In order to explore whether using a system specific norm could potentially impact detection of the middle-ear pathology, a group of 20 patients with surgically confirmed otosclerotic ears were included in this study.

Of these, 10 participants were tested with the GSI system and the remaining 10 participants were tested with the Virtual system. The appropriate gender and ethnic specific norms obtained using each system (Table 1, 2, and Table 3) were used for each of the variables that have been shown useful for detection of otosclerotic ears (Shahnaz & Polks, 1997). The patterns of test performance were examined in individual otosclerotic ears (Table 4) for the Ytm and the TW obtained at standard 226-Hz probe tone frequency and for the RF and the F45° obtained using MFT. For the Ytm, the 5th percentile is commonly used for the detection of high impedance pathologies such as otosclerosis (Shahnaz & Polka, 1997). The 95th percentile of the RF and the F45° was used for the detection of otosclerotic ears as these

parameters have been shown to be higher in otosclerosis (Shahnaz & Polka, 1997). For the TW, the 5th percentile cut-off score was selected as previous work indicated that the TW could potentially be narrower in some otosclerotic ears (Shahnaz & Polka, 1997). The cut-off scores for each variable were used to assign each individual to normal or pathological group. This assigned diagnosis was then compared to the real group status for each measure.

In Table 4, the positive sign (+) indicates a correct diagnosis (true positive) in the otosclerotic group. The negative sign (-) indicates incorrect identification as a normal ear (false negative) in the otosclerotic group. As can be seen in Table 4, the norms obtained by the two systems perform equally well in identifying otosclerotic ears. Very few cases that were missed by the norm obtained for one system were identified correctly by the other system. The overall identification rate was very similar regardless of the system used. The only exception was for the TW norm obtained using the Virtual system which resulted in a noticeably higher identification rate than the TW norm obtained using the GSI system.

Discussion

Standard 226-Hz Tympanometry

Static admittance (SA): The normative data generated by each system were comparable between the two systems (see Table 1). This was consistent with findings from Chicchis and Nozza (1996) that showed comparable means and 90% ranges between the GSI-33 (similar to Tymptstar used in this study) and the Virtual 310 systems. The Chinese group had a significantly lower mean SA compared to the Caucasian group. Males had a significantly lower mean SA compared to females, regardless of the system (GSI or Virtual) used. This finding was consistent with Shahnaz and Davies (2006). The norms obtained by the GSI system in the Chinese and the Caucasian groups were similar to the norms obtained in the Chinese group studied by Wan and Wong (2002) and in the Caucasian group studied by Roup, Wiley, Safady, and Stoppenbach (1998; see Table 1).

Tympanometric Width (TW): While this measure was not statistically different between the two systems, the 95th percentile in the Chinese group (Table 1) was so different between the two systems that it could potentially change diagnostic outcomes. The 95th percentile can be used for the detection of middle-ear effusion (Nozza, Bluestone, Kardatzke, & Bachman, 1994). Therefore, when testing Chinese individuals with suspected middle-ear effusion, it is advisable to compare the outcome of this measure to the norm obtained with the corresponding system. While Chicchis and Nozza (1996) also did not find statistically different TW values between the two systems, their mean and 90% range was comparable between the two systems. The mean value for TW was significantly higher in the Chinese group than in the Caucasian group and higher in females than males regardless of the system used. However, the effect was more pronounced for the GSI system (see Table 1). This is consistent with findings by Shahnaz and

Davies (2006) and Wan and Wong (2002). The 90% ranges obtained using the GSI system in the Chinese group and the Caucasian group were different from the 90% ranges obtained in the Chinese group in the Wan and Wong (2002) study and in the Caucasian group in Roup et al. (1998) study. Similar systems, pressure directions, pump speeds, and compensation procedures were used in all these studies. The sources of these differences could potentially be attributed to the larger sample size used in the Wan and Wong (2002) and Roup et al. (1999) studies.

Tympanometric peak pressure (TPP): The TPP value was not significantly different between the two ethnicities, genders, and between the GSI and the Virtual system. However, both the 5th and the 95th percentiles (Table 1) were different between the two systems. These differences are not in a magnitude that would potentially skew the differential diagnosis of middle-ear pathology. In contrast, Chicchis and Nozza (1996) found numerically more positive TPP values for the GSI-33 system compared with the Virtual system. While not statistically different, the current study also shows more positive TPP values for the GSI system than for the Virtual system. This measure is the least useful measure in standard tympanometry for differential diagnosis of middle ear pathologies (Margolis & Heller, 1987).

Equivalent ear canal volume (EECV): The EECV obtained using the Virtual system was significantly lower than for the GSI system. This is most likely due to the fact that it was measured at a higher positive pressure (+250 daPa) than the pressure preset in the GSI system (+200 daPa). It has been shown that lower canal volume estimates may be observed as the ear canal pressure used to correct the volume is increased (Van Camp, Margolis, Wilson, Creten, & Shanks, 1986). The 5th percentile (Table 1) was also different between the two systems. The 5th percentile can be used to detect the blockage of the probe by cerumen or ear canal wall. The 95th percentile was comparable between the two systems. The 95th percentile can be used for detection of tympanic membrane perforation, patency of pressure equalization (PE) tubes, and to predict the recovery/recurrence from middle ear disease and the outcome of reconstructive surgeries of the middle ear (Fowler & Shanks, 2002). This measure was not evaluated by Chicchis and Nozza (1996).

The mean EECV value in the Chinese group was significantly lower than in the Caucasian group and the mean EECV value for the females was significantly lower than for the males in the Chinese group, which was consistent with Shahnaz and Davies' (2006) and Wan and Wong's (2002) findings. However, the mean EECV in males was lower than in females in the Caucasian group regardless of the system used. This is contrary to what has been found in the literature, potentially due to a smaller sample size used in this study.

Multi-frequency Tympanometry (MFT)

To our knowledge, the comparability of the multi-frequency tympanometric norms between the GSI-

Tympstar and Virtual 310 systems has not been investigated. These two systems are the only two commercially available MFT systems that can measure different MFT parameters, such as resonance frequencies (RF).

Static admittance (Ytm) at multiple probe tone frequencies: Ytm was consistently lower with the Virtual system than with the GSI system at all three probe tone frequencies; however, it was only significantly different at 1 kHz. These differences became larger as probe tone frequency increased (Figure 3). It should be noted that higher compensated static admittance should have been observed by the Virtual system as the ear canal pressure used to correct the ear canal volume was higher. A potential source for the observed difference is the faster pump speed used by the GSI system (200 daPa/sec) as opposed to that of the Virtual system (125 daPa/sec). Faster pump speed results in a higher Ytm value (Van Camp et al., 1986). While at a standard 226-Hz probe tone frequency, the overall 5th percentile (used for detection of high impedance pathologies such as otosclerosis) is similar between the two systems. However, at 678-Hz and 1 kHz, both the 5th and the 95th percentiles are quite different between the two machines (Table 2). The 95th percentile is being used for detection of low impedance pathologies such as ossicular discontinuity. Therefore, when measuring the Ytm, clinicians should compare their results to norms that were obtained using the same measurement protocol (i.e., pump speed), irrespective of the type of system used. The Ytm was consistently lower in the Chinese group than in the Caucasian group for both systems across all three probe tone frequencies (Figure 3). This finding was consistent with findings from Shahnaz and Davies (2006).

Resonance frequency (RF): The RF of the middle ear system may be shifted higher or lower by various pathologies in comparison to healthy ears. The RF was higher in Chinese females than Caucasian females with both the GSI and Virtual systems (Table 3), which was consistent with Shahnaz and Davies' (2006). However, the RF was lower in Chinese males than Caucasian males with the GSI System but slightly higher in Chinese males than Caucasian males with the Virtual system (Figure 4). The differences between the GSI system and the Virtual system were more pronounced in both males and females in the Chinese group. The mean RF in females was higher in the GSI system than in the Virtual system. However, the mean RF in males was higher in the Virtual system than the GSI system. This was also reflected in the 90% range between the two systems in Chinese males and females (Table 3). The overall 90% range between the two systems was comparable in the Chinese group but it was different in the Caucasian group (Table 3). The 5th percentile can be used for detection of low impedance pathologies such as ossicular discontinuity (Valvik et al., 1994) and the 95th percentile can be used for detection of high-impedance pathologies such as otosclerosis (Shahnaz & Polka, 1997). The overall mean and 90% range of the GSI system in the Caucasian group were comparable to the mean and 90% range of Hanks and Mortenson (1997) who used a similar system.

Frequency corresponding to a 45° phase angle (F45°):

Similarly to the RF, this parameter may also be shifted higher or lower by various middle ear pathologies. Preliminary findings suggest that the F45° may be a better index than the RF with respect to distinguishing healthy ears from otosclerotic ears (Shanks, Wilson, & Palmer, 1987; Shahnaz & Polka, 1997). Overall, the F45° was significantly higher in the Virtual system than in the GSI system. While only the 5th percentiles was different between the two systems (Table 3) in the Caucasian group, both 5th and 95th percentile were different between the two systems in the Chinese group. The mean and 90% range of F45° were comparable between the two ethnic groups (Table 3) regardless of the system used. This finding was inconsistent with Shahnaz and Davies (2006), potentially due to the smaller sample size of the current study.

Clinical Implications

While there were some differences in the measured responses for several tympanometric variables between the two systems, the overall identification rate was quite comparable between the two systems for the Ytm, the RF and the F45°. It seems that the difference between normal and otosclerotic ears on these tympanometric variables is larger than the difference between the two systems' norms. However, the clinical significance of these differences needs to be examined in other middle ear pathologies such as ossicular discontinuity and otitis media.

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■ Phonological Awareness Tasks for French-Speaking Preschoolers

■ Tâches de mesure de la conscience phonologique chez les enfants d'âge préscolaire francophones

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Abstract

In this study, a new battery of phonological awareness tasks designed for French-speaking preschoolers was developed and tested. In Experiment 1, a cross-sectional design showed that a combination of seven phonological awareness tasks accurately described developmental differences in phonological awareness between 4 and 5 years-olds, but was too difficult for 3 year-olds. Four of the initial tasks (rhyme judgment, initial consonant categorization, syllable segmentation, and syllable deletion) were then selected to form the "Épreuve préscolaire de conscience phonologique" (EPCP). In Experiment 2, a pretest-posttest design including a control and an experimental group showed that the EPCP could effectively measure phonological awareness gains due to a speech-language therapy intervention in 4- to 5-year-olds. The EPCP has the potential to become a useful tool for researchers and clinicians working with French-speaking preschoolers in the area of emergent literacy.

Abrégé

La présente étude a élaboré et mis à l'épreuve une nouvelle batterie de tâches de conscience phonologique conçues pour les enfants francophones d'âge préscolaire. Pour l'expérience 1, un devis transversal a démontré qu'une combinaison de sept tâches de mesure de conscience phonologique décrivaient avec précision des différences dans le développement de la conscience phonologique entre les enfants de 4 et 5 ans, mais que ces tâches étaient trop difficiles pour les enfants de 3 ans. Quatre des sept tâches initiales (jugement de rimes, catégorisation de la consonne initiale, segmentation syllabique et omission syllabique) ont été retenues pour former l'Épreuve préscolaire de conscience phonologique (ÉPCP). Dans l'expérience 2, un design de recherche incluant des mesures en prétest et en posttest auprès d'un groupe témoin et d'un groupe expérimental a montré que l'ÉPCP peut mesurer avec efficacité l'amélioration de la conscience phonologique à la suite d'une intervention orthophonique chez les enfants de 4 et 5 ans. L'ÉPCP a ce qu'il faut pour devenir un outil utile aux chercheurs et aux cliniciens qui travaillent en éveil à l'écrit auprès des enfants francophones d'âge préscolaire.

Key words: phonological awareness, assessment, preschool, French

Phonological awareness refers to the sensitivity to the sound units of language, such as syllables, rhymes, and phonemes, and to the ability to manipulate them (Gillon, 2004). It is one of the best predictors of reading achievement in the early school years (National Early Literacy Panel, 2007). Training children to improve their phonological awareness allows them to acquire word recognition skills

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more easily (e.g. Ball & Blachman, 1988). In order to evaluate the efficacy of phonological awareness training programs and activities, researchers and practitioners in early childhood need valid and reliable assessment instruments that can measure gain accurately in young children. However, existing assessment instruments often lack sensitivity to phonological awareness growth (Troia, 1999), and many of them are not adapted to young children before they enter kindergarten. In addition, few instruments are available in languages other than English. The purpose of the research presented here was to explore the usefulness and applicability of different phonological awareness tasks designed for French-speaking preschoolers.

Phonological Awareness Assessment Methods

Performance assessments are typically made with reference to test-specific criteria (e.g., how well did a person do on a test, based on the score) or to norm values (e.g., how well did a person do in comparison to his or her age-group). In the case of phonological awareness skills, criterion-referenced tests are considered more appropriate than norm-referenced measurements for assessing the impact of interventions (Sodoro, Allinder, & Rankin-Erickson, 2002). A good test should include sets of items that address different phonological awareness skills. It should also be quick to administer.

The psychometric properties criterion-referenced experimental tasks are rarely documented, given that they are not standardized (Salvia & Ysseldyke, 1998). However, psychometric features can still be appraised. For example, the internal consistency can be measured by the Cronbach Alpha (α) coefficient, intercorrelations among tasks can be quantified to assess whether they all tap into the same underlying construct, and the concurrent validity can be assessed by correlating the test scores with another reputable and valid test (Anastasi, 1988). All this can provide information on the qualities of the tasks in a test. In order to have valid psychometric properties, the design of a criterion-referenced phonological awareness test should be based on a solid theoretical background about the language in which it is developed. In the development of such a test, developmental processes of phonological awareness, the properties of specific tasks, and the linguistic factors associated with the stimuli must all be considered.

Linguistic Differences Between French and English

Most of the research concerning phonological awareness has focused on English and cannot be directly applied to French. French is a syllable-timed language whereas English is a stressed-timed language (Abercrombie, 1967). Most of the syllables in French display an open structure with the consonant-vowel pattern while English has a greater proportion of syllables with a closed structure showing a consonant-vowel-consonant pattern (Delattre, 1966). French is mainly polysyllabic, with only a small proportion of monosyllabic words, while English has a higher proportion of monosyllabic words (Sprengrer-

Charolles & Colé, 2006). The stress pattern in words that are polysyllabic words is often different between the two languages: in French, stress remains constantly on the last syllable creating a weak-strong pattern, while in English, the stress position is variable with a greater preponderance of the strong-weak pattern (Delattre, 1966). The syllabic nature of the French language and its great proportion of open syllabic structures, multisyllabic words, and weak-strong stress patterns, therefore, directly influences the stimuli that can be used in phonological awareness tasks designed for French-speaking children.

Development of Phonological Awareness in French-Speaking Children

Knowledge about the development of phonological awareness provides information that must guide the design of phonological awareness tasks (Gillon, 2004). Authors who have studied English-speaking children propose that phonological awareness develops in a universal sequence in which awareness of larger units precedes awareness of smaller units (Treiman & Zukowski, 1996). However, Gombert (1992), who conducted research with French children, proposed that phonological awareness development is an environmentally-driven process influenced by the phonotactics of the language and the literacy training provided to children. A study conducted by Duncan, Colé, Seymour, and Magnan (2006) supported this hypothesis by showing that phonological awareness development in English-speaking and French-speaking children from 4 to 6 years of age followed distinctive steps, and that both sequences differed from the previously proposed universal large-to-small unit sequence. Most of the studies in French recognized that the syllable level was clearly more accessible for phonological awareness tasks prior to formal literacy instruction and that phoneme and rhyme awareness emerged with formal literacy instruction in school (Bruck, Genesee, & Caravolas, 1997; Courcy, Béland, & Pitchford, 2000). According to these findings, the precedence of syllable awareness in French-speaking preschoolers is important to take into account when choosing phonological awareness tasks for this age group.

Conversely, Lecocq (1991) found in a longitudinal study with French-speaking children that sensitivity to rhymes and initial phonemes emerged at 4 years of age, before sensitivity to syllables. Gombert's (1992) distinction between epilinguistic and metalinguistic stages of awareness could reconcile these contradictory results. Epilinguistic abilities in children, such as memorizing nursery rhymes, self-correcting speech, and syllable tapping require only a low level of abstract understanding. Such activities lack intentionality and are embedded in a rich situational context. Metalinguistic behaviours, in contrast, emerge later and require a higher degree of abstraction as well as conscious metacognition. Stanovich (1987) proposes a developmental continuum in which children move from a shallower (epilinguistic) to a deeper level of understanding (metalinguistic) of speech sound units. Thus, Lecocq's

phonological awareness categorization tasks involving rhymes and initial phonemes may have tackled a shallower epilinguistic level of phonological awareness than his metalinguistic tasks involving manipulation of syllables. Categorization tasks involve a forced choice in which the child is asked to decide if specific sound segments in two words are the same. Manipulation tasks require the child to make a cognitive operation such as deleting or moving a sound segment. In preschoolers, therefore, categorization tasks requiring a shallower level of rhyme and phoneme awareness would be appropriate to assess age-appropriate skills. Tasks involving manipulation of the rhymes and phonemes require more complex cognitive operations, which are only acquired at a later developmental stage.

Parameters of Phonological Awareness Tasks

Different types of phonological awareness tasks have been used in previous research, and it has been noted that there can be considerable variability in performance between tasks (Chabon & Prelock, 1987). Different types of tasks place different demands on abilities underlying phonological awareness, such as speech perception and discrimination, short-term verbal memory, cognitive abilities, attention span, and communication abilities (McBride-Chang, 1995). The following sections describe the parameters of the phonological awareness tasks that can influence children's performance.

Verbal instructions. The vocabulary, utterance length, grammatical elements and conceptual level of the instructions given to the children play an important role in the comprehension of the task (Chabon & Prelock, 1987). Word stimuli can be presented in pictures to minimize the demands on verbal memory. In addition, training items can be provided in order to familiarize the child with the tasks and ensure comprehension. Verbal instructions in tasks designed for preschoolers should be simple and provide them with visual support and training items.

Response requirements. Tasks that require a verbal production as a response may vary in the communication demands they impose (Chabon & Prelock, 1987). A yes/no type of response is easier than a response requiring an oral production. The latter can vary in complexity on multiple levels: repetition of one of the experimenter's words, production of a new word, or production of a non-word. The articulatory complexity of the response can influence children's ability to produce a correct answer. Usually, younger children have not acquired the full phonemic inventory of their spoken language (Sanders, 1972). In French, phonemes like /s/ and /z/ as well as consonant clusters with larger distances between the places of articulation (e.g., /tr/, /kl/) tend to emerge later in children's oral productions (Beauchemin, Martin, & Ménard, 2000). In order to be suitable for preschoolers, tasks should require only simple responses or oral productions with a developmentally appropriate articulatory complexity.

Cognitive demands. Treiman & Zukowski (1996) and Yopp (1988) found that cognitive load may influence

performance on phonological awareness tasks. Complex tasks that require multiple cognitive operations increase the demands on verbal short-term memory and working memory. Ball (1993) classified phonological awareness tasks into two categories. Simple tasks require one mental manipulation, such as rhyme judgment, segmentation or blending. Complex tasks require more than one mental manipulation such as deletion, substitution, or reversal. Phonological awareness assessment instruments designed for preschoolers should target tasks with lower cognitive demands.

Duration. Given that preschoolers have a shorter attention span, a high distractibility and a low tolerance for frustration, they tend to fatigue easily in testing situations (Nagle, 2007). Shortening the duration of the tasks or of the overall assessment session can prevent fatigue effects.

Sound unit involved. It is usually recognized that it is easier to perform a task with larger rather than smaller sound units (Gillon, 2004). In fact, it is not the size of the sound unit but rather its position in the phonological hierarchy that influences the task difficulty (Treiman & Zukowski, 1996). Tasks at the syllable level would be easier than those at the rhyme level, and those at the rhyme level would be easier than those at the phoneme level. As discussed, researchers are not unanimous about this sequence. The task difficulty may be affected by environmental linguistic influences, the level of intentionality, and mental alertness required. For the reasons described earlier, we argue that phonological awareness tasks designed for French-speaking preschoolers must involve syllables. Tasks involving rhymes and phonemes, if chosen, should tap shallower levels of phonological awareness (e.g., using categorization), rather than deeper levels (e.g., using manipulation tasks).

Linguistic Parameters of the Stimuli. The linguistic characteristics of the stimuli are another important factor that may influence children's performance in phonological awareness tasks (Chafouleas, VanAuken, & Dunham, 2001). Stahl and Murray (1994) found that linguistic complexity explained children's performance better than the nature of the tasks used. The following sections describe the parameters that may influence linguistic complexity of the stimuli in phonological awareness tasks.

Lexical status of stimuli. Both real words and non-words have been used in experimental phonological awareness tasks. With young children, high frequency words are often used instead of non-words to ensure that a clear phonological representation is available in the long-term memory (Fowler, 1991). However, these high-frequency words also have a strong semantic representation that can introduce bias in the task, as young children may have difficulty separating the sound structure of the word from its meaning (van Kleeck, 1995). Courcy and Béland (1998) found that the use of non-words was effective in phonological awareness tasks for young children. Using non-words stimuli thus seems to be more appropriate

than using real words in order to avoid possible semantic bias.

Phonemic length. Task difficulty increases with the number of phonemes in the stimuli. McBride-Chang (1995) related this length effect to limitations of the short-term verbal memory. Consequently, shorter stimuli should precede longer ones within a task to gradually increase its complexity.

Location of the sound unit involved. There is consensus in the research to date that sound units embedded in the middle of words are harder to perceive and manipulate than are those at the beginning or at the end of the stimuli (McBride-Chang, 1995; Stanovich et al., 1984). Primacy and recency effects in verbal short term memory would favor initial and final positions (Treiman, Berch, & Weathersont, 1993), and the higher level of coarticulation in the middle of the word would render units in this position less accessible (Stage & Wagner, 1992). Research has found an advantage of the initial position over the final position (Stage & Wagner, 1992; Stanovich et al., 1984; Treiman et al., 1993), although there is some disagreement (McBride-Chang, 1995). Therefore, testing sound units in the middle of the word should be avoided when designing tasks for young children. The focus should be on both the initial and the final positions.

Syllabic structure. The presence of consonant clusters in the syllabic structure of the stimuli makes phonological tasks more difficult to complete (McBride-Chang, 1995). Consonant clusters may cause confusion in speech perception. Further, phonological tasks involving closed syllables might be more difficult for younger children because the French language displays a higher frequency of open syllables in words. Therefore, in order to gradually increase task complexity, stimuli with a simple open syllabic structure should precede those with more complex syllabic structures within the task.

Nature of phonemes. McBride-Chang (1995) reported that the acoustic properties of phonemes influence phonological awareness tasks because of their impact on speech perception. Continuant consonants like liquids (e.g., /l, r/) and fricatives (e.g., /s, v/) are easier to identify and manipulate than are stops (e.g., /p, d/; McBride-Chang, 1995; Stahl & Murray, 1994). Consequently, stimuli involving continuants should precede those involving stops to gradually increase complexity within a task. Treiman, Broderick, Tincoff, and Rodriguez (1998) also found that consonants that differ only in voicing (e.g., /t/ versus /d/) were harder to compare. Thus, in tasks such as rhyme judgment or initial phoneme categorization, the comparison of stimuli with consonants differing in many parameters (e.g., voicing, placement, and manner) should precede those with consonants differing only in voicing.

Phonological Awareness Tasks for Preschoolers in French. Most of the phonological awareness tasks currently available in French are embedded in more general norm-referenced tests and are not designed specifically to measure intervention effects. In addition, most tests for children

were constructed for kindergarteners and school-aged children. The same is true with criterion-referenced tasks used in studies conducted in French (e.g., Duncan et al., 2006; Courcy et al., 2000; Boudreau, Giasson, & Saint-Laurent, 1999; Lecocq, 1991).

The goal of the current study was to develop a battery of criterion-referenced phonological awareness tasks that would be appropriate to measure developmental growth as well as therapy effects. Three research questions were addressed:

- What combination of phonological awareness tasks is suitable for preschoolers and sensitive to development and growth?
- Can this combination of tasks be used to quantitatively appraise intervention effects?
- What are the main psychometric properties of these tasks?

Two experiments were conducted to answer these questions.

Experiment 1

Method

Study design. The goal of the first experiment was to develop a battery of phonological awareness tasks that would take into account the characteristics of the French language, the developmental stage of the phonological awareness, the task parameters, and the linguistic parameters of the stimuli. It examined which combination of these tasks was both suitable for preschoolers and sensitive to developmental growth. A cross-sectional design was used to measure phonological awareness across three age groups of preschoolers: 3, 4 and 5 year-olds.

Participants. The children were recruited in ten publicly subsidized childcare centres of Québec City and of Montréal, Québec, Canada. The participants met the following inclusion criteria: French as their first language (i.e., exposed to French 90% of the time), normal language development and hearing (as reported by the parents), and pre-literate (as reported by the parents). The children's age fell in one of the three age groups at testing: from 32 to 40 months (3 year-old group), from 44 to 52 months (4 year-old group), and from 56 to 64 months (5 year-old group). Thirty-four children were included: 12 in the 3-year-old group, 12 in the 4-year-old group, and 10 in the 5-year-old group.

Table 1 summarizes the characteristics of the children in the three groups. No difference was found in the sex distribution across the three groups, $\chi^2(2, N = 34) = 0.22$, $p = .90$, nor in receptive vocabulary score, $F(2, 31) = 1.53$, $p = .23$.

Materials. Seven tasks were developed, largely inspired by the metaphonological tasks used by Courcy et al. (2000) in their research with French-speaking kindergarteners and 1st graders in Québec, Canada, and those used by Lonigan et al. (1998) with 3- to 5-year-old English-speaking pre-

Table 1
Characteristics of the Participants in Experiment 1

Variables	Group		
	3 year-olds (<i>n</i> = 12)	4 year-olds (<i>n</i> = 12)	5 year-olds (<i>n</i> = 10)
Gender			
Number of males	6	7	5
Number of females	6	5	5
Mean age in months (SD)	36.7 (2.0)	48.4 (2.2)	61.4 (1.4)
Mean vocabulary score ^a (SD)	110.0 (18.0)	119.5 (19.3)	123.3 (18.4)

Note. ^a Standardized receptive vocabulary score on “Échelle de vocabulaire en images Peabody” (EVIP; Dunn, Thériault-Whalen, & Dunn, 1993)

schoolers. The seven tasks were administered in this order: (a) rhyme judgment, (b) initial syllable categorization, (c) syllable blending, (d) syllable segmentation, (e) syllable deletion, (f) syllable inversion, and (g) initial consonant categorization. These tasks were chosen because it was expected that they would be developmentally appropriate for the participants. Based on the findings from the literature discussed in the previous section, the tasks were ordered following an increasing level of difficulty.

The tasks for rhyme judgment, initial syllable categorization and initial consonant categorization involved a comparison of only two stimuli at a time to avoid overloading of the children's verbal short-term memory. Taken together, the tasks involved the levels of rhyme, syllable, and phoneme in order to cover all of the sound units in which phonological awareness develops. A greater proportion of tasks involved the syllable level because of the syllable-timed nature of the French language. Each task included three practice items and 10 assessment items. Ten was considered a reasonable minimum number of items for reliably and efficiently measuring phonological awareness while not exhausting the children's attention (Chafouleas & Martens, 2002; Stanovich, Cunningham, & Cramer, 1984). Verbal instructions to the children were given in simple vocabulary and short sentences. The words “rhyme”, “syllable” and “sound” were used but they were explained (e.g., a syllable is a small chunk of a word) and visually represented by wooden blocks. Manipulation of the blocks made the task instruction more concrete (e.g., two blocks were separated to illustrate syllable segmentation). The first two and the last task required a yes / no response. The correct answers (yes vs. no) were arranged in a quasi-random order. The five other tasks required verbal

answers. Every effort was made to reduce the articulatory complexity of the requested answers by avoiding phonemes that emerge later in children's oral production (e.g. /ʃ/ and /ʒ/) and consonant clusters with larger distances between the places of articulation (e.g. /tr/ or /kl/).

The tasks used multisyllabic non-words as stimuli to reflect the multisyllabic nature of words in French and to control for possible lexical and semantic biases. The phonemic length, the location of the target sound unit, the syllabic structure and the nature of the phonemes in the non-words were manipulated in order to increase the difficulty level within each task. For the categorization tasks (rhyme judgment, initial syllable categorization, and initial consonant categorization), the following rules were applied:

- phonemic length: from 4 to 5 phonemes;
- syllabic structure of target unit: from simple consonant - vowel (CV) structure to complex CVC and CCV structures.
- nature of the consonant: for different pairs, from high contrast (voiced fricative vs. voiceless stop to low contrast (voiceless stop vs. voiceless stop) and for similar pairs, from voiced fricative to voiceless stop.

For the manipulation tasks (syllable blending, segmentation, deletion and inversion), the following rules were applied:

- phonemic length: from 4 to 6 phonemes and from 2 to 3 syllables in the segmentation task;
- syllabic structure: from simple CV\$CV (\$ indicates syllable boundary) to complex CV\$CCV, CVC\$CV, CCV\$CCV, CVC\$CVC and CV\$CV\$CV (for blending and segmentation only);
- type of consonant: different place of articulation but similar voicing in each syllable to facilitate the response;
- location of the sound unit to delete for syllable deletion task only: from initial to final.

The tasks and the stimuli are listed in the appendix. To provide information about the concurrent validity of the tasks, the receptive vocabulary test “Échelle de vocabulaire en images Peabody” (EVIP; Dunn, Thériault-Whalen, & Dunn, 1993) was chosen. The reliability and validity of the EVIP have been established. This test was also considered useful because of the strong relationship between

vocabulary and phonological awareness development (Metsala & Walley, 1998). It was expected that the scores from the EVIP and the phonological awareness tasks would be positively correlated.

Procedures. First, the EVIP was administered to the children. The phonological awareness tasks were then administered through a puzzle game in order to secure the children's participation. After the completion of each task, the child received a different box containing pieces of a puzzle. The completion of all tasks was required to complete the puzzle. For scoring purposes, each response was worth 1 point for a maximum of 10 points per task, and a total test score of 70 points. Positive verbal reinforcement was given regardless of the correctness of the child's response during the test. Feedback on correctness was provided for the three practice items only. No repetition of any stimuli was permitted. After five consecutive incorrect responses or two refusals from the child within a task, the experimenter gave the gift box to the child and went on to the next task. The test administration was stopped after three consecutive tasks in which the child scored 0. The assessments were conducted in the children's childcare centers, in a separate room where visual and auditory distracters were reduced. The second and third authors each administered half of the assessments. They were trained by the first author to systematically use the verbal instructions with the non-verbal cues that were described on the phonological awareness tasks form. The examiners filled in the response forms on site. The assessments were recorded on audiotape to assess the inter-rater reliability of the manipulation tasks (which required verbal responses). Inter-rater reliability was established based on 70% of the tasks involving production by the child. The two experimenters listened to the recordings that had been performed by their colleagues. A 97% agreement rate on item scoring was obtained.

Results

Differentiation of age groups.

Table 2 shows the mean scores and standard deviations on the tasks across the three age groups. Non-parametric tests were used (Kruskal-Wallis H and Mann-Whitney U) for comparison analyses based on an inspection of the data distributions and the equality of the variances across the groups. A significant main effect was found among the three groups in total score, $H(2) = 16.82, p < .01$. The post hoc comparisons were made with the alpha level set at .017 (Bonferroni correction). The total scores were higher for the 5 year-olds than those for the 4

year-olds ($U = 20.5, p < .01$), and the 3 year-olds ($U = 0.5, p < .01$). No significant difference was found between the total scores of the 3 and 4 year-olds ($U = 42.5, p = .08$). A floor effect was observed in the 3 year-olds' overall score. Children in this age group responded at chance level on the categorization tasks (rhyme judgment, initial syllable categorization and initial consonant categorization) and did not succeed in any of the manipulation tasks (syllable blending, segmentation, deletion, and inversion). In general, none of the groups scored well (from 15.2 to 31.6 out of a maximum score of 70).

Significant differences across the groups were found for the following specific tasks: (a) rhyme judgment, $H(2) = 7.4, p = .03$; (b) syllable blending, $H(2) = 11.0, p < .01$; (c) syllable segmentation, $H(2) = 17.3, p < .01$; (d) syllable deletion, $H(2) = 11.2, p = .01$; and (e) initial consonant categorization, $H(2) = 16.0, p < .01$. The initial syllable categorization and syllable inversion tasks did not discriminate between the age groups. The post hoc comparisons revealed that the 4 year-olds performed better than the 3 year-olds on the syllable segmentation task ($p < .01$). The 5 year-olds performed better than the 4 year-olds only on the initial consonant categorization task ($p < .01$). The 4 year-olds performed at chance level of performance on this task. The 5 year-olds performed better than the 3 year-olds on all tasks ($p < .01$).

Intercorrelations among the tasks. To verify if all tasks tapped into the same underlying construct, Kendall's tau (τ) non-parametric correlations were calculated (see Table 3). All tasks correlated with each other except the syllable segmentation and syllable

Table 2
Mean Score (SD) on the Phonological Awareness Tasks Across Groups

Task (max = 10)	Group		
	3 year-olds	4 year-olds	5 year-olds
Rhyme judgment	5.0 (1.1)	5.5 (2.4)	7.4 (2.1)
Initial syllable categorization	5.2 (1.5)	5.9 (1.6)	6.2 (2.4)
Syllable blending	0.0 (0.0)	0.6 (1.7)	2.5 (2.5)
Syllable segmentation	0.0 (0.0)	3.0 (4.0)	7.1 (2.9)
Syllable deletion	0.0 (0.0)	1.3 (3.0)	1.9 (2.6)
Syllable inversion	0.0 (0.0)	0.5 (1.7)	0.1 (0.3)
Initial consonant categorization	5.0 (0.0)	5.2 (0.6)	6.4 (1.5)
Total score (max = 70)	15.2 (2.4)	22.0 (12.3)	31.6 (8.7)

Table 3*Non parametric Intercorrelations Among Phonological Awareness Tasks*

Task	1	2	3	4	5	6	7	8
1. Rhyme judgment	-	.40**	.63**	.37*	.54**	.33*	.53**	.64**
2. Initial syllable categorization		-	.39**	.36*	.40**	.37*	.41**	.52**
3. Syllable blending			-	.43**	.53**	.52**	.66**	.55**
4. Syllable segmentation				-	.66**	.31	.56**	.70**
5. Syllable deletion					-	.44**	.79**	.64**
6. Syllable inversion						-	.46**	.35*
7. Initial consonant categorization							-	.59**
8. Total score								-

* $p < .05$. ** $p < .01$.

inversion tasks, respectively the easiest and the hardest task. The correlations were moderate to strong according to Cohen's (1988) criteria.

Internal consistency and concurrent validity.

Internal consistency of the whole group of phonological awareness tasks was calculated using the Cronbach's α coefficient. The value reached .92, suggesting a satisfactory level of internal consistency (Hills, 1981). Using Kendall's tau (τ), a weak but significant non-parametric correlation was found between the total phonological awareness score and the EVIP raw score, $\tau = .42$, $p < .01$.

Discussion of the results of Experiment 1

Taken together, the phonological awareness tasks differentiated well between the developmental stages of the 4 and 5 year-olds. Taken separately, only the initial consonant categorization task differentiated between these two groups. The 4 years-olds performed at chance level on this task. All tasks were too difficult for the 3 year-olds. The moderate to strong intercorrelations suggest that all tasks tapped into a common underlying construct. The analyses revealed a satisfactory internal consistency and concurrent validity with the EVIP. The weak but significant correlation between the phonological awareness tasks and the EVIP could be taken to suggest that the two tests measured different constructs: phonological awareness versus receptive vocabulary.

Based on the overall poor performance of the children in Experiment 1, it was decided to remove some tasks from the phonological awareness assessment. It was also desirable to shorten the assessment in order to reduce possible fatigue effects, since the administration time for the complete protocol was as long as 45 minutes. The syllable inversion task was eliminated because only two children passed at least one item in this task. The initial syllable categorization task was also eliminated because it was not discriminative between children from different age groups. In order to reflect phonological awareness at all sound unit levels, the rhyming judgment and the initial consonant categorization tasks were retained. Of the other three tasks on the syllable level, only segmentation and deletion were retained. Segmentation and blending are similar tasks, but segmentation was more discriminative than blending across the age groups.

Four tasks were chosen to form the "Épreuve préscolaire de conscience phonologique" (EPCP): (a) rhyme judgment, (b) initial consonant categorization, (c) syllable segmentation, and (d) syllable deletion. Since some children struggled with the shift from categorization tasks to manipulation tasks, it was decided that the rhyme judgment and initial consonant categorization tasks should precede the syllable segmentation and deletion tasks. In addition, some non-word stimuli were modified because they resembled real words (/diru/ was changed

to /dimu/ because it sounded like “dix roues” which is a Quebec French term equivalent of “ten-wheeler”). Finally, modifications were made to the instructions: redundancy in the explanations was reduced and the three practice items were changed to two training items and four practice items. In the training items, the experimenter gives examples of correct answers. In the practice items, the child is asked to give an answer and corrective feedback is provided by the experimenter. The child has to give two correct answers in the practice items before being presented with the 10 items of the task. If he or she does not give two correct answers, the task is skipped.

Table 4
Characteristics of Participants in Experiment 2

Variables	Group	
	Experimental (<i>n</i> = 10)	Control (<i>n</i> = 13)
Gender		
Number of males	6	8
Number of females	4	5
Number with language delay	4	7
Mean age in months (SD)	57.1 (4.3)	57.5 (3.6)
Vocabulary score ^a (SD)	99.5 (14.3)	100.9 (18.5)

^a Standardized receptive vocabulary score on EVIP.

In order to assess whether the EPCP can detect changes in phonological awareness due to intervention, a subset of data were analyzed from a larger study on the efficacy of an intervention program for at-risk French-speaking preschoolers (Lefebvre, Trudeau, & Sutton, 2008).

Experiment 2

Method

Study design. The second experiment used a control-group pretest-posttest design. Children were recruited from four childcare centers. Each of two sites was randomly assigned to either an experimental or a control group. The control group received an evidence-based shared storybook reading program fostering oral language and

print awareness skills. The experimental group received an enhanced version of the shared storybook reading program, which targeted phonological awareness in addition to oral language and print awareness skills. Both programs lasted 10 weeks.

Participants. The children were recruited in publicly subsidized childcare centers of Québec City, Québec, Canada. Participants met the following inclusion criteria: French as first language (i.e., exposed to French 90% of the time), preliterate according to the parents, normal nonverbal cognitive skills on the Leiter International Performance Scale-Revised (Roid & Miller, 1997), and normal hearing status according to an audiometric screening test. Twenty-three children were recruited: 10 in the experimental group and 13 in the control group. Their characteristics are shown in Table 4. There were no differences on the variables age, $t(21) = 0.22$, $p = .83$; sex distribution, $\chi^2(1, N = 23) = 0.01$, $p = .94$; distribution of children with language delay, $\chi^2(1, N = 23) = 0.43$, $p = .51$; and child vocabulary scores, $t(21) = 0.20$, $p = .84$.

Procedure. Before and after the 10-week intervention program, all children were seen for an individual assessment of their oral language and emergent literacy skills, which included the administration of the EPCP. The EVIP was also administered as a pretest only. The EPCP was again administered through a puzzle game. Each answer was worth 1 point for a maximum of 10 points per task, for a total test score of 40 points. Positive verbal reinforcement was given, but no repetition of the stimuli was permitted. After five consecutive incorrect answers or two refusals from the child, the task was skipped. Trained graduate students and the first author administered the assessments in the children's child care centers, in a separate room where visual and auditory distracters were reduced. The post-intervention assessments were performed by one trained graduate student who was blind to the interventions. The response forms were completed on site. The assessments were recorded on audiotape for the subsequent inter-rater reliability measures. A 96% agreement rate was obtained between the experimenter and a graduate student who scored the assessment sessions independently based on the audiotapes.

Results

Sensitivity. A *t*-test confirmed that the groups obtained equivalent scores on the EPCP before intervention, $t(21) = 0.46$, $p = .65$. A series of paired *t*-tests were used to verify whether the EPCP could detect improvement in phonological awareness measures due to intervention. The experimental group had a mean score of 15.2 out of a maximum of 40 ($SD = 5.9$) before intervention, and improved to 29.5 ($SD = 5.6$) on the EPCP after the intervention. This improvement was statistically significant, $t(9) = 8.98$, $p < .01$, $d = 2.33$. The control group obtained a mean score of 13.9 ($SD = 7.8$) before and 17.8 ($SD = 8.1$) on the EPCP after the intervention. This improvement was significant, but with a smaller effect size, $t(12) = 2.19$,

$p = .049$, $d = 0.37$. After the intervention, the scores of the experimental group were higher than those of the control group, $t(21) = 3.91$, $p < .01$. No floor effects were observed in the overall scores of any of the groups.

Internal consistency and concurrent validity. The assessment instrument provided satisfactory Cronbach's α s before and after the intervention (.86 and .91 respectively). The correlation between the EPCP scores before the intervention and the EVIP raw scores was similar to that obtained in Experiment 1 ($\tau = .40$, $p = .01$).

Discussion of Experiment 2

The EPCP quantified the intervention effects in preschoolers even when the analyses included a small number of children. A larger effect size was found when the interventions in the shared reading program explicitly addressed phonological awareness. Internal consistency and concurrent validity remained good despite the modifications of the tasks following Experiment 1.

General discussion

This study describes the development of a new instrument for the specific assessment of phonological awareness, in French-speaking preschoolers. In the development of the EPCP, the specific characteristics of the French language, the developmental stage of the phonological awareness, the complexity of the tasks, and the linguistic features of the stimuli were all considered. The results indicated that the final version of the EPCP could measure the improvement in phonological awareness due to natural development or therapeutic intervention, even when the groups analyzed were small (n from 10 to 13 per group).

The different tasks of the EPCP were moderately to highly correlated, which suggest that they tap into the same underlying construct. The correlations between the tasks match the results obtained in other studies (McBride-Chang, 1995; Stanovich et al., 1984; Yopp, 1988). The internal consistency and concurrent validity of the EPCP were good in both experiments.

The EPCP assesses phonological awareness on multiple conceptual levels, which may be advantageous. The combination of tasks involving different sound units and mental operations in the final version of the EPCP may make the assessment more suitable for young children. In contrast, single task instruments such as the initial phoneme oddity task developed by Boudreau et al. (1999) are not sensitive in younger children. Overall, the current study indicates that the EPCP may be a valuable addition to our assessment inventory.

Limitations

The EPCP was too difficult for 3 year-olds. Modifications would be needed in order to use this instrument with children of this age. The concurrent validity was established with a vocabulary test. It would have been desirable to use another phonological awareness test if one had been available. Lacking such an opportunity

for a direct comparison, future research should compare the EPCP to skills such as short-term verbal memory, as these are more directly linked to phonological awareness. Further research on other psychometric characteristics such as predictive validity or test-retest reliability would provide more evidence of the reliability and validity of the EPCP. Finally, further research with larger samples of children and from more geographically diverse participant groups is needed in order to provide normalization data useful for detecting children who experience delay in their phonological awareness development.

Clinical implications

The EPCP shows promise as an instrument that is sensitive to the phonological awareness in 4- and 5 year-old French-speaking preschoolers and that provides good psychometric properties. It shows some potential to be used in research or in clinical settings to measure phonological awareness training efficacy before kindergarten. The EPCP also has a potential utility in older children because no ceiling effects were obtained in the current study. However, more research is needed with larger sample of children to confirm the clinical value of the EPCP.

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Appendix

Phonological Awareness Tasks and Stimuli

Task	Stimuli in International Phonetic Alphabet	
Rhyme judgment	1. /moɤi/ & /leti/	6. /takɔv/ & /niʒɔv/
	2. /voke/ & /diɤu/	7. /pofas/ & /luʒas/
	3. /ʃemi/ & /loti/	8. /nevug/ & /fidug/
	4. /sedo/ & /ʃiba/	9. /mezɔt/ & /fotab/
	5. /levuʒ/ & /kɔfip/	10. /pevat/ & /ʒunik/
Initial syllable categorization	1. /vali/ & /turo/	6. /kotu/ & /kova/
	2. /ziku/ & /zipa/,	7. /vɤidu/ & /vɤina/
	3. /ʃubi/ & /ʃuda/,	8. //plute/ & /tɤaki/
	4. /fope/ & /ʃifu/	9. /zilʃe/ & /zilmo/
	5. /bezi/ & /beka/	10. /tirlo/ & /tirva/
Syllable blending	1. /zi/ & /go/	6. /gɤa/ & /blo/
	2. /bi/ & /va/	7. /bil/ & /daz/
	3. /fe/ & /pa/	8. /ta/ & /pi/ & /ko/
	4. /da/ & /gɤo/	9. /de/ & /bu/ & /ga/
	5. /bal/ & /do/	10. /ki/ & /va/ & /le/
Syllable segmentation	1. /duve/	6. /gɤubli/
	2. /fetu/	7. /dalgiz/
	3. /bɔza/	8. /patoki/
	4. /bigɤu/	9. /bedagu/
	5. /dulbe/	10. /zulate/
Syllable deletion	1. /si/ from /pasi/,	6. /ze/ from /zebo/,
	2. /fal/ from /tofal/,	7. /zi/ from /zidul/,
	3. /ʒi/ from /dɔʒi/,	8. /vɔl/ from /vɔlde/,
	4. /flu/ from /kɤeflu/,	9. /fɤi/ from /fɤiplo/,
	5. /zav/ from /bɔlzav/,	10. /ʃis/ from /ʃistal/
Syllable inversion	1. /vidu/	6. /bazil/
	2. /zudi/	7. /gɤoza/
	3. /tefa/	8. /vulbe/
	4. /pofe/	9. /flikɤa/
	5. /vogɤi/	10. /dazvil/
Initial consonant categorization	1. /tulo/ & /vaki/	6. /dimo/ & /puba/
	2. /pofa/ & /seli/	7. /fluma/ & /fɤibe/
	3. /fopi/ & /zegu/	8. /fɤemo/ & /plafi/
	4. /zuɤi/ & /zake/	9. /bɤazi/ & /kledo/
	5. /ʃetu/ & /ʃali/	10. /kɤizo/ & /klume/

■ **An Assessment of Parents' Decision-Making Regarding Paediatric Cochlear Implants**

■ **Un examen du processus décisionnel des parents concernant l'implantation cochléaire pédiatrique**

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Abstract

Parents of children with severe to profound hearing loss have to make a number of fundamental decisions for their children. These decisions include communication and amplification options. In particular, the parents must decide whether and when their child will receive cochlear implants, and whether these will be implanted unilaterally or bilaterally. The objective of this study was to describe the decision-making needs of parents making the cochlear implant decision for their children. Semi-structured interviews were conducted with eight parents and eight cochlear implant team members at a Canadian cochlear implant centre to document parental and clinician recollections and opinions of the decision-making process related to a unilateral or bilateral cochlear implantation. The results demonstrated that the decision to go ahead with a cochlear implantation was consistently based on the parents' preferences for spoken communication for their children. Parents reported satisfaction with the cochlear implant decision-making process. Two of eight parents felt that additional information on unilateral cochlear implantation risks and benefits should have been provided. Four of eight parents described how more information on the experiences of other families would have been helpful for their decision. Parental and clinical perceptions of the bilateral implantation decision were highly variable. All parents stated that additional information on bilateral cochlear implantation was needed. Based on the results of the interviews, it is concluded that there is a need for information and resources for bilateral cochlear implantation decision-making.

Abrégé

Les parents d'un enfant ayant une perte auditive de degré sévère à profond ont des décisions fondamentales à prendre pour leur enfant. Ces décisions comprennent des options de communication et d'amplification. Plus spécifiquement, ils doivent décider si leur enfant recevra un ou deux implants cochléaires et à quel moment. La présente étude visait à décrire les besoins des parents dans le processus décisionnel de l'implantation cochléaire pour leur enfant. Des entrevues semi-structurées ont été menées auprès de huit parents et de huit membres d'une équipe d'un centre canadien d'implantation cochléaire pour documenter ce dont se souviennent les parents et les cliniciens et leur avis concernant la décision menant à une implantation unilatérale ou bilatérale. Les résultats montrent que le fait de choisir l'implantation cochléaire était systématiquement fondé sur la préférence des parents pour la communication orale de leur enfant. Les parents ont dit être satisfaits du processus de décisions liées à l'implantation cochléaire. Deux des huit parents trouvent qu'ils auraient dû recevoir davantage d'information sur les avantages et les risques de l'implantation unilatérale. Quatre des huit parents ont dit qu'ils auraient trouvé utile d'avoir davantage d'information sur l'expérience d'autres familles avant de prendre leur décision. La perception des parents et des cliniciens concernant le choix de l'implantation bilatérale variait considérablement. Tous les parents ont précisé qu'ils

auraient eu besoin de plus de renseignements sur l'implantation bilatérale. Les résultats des entrevues mènent à la conclusion qu'il manque d'information et de ressources pour prendre des décisions dans le cas de l'implantation cochléaire bilatérale.

Key words: hearing loss, cochlear implants, needs assessment, decision making, audiology

Almost immediately after the diagnosis, the parents of children with bilateral, permanent, sensorineural hearing loss are required to make a number of fundamental decisions regarding the communicative rehabilitation of their child. These decisions involve use of the choice of amplification or cochlear implantation, and the communication approach for their child. Most of these parents have never experienced hearing loss, which may make the decisions more difficult and daunting (Northern & Downs, 1991). Their lack of knowledge regarding hearing loss, options for communication, and technologies for rehabilitation can be overwhelming for parents. They must absorb significant amounts of technical and scientific information during a period of grief about their child's hearing loss (Anagnostou, Graham, & Crocker, 2007; Kurtzer-White & Luterman, 2003). While the treatment team can provide parents with necessary information, the actual decision-making process is usually invisible to the professionals. A better understanding of the parents' process for decision-making may allow the cochlear implant team to reduce some of the parental stress and anxiety during this delicate and emotional time.

Family decisions about treatment vary depending on the severity and characteristics of the child's hearing loss. A child with any significant degree of bilateral hearing loss usually requires specialized early interventions in order to develop language (Samson-Fang, Simons-McCandless, & Shelton, 2000). A child with a severe to profound hearing loss may require considerable intervention in the form of amplification and aural rehabilitation in order to develop functional spoken communication. For these children, cochlear implants (CIs) are one of the available options. The criteria for CI use in children with significant hearing loss have expanded considerably since the initial approval of the device by the American Food and Drug Administration in 1990 (Candidacy Criteria, 2008). Originally used in older children with profound hearing loss, now children 1 year of age and even younger with severe to profound losses are routinely eligible for CIs (Thoutenhoofd et al., 2005). Because binaural hearing is important for sound localization and speech intelligibility in noise, bilateral implantations have become common in some paediatric centres (Berg, Ip, Hurst, & Herb, 2007).

When parents are considering cochlear implantation for their child, they are interested in the medical, speech and language, educational, and social outcomes of other users of the device. A systematic review of the effectiveness of unilateral paediatric cochlear implants reports that there are consistent benefits for children who use CIs rather than hearing aids in terms of hearing sensitivity levels and speech perception (Thoutenhoofd, et al., 2005). A recently published, multi-site study shows greater improvements in the language of children using CIs as compared to earlier evaluations of children using hearing aids (Moog & Geers, 2003). The evidence is less clear-cut regarding the relative benefits of CIs over hearing aids for children with residual hearing and children with comorbidities or congenital syndromes (Thoutenhoofd et al., 2005). Practices for the latter populations vary across CI centres.

There are risks associated with the CI surgery that may influence parental decision-making. Early studies estimated that 18% of CI surgeries were accompanied by some type of minor or major complication (Cohen, Hoffman, & Stroschein, 1988). The current estimates suggest that major complications range from 3 to 4% of CI surgeries (Tambyraja, Gutman, & Megerian, 2005). One major risk is the post-surgical complication of meningitis among children who have received an implant. Recent work has attributed the increased risk of meningitis, in part, to a particular positioner device that has since been withdrawn from the market (U.S. Food and Drug Administration, 2007; Biernath, et al., 2006). Vaccinations to prevent meningitis continue to be recommended for the entire CI recipient population. Facial nerve paralysis, vestibular problems, and risks associated with the use of a general anaesthetic are some of the other complications of CI surgery (Fayad, Wanna, Micheletto, & Parisier, 2003; Fina et al., 2003; Gysin, Papsin, Daya, & Nedzelski, 2000). Finally, once the CI surgery is undertaken, there is a high risk of losing the residual hearing in that ear (Bergeron, 2000; Boggess, Baker, & Balkany, 1989). Therefore, the parental decision to use a CI is typically irreversible.

Bilateral implants have recently become available in many paediatric cochlear implant centres, although not yet universally in Canada. The research indicates that there are benefits for patients receiving bilateral stimulation compared to the use of a single CI, demonstrated on measures of speech recognition in noise and sound localization (Brown & Balkany, 2007; Ching, van Wanrooy, & Dillon, 2007; Murphy & O'Donoghue, 2007; Schafer & Thibodeau, 2006). New guidelines for patient selection and other position papers have also recently been published (William House Cochlear Implant Study Group, 2008; Perreau, Tyler, Witt, & Dunn, 2007). The addition of the bilateral implantation option further complicates the parental and clinical decision-making process. Recent audiology and otolaryngology literature has discussed the need for additional evidence of bilateral CI effectiveness above and beyond the improved speech recognition in noise and sound localization (Berg et al., 2007; Gregoret, 2003).

Parental cochlear implant decision-making

Publications from around the world have described the challenges parents face in deciding on cochlear implantation for their children (Sorkin & Zwolan, 2008; Sach & Whynes, 2005; Li, Bain, & Steinberg, 2004; Incesulu, Vural, & Erkam, 2003; Most & Zaidman-Zait, 2003; Peters, 2000; Steinberg, et al., 2000). Incesulu et al. (2003) report that 81% of parents responding to a survey indicated that the CI decision was the most difficult aspect of the implantation process for them. Most and Zaidman-Zait (2003) also describe the high parental stress during the implantation decision-making process and the specific parental needs for information to aid in the process.

In contrast, Sach and Whynes (2005) of the UK report that most of the 216 interviewed families found the decision regarding implantation to be straightforward. They did, however, describe the overall stress for families undergoing cochlear implantation. A very recent survey of parents in the US indicates that those who chose the CI for their child felt that they lacked "comprehensive and bias-free" information when making the decision (Sorkin & Zwolan, 2008).

The medical decision-making literature makes a distinction between preference-sensitive and effective decisions (Wennberg, 2002). In medical decision-making, a decision is considered preference-sensitive when the available evidence indicates that there are several available choices that carry both harms and benefits. In such a scenario, the personal beliefs and preferences of the patient may affect his or her perception of the relative weight of the harms and benefits of an intervention. The patient's care must therefore acknowledge these preferences (O'Connor, Legare, & Stacey, 2003; Wennberg, 2002). This is in contrast to effective care. In an effective care scenario, the benefits of a treatment clearly outweigh possible harmful treatment effects. Based on findings in the pertinent literature, the CI decision appears to be preference-sensitive.

When individuals are faced with making preference-sensitive decisions, they can experience increased decisional conflict. Decisional conflict is the state of uncertainty about the best course of action (O'Connor, 1995). Previous CI studies have not referred to, nor measured, the decisional conflict in parents making the CI decision. They also have not contextualized the CI decision within the broader medical decision-making literature.

The literature indicates that there is variability in the decision-making process across geographical regions, cultural backgrounds, and CI centres (Sorkin & Zwolan, 2008; Sach & Whynes, 2005; Li, Bain, & Steinberg, 2004; Incesulu, Vural, & Erkam, 2003; Most & Zaidman-Zait, 2003; Peters, 2000; Steinberg, et al., 2000). However, even within an individual CI centre, families may experience very different forms and levels of decisional conflict and emotional stress. The reported stress may be due to uncertainty about possible risks and benefits. The parents may be uncertain or conflicted in their values regarding communication approaches (e.g., oral or sign language)

that may be linked to the CI decision. They may feel that they have inadequate information about their options, or feel under pressure from clinicians or other family members. Having a better understanding of the CI decision-making process may identify a way to reduce parental stress during this process or to meet any specific information needs that are identified. There is currently no available literature on parental perceptions of the bilateral CI decision.

Purpose

The present study was undertaken to investigate the decision-making process and the needs of parents regarding unilateral and bilateral CIs. Research objectives were to explore:

- (a) The parental and clinician perceptions of the unilateral and bilateral decisions: How did parents and clinicians perceive different options with regards to their respective advantages and disadvantages?
- (b) The parents' and clinicians' perceptions of their knowledge, values and expectations, as well as the support and resources available to them during CI decision-making.
- (c) The parents' recollections of the manifestations of decisional conflicts and their contributing factors during the decision-making process.
- (d) The need for a formal decision aid to support parents and clinicians in the cochlear implant decision-making process.

Framework

The Ottawa Decision Support Framework (ODSF; O'Connor et al., 1998) was chosen as the framework to guide the needs assessment in the present study. A schematic overview of the ODSF is presented in Figure 1. This framework is appropriate for decisions that "(1) are stimulated by a new circumstance, diagnosis, or developmental condition, (2) require careful deliberation because of the uncertain and/ or value-sensitive nature of the benefits and risks, and (3) need relatively more effort in the deliberation stage than the implementation stage" (O'Connor et al., 1998, p.268). The paediatric cochlear implantation decision meets each of these criteria. The ODSF depicts how a family's decisional needs and decisional quality influence each other. Decisional needs include (a) elements of the decision, such as timing, stage, and leaning, (b) decisional conflict, (c) knowledge and expectations, and (d) values. Decision support can be used to address decisional needs to improve the quality of decisions.

Method

Participants and recruitment

A sample of parents at various stages of decision-making were recruited. Eligible participants included parents whose children were (a) were currently assessed for CI candidacy, (b) were awaiting surgery, or c) had undergone surgery within the last 2 years, and had used

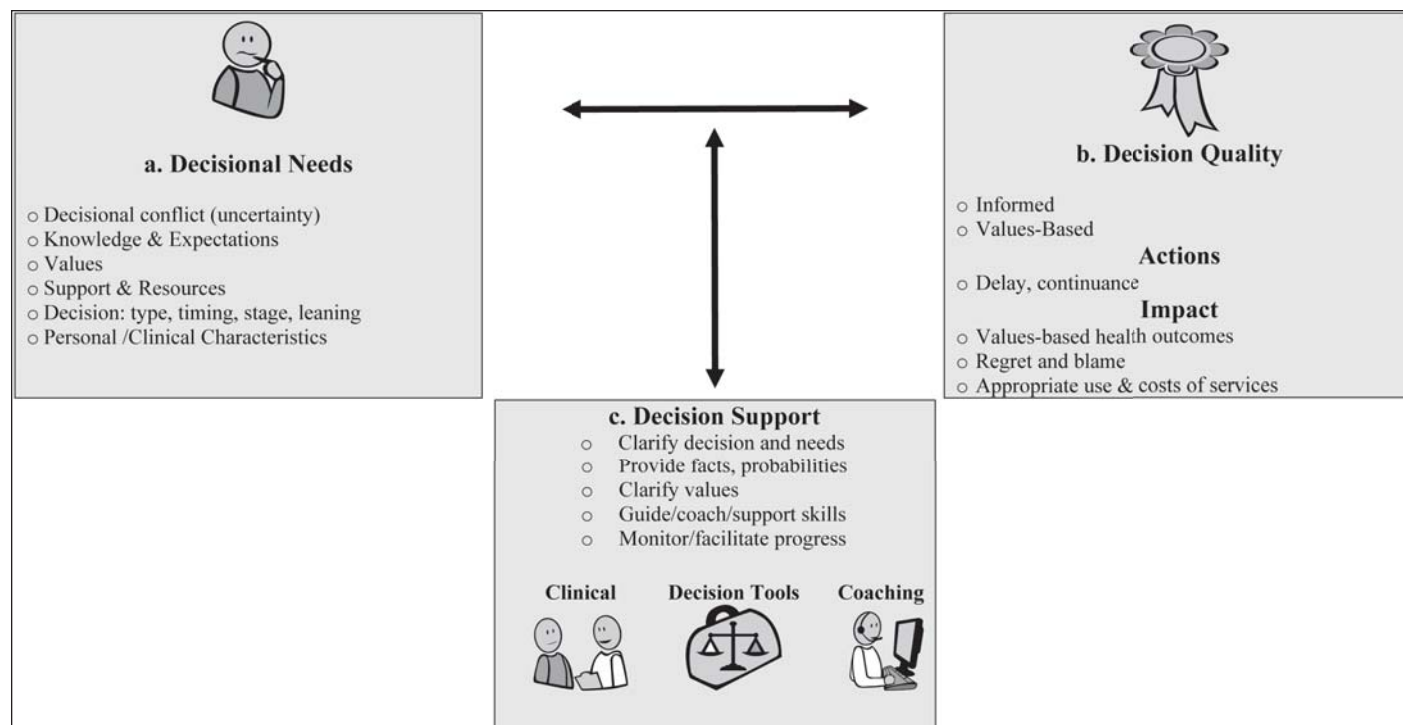


Figure 1. Ottawa Decision Support Framework

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their implants for at least 6 months. All families had to speak and understand English because the interviews were conducted in English.

The hospital CI clinicians were also invited to participate. The potential participants included audiologists, rehabilitation therapists, a psychologist, a social worker, and a CI surgeon. Consent for participation was obtained from each participant prior to study commencement. Ethical approval for the study was received from the Children's Hospital of Eastern Ontario and the University of Ottawa, Research Ethics Boards.

Interview procedure

A semi-structured interview guide was developed based on the standard needs assessment questions of Jacobson and O'Connor (2006). The open ended questions were guided by the ODSF. Interview questions for parents and professionals focused on (a) reactions and decisions surrounding the identification of their child's hearing loss, (b) the options available to them, (c) the perceived benefits and risks associated with their options, (d) manifestations of decisional conflict (uncertainties), (e) knowledge and expectations, (f) values, (g) support and resources including usual roles in decision making, (h) patient

characteristics such as age of identification and etiology, (i) barriers and facilitators in receiving decision support; and (j) potential strategies for over-coming barriers. See the appendix for a copy of the interview guide used with parents. While there was only a single open-ended question on bilateral implantation, this sparked considerable discussion and additional follow-up questions were asked depending on parent responses.

The parent interviews lasted between 30 and 60 minutes and were conducted at a mutually agreeable location, either in the parents' home or at the clinic. The clinician interviews lasted about 30 minutes and were held at the clinic. The interviews were audio recorded and transcribed. The clinical characteristics of the children undergoing the CI implantation were obtained during the interview.

Analysis and interpretation

A mixed methods approach was used in analysing the data. This approach seeks to use both qualitative and quantitative research methods to answer research questions (Tashakkori & Teddlie, 2003). The interview data from the parents and clinicians were analyzed together. Frequencies and counts were used where appropriate to describe

structured, quantifiable responses that corresponded to the answer templates in the interview guide. A deductive coding strategy based on the ODSF was used to analyze the content of the open-ended responses. Similar items were grouped together based upon the elements in the ODSF. Nuances in the responses were qualitatively explored based on the clinical characteristics, such as the child's age at the diagnosis of the hearing loss, the aetiology, the presence of co-existing health issues, and the current status in the implantation process (pre- or post-implant). Due to the exploratory nature of the research and the small sample size, no statistical analysis could be undertaken to formally quantify the effect of these factors on parental responses.

Results

Characteristics of participants

Seven families participated in the interviews. From these seven families, eight parents or guardians of eight children took part in the study. Four children had already received a unilateral CI, one had received bilateral implants, and three were awaiting their surgery for a unilateral implant. At the time of the interview, the children were between 1 and 5 years of age. Two of the eight children had co-existing health issues at the time of diagnosis. One was recovering from meningitis and the other had a congenital health concern. Half of children were candidates for CIs upon diagnosis and the remaining four children had hearing losses that progressed to make them CI candidates. Two of the children had auditory neuropathies. Four of the children were only children. Two of the children had a sibling with hearing loss in a family of two children. Two of the children were the only child with a hearing loss in a family of two children.

One of the children was identified with a hearing loss after 18 months of age following medical referral, one child had meningitis as an infant, and six were identified through newborn hearing screening programs. All children used auditory-verbal therapy (AVT) as their primary communication approach. An effort was made to seek out families who had declined CI surgery. However, the families who were identified declined participation in the interview. Eight of the ten CI team members participated in individual interviews. The CI team members came from a range of disciplines with a wide range of experience in CI.

Identification of hearing loss and early decision-making

The responses of parents and guardians to the identification of hearing loss varied depending on the co-occurrence of other health issues at the time. Parents of children ($N = 6$) with no co-occurring health issues described the uncertainty and shock associated with the diagnosis:

"We were shocked. It was very painful. We just couldn't believe it. My wife was crying. It was a horrible experience." [parent of 3-year-old]

"At the beginning, when we found out about our child it was really hard for us. We didn't know what to do and where to go and how things were going to work for him in the future. We didn't know anything about if he's going to go for sign language or going to go for only hearing aids, or that. We didn't know anything. We didn't know what the hell's going on." [parent of 1-year-old child]

Parents who had children that suffered from meningitis and postnatal health problems ($N = 2$) described less shock at the identification of hearing loss than parents of children without co-occurring health concerns:

"Because he had other health issues at birth, I guess we kind of took it as a grain of salt. We were just really grateful that he made it through because he wasn't expected to live, and I figure if he had to have some sort of incapacity, I'd prefer the hearing to the eyesight. So I don't think we were ever in shock about it. I don't remember being in shock, anyway." [parent of 4-year-old child]

Parents and clinicians were asked to describe some of the decisions that had to be made following the identification of their child's hearing loss. Both groups identified the communication approach as the first decision that parents have to make. The parents made a distinction between using an aural/ auditory-verbal approach or sign language with their child. They did not describe struggling with the communication approach decision and all chose an auditory-verbal approach for their children. Other decisions named by both parents and clinicians included whether to use a hearing aid, the decision to undergo cochlear implantation, the type of implant or manufacturer to choose, when to proceed with the implantation, and the decision for a parent to return to work or stay at home to teach their child.

Introduction of cochlear implants

When asked when and how the topic of CIs was first introduced to them, the parents provided varied answers. The parents of the four children that were initially diagnosed with profound hearing loss stated that the topic had been introduced at the time the diagnosis was shared. The parents with the four children with progressive hearing loss stated that the topic had been introduced a year or later after the initial diagnosis. Some parents had felt shocked when the clinicians had suggested a CI while others had been relieved:

"It actually came as a bit of a surprise to us because [my child] now wears a hearing aid and a cochlear implant, and so he had both ears equipped with hearing aids, and he was making progress, and we were getting language... So it was a little of a set-back emotionally." [parent of 3-year-old child]

"I kind of just heard from other parents in the department, like seeing them in the waiting room, and chatting about it. Their kids may have had hearing aids but now they had a cochlear implant, and now it's much better. So, we had a positive image right away from that because the parents were like, 'Oh, yeah. No more feedback, no more... you know... they can hear so much better.' Well, I think as his hearing

Table 1*Perceived Advantages and Disadvantages of Available Options as Described by Parents and Clinicians*

Cochlear Implant Option		Hearing Aid Option		Sign Language Option	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
<ul style="list-style-type: none"> - Greater exposure to speech and language at early age - Consistent with hearing family's culture - Potential for the child to use spoken communication - Potential for the child to communicate with larger community - Possible removal later if child chooses sign language - Cost of device is covered compared to hearing aids 	<ul style="list-style-type: none"> - Surgical risk - Increased risk of Meningitis - Making a decision for a child that might have made a different decision - Reduced possibility of using newer technology - Challenges of repairs, device failure, programming - Cosmetic issues of external and internal device - Travel and time for fitting and programming 	<ul style="list-style-type: none"> - No surgical risk - Consistent with hearing family's culture - Ability to hear the child speak - Possible removal later if child chooses sign language - No loss of residual hearing 	<ul style="list-style-type: none"> - Less speech and sound exposure from greater distances - Slower speech and language development than with CI - Challenges of feedback, hearing aid repairs 	<ul style="list-style-type: none"> - No surgical risk - Consistent with signing family's culture - A small, warm cultural community available to child 	<ul style="list-style-type: none"> - Child enters a culture unfamiliar to hearing family and friends - Entire hearing family needs to acquire a new language - Living in a minority culture - Fewer employment/ educational options available - Limited opportunity to chose oral communication after childhood

started getting worse, we felt frustrated, so when it was first brought up with us, I think we kind of felt happy because, in a way, it was not... we weren't happy that it was getting low like that, but we were happy that we were going to have another option because we were getting frustrated." [parent of 2-year-old child]

The parents and clinicians reported that the professions most likely to be involved in first discussing the CI with families were the audiologists and auditory-verbal therapists working with their children. Five out of the eight parents received information from other families in the clinic waiting room and the internet before discussing the CI with their clinicians.

Options available

When asked about their options regarding the CI decision, half of the parents perceived their decision as a choice between a CI and hearing aids. Of these parents, all

had children with hearing losses that had progressed from severe to profound over time. The other half of parents perceived their decision as a choice between a CI and sign language. These parents had children with profound losses as a result of genetic losses, auditory neuropathies, and meningitis. The clinicians varied little in their perceptions of the options.

Five of the eight clinicians perceived parental decisions as a choice among three options: CI, hearing aids, or sign language. One clinician perceived the two options: CI or hearing aids. The remaining two clinicians perceived two different options: CI or sign language.

Perceived advantages and disadvantages of options

After identifying the available options, the parents and clinicians were asked to list some of the perceived advantages and disadvantages of each. Table 1 provides a

summary of the advantages and disadvantages that were generated by the parents and clinicians. All parents reported that the CI option was most consistent with their family's communication culture and linguistic backgrounds.

The clinicians' perceptions of parents' choices were consistent with parent's views. This consistency between the CI choice and the families' communication culture was the perceived benefit of the CI option:

"Most of the hearing impaired children are born into hearing families where spoken language is the language of the home whether or not there are other children. So, in terms of ease of natural language simulation in most families it would come through speaking. So, I mean, there would be an understanding in sign language that the parents are going to be learning a new language system. And then, also hopefully, to have other friends and extended family getting involved with communication systems as well. If sign language is the language at home for a particular family, I would think that that would be the natural option for those families." [clinician]

Two of the eight parents commented on their qualms making a decision for their child in light of the uncertainty that their child might later disagree with their decision. However, they felt that they were making the best decision for their family at the present time:

"We had concerns in having to make a decision for a child who might have made a different decision later... It is always possible later on to have the devices removed if she chose that later, and we wouldn't have had the opportunity, necessarily, to have the same opportunity to get [speech and language] results." [parent of 2-year old child]

In this study, most families found it difficult to perceive any benefits of sign language. All families had chosen AVT as their primary communication approach and were enrolled in a program. Seven parents reported that sign was not a fit for their family. However, one parent wished that the family had the option to communicate to their child in sign language. However, the parent realized that this would have been inconsistent with the AVT philosophy. The benefits regarding sign language that are listed in Table 1 were all derived from clinicians' interview data.

Manifestations of decisional conflict

The responses to the structured question on feelings during the cochlear implant decision-making process are summarized in Figure 2. The parents were also given an opportunity to expand and comment further.

The parents reported feeling most concerned about what could go wrong: *"They make a hole in the bone, so there's no protection here only more... only that piece of equipment there."* Another concern was that their child would not benefit sufficiently from the cochlear implant: *"I was worried that it wouldn't work. I was really worried but at the same time that wasn't something that would stop us from trying the cochlear implant."*

Parents did not report delaying the decision, wavering between choices, feeling uncertain about what was important, or dwelling excessively on the decision. All

parents emphasized that they were confident that the CI decision was the appropriate decision for their family:

"Even though I didn't grow up with anyone with a hearing loss I knew it wasn't something I wanted my son to do. I want to hear the words, 'I love you mom,' I want to be able to just communicate and be able to tell him when his back is to me, 'Can you go get your shoes?'" [parent of 3-year-old]

Factors contributing to decisional conflict

When asked which factors had contributed to decisional conflicts, neither parents nor clinicians felt that parents were unclear about what was important to them or that they lacked the skills to make the CI decision. Figure 3 presents the responses to the structured question. The parents and clinicians responded similarly on most items. However, four of the eight parents felt that they had lacked information on the choices that other families had made regarding CIs. Only one clinician of eight perceived this as a possible gap in the information provided to families. In general, the clinicians reported that they consistently linked families with each other to provide mutual support and share information. One of the interviewed parents commented as follows:

"We wanted to know how it worked for other people, and we weren't that well connected to a lot of families. I had requested all along to be connected with families, and that never happened. I did it on my own. And I think that's one thing that every family should have that ability to connect very quickly, and it took us a while." [parent of 2-year old]

Clinicians and parents also varied slightly on their perception of pressure in decision-making. Parents did not report feeling pressure to choose the CI option. Four of the eight clinicians reported that parents might feel pressure to make the decision to go ahead with cochlear implantation:

"We never pushed the parents into getting the implant, but it depends on how that's worded. You know, and I'm not there to see the [other team members], how they actually provide the info, but there might be a bit of solid pressure." [clinician]

Perception of others' opinions, practices, support, and pressures

Parent participants reported that the individuals most likely to be involved in the CI decision were the audiologists, auditory-verbal therapists, and the CI surgeon. The parents valued the team approach to the CI process. Individuals outside of the CI team were not named as stakeholders in the decision-making. When asked about the influence that extended family members might have on the process, most parents said that there was little such influence.

When clinicians and parents were asked to describe the decision-making dynamic that they had or were experiencing, both parents and clinicians reported equally that it was either a shared decision or that the clinic team members provided support for them to make the decision themselves. No parent reported that the decision was made for them by clinicians.

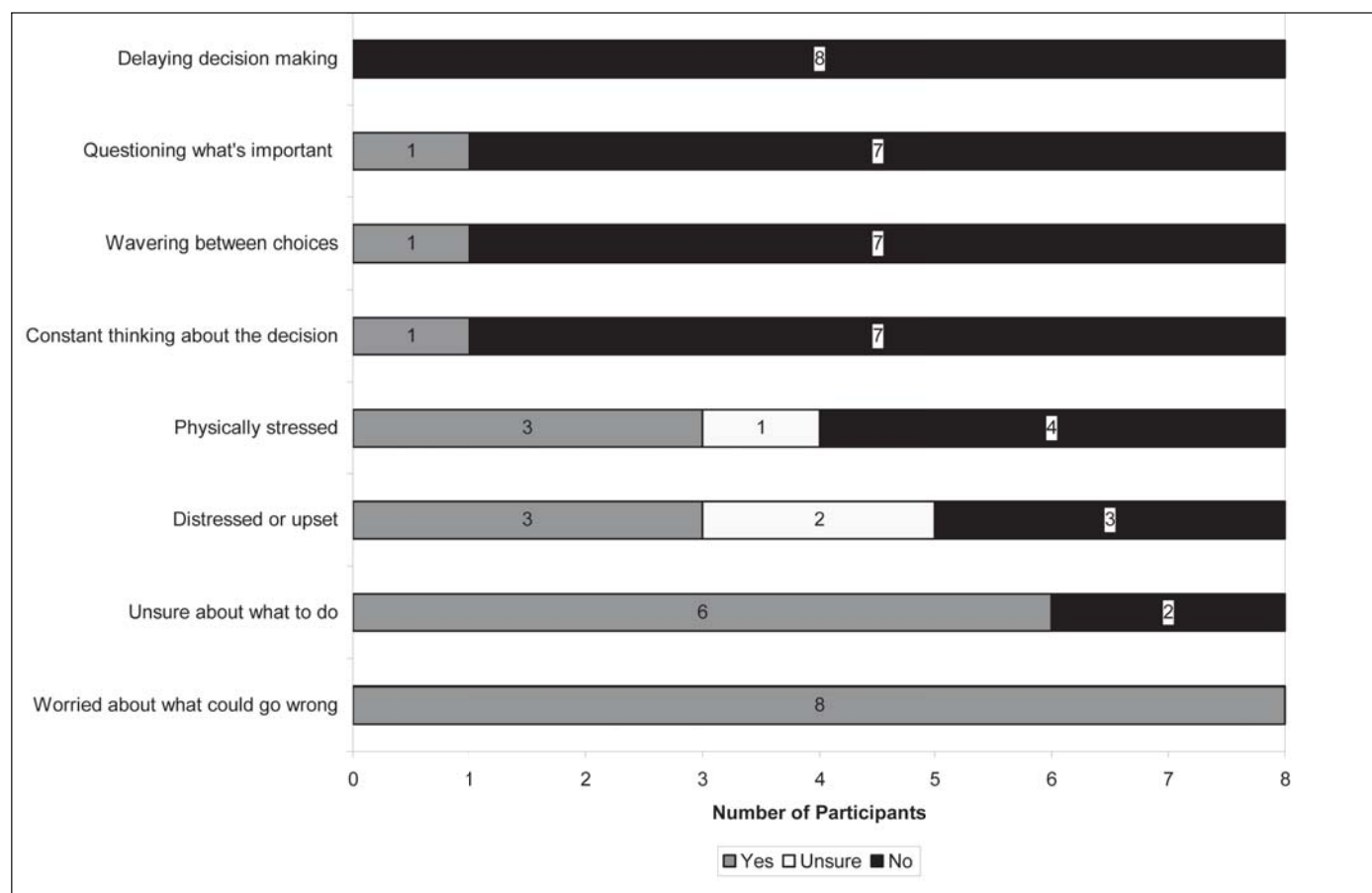


Figure 2. Parent responses to structured questions regarding reported behavioral manifestations of decisional conflict about the cochlear implant decision-making process.

Resources in the decision-making process

Families and clinicians were asked about the type of information they accessed to make a decision and which additional resources they perceived as potentially beneficial. Most families felt that the clinicians provided them with adequate information on the treatment options and the associated risks and benefits. The parents also commented on their need to seek additional information on their own to supplement the information from the clinic. This was often accomplished through the internet or by meeting families who had already experienced the CI process. Five parents reported meeting with other families before they made their decision or before they had the surgery. They all spoke highly of this contact with other families: "If I hadn't talked to those families I did talk to, I would have felt at a real loss for not knowing things. And having that ability to contact them was huge." The other three parents did not have the opportunity to meet other families. They indicated that they would have liked to have the interactions with others who have made similar decisions for their children.

Meeting with the surgeon to hear about the risks and benefits of the CI surgery was also mentioned as an important source of information for parents:

"The meeting with the physician before the surgery, that was obviously key. That was a really big one for us. To actually talk to the guy who was going to do this, and to find out whatever we can about success, failure, problems, all that kind of stuff." [parent of 2-year-old]

In terms of the appropriate format for sharing information, all parents and clinicians agreed that counselling from a health professional, information pamphlets, books, videos, and the internet were useful ways of helping with their decision-making. All participants were uncertain of the value of support or discussion groups for families making the same decision. Most parents suggested that it might be useful for some families but that they would be unlikely to use a support group.

When asked about who should disseminate the information, there were some variations in the responses.

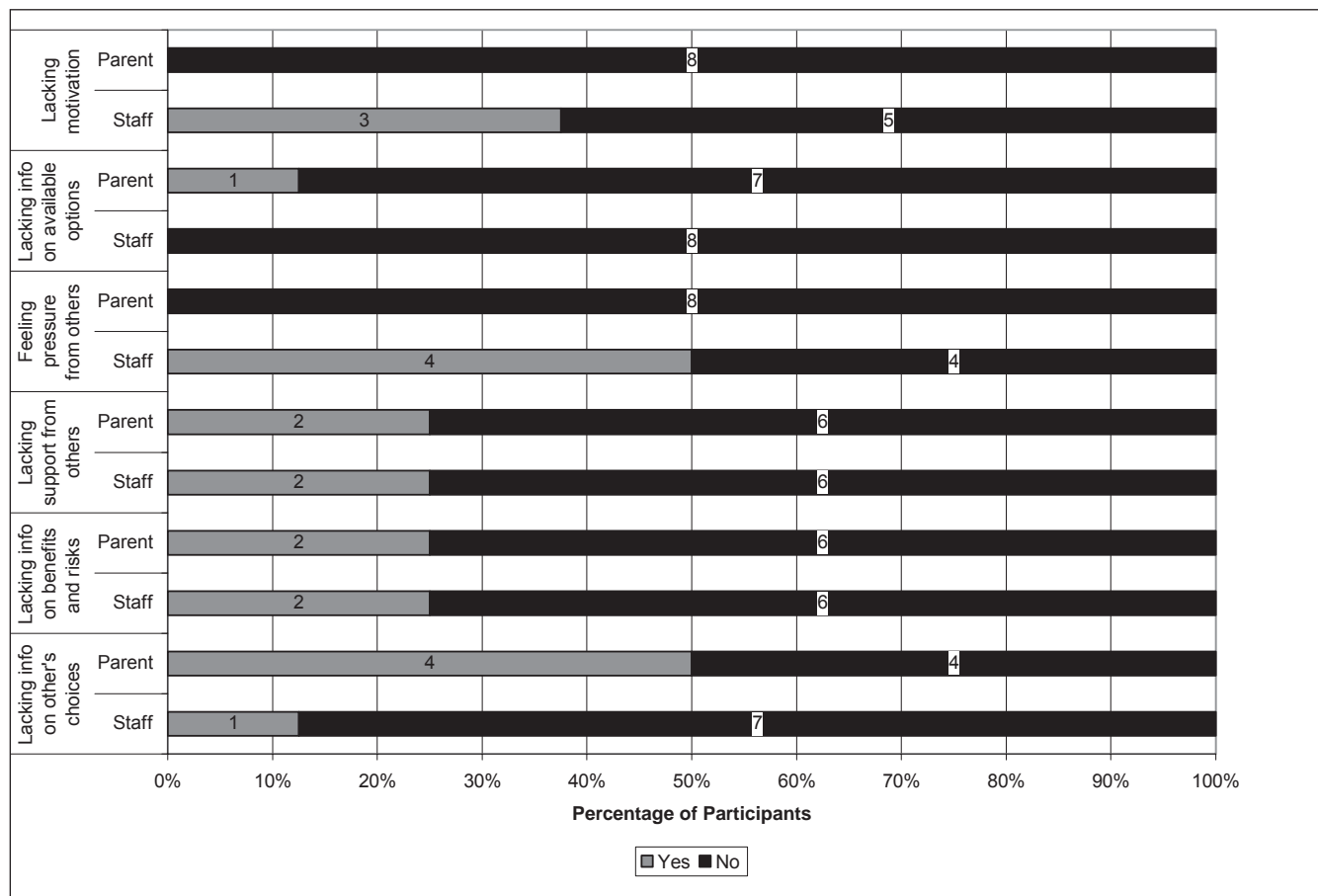


Figure 3. Clinicians' and parents' responses regarding what makes the cochlear implant decision difficult.

There was general agreement that the government and health societies and non-profit groups had only a small role to play in the development of resources for families. All clinicians and parents agreed that information materials should be prepared by medical staff and researchers. One clinician summarized the current challenge in providing unbiased research information:

"Preferably, I'd like nice unbiased research. Although, in reality, I mean, that's kind of difficult to still find, and a lot of the information that's available... and a lot of the research has been sponsored by one of the companies or the other, and so giving decent advice information sometimes is a little difficult." [clinician]

Four of the clinicians felt that CI manufacturers should create the information pamphlets, but the other four clinicians noted that this could result in biased information for families. While some parents ($N=3$) felt that the information should not come from CI manufacturers because of potential bias, other families felt that the manufacturers had a role to play in providing information.

Half of the parents felt that parents of children with CIs should help prepare information materials. This echoes the request for additional resources regarding the experiences of other families who have chosen CIs for their children. Clinicians did not feel strongly about parents' participation in preparing information.

Bilateral cochlear implantation

There was uncertainty and variability when participants were asked about their perceptions of the bilateral CI option for their child. The parents and some clinicians discussed (a) their perceptions of the bilateral decision, benefits, and risks. (b) their pre-disposition to the bilateral cochlear implantation decision, and (c) some of the barriers to decision-making.

Perceptions of the bilateral cochlear implant decision. There were differences in the parent and clinician perceptions of the benefits and risks associated with bilateral implantation. In contrast to the benefits from unilateral implantation that all parents were unanimous about, only one parent brought up the additional benefits of a bilateral

CI, such as such as an improvement in sound localization and hearing in noise. The other parents brought up their concerns regarding the perceived risks of a second CI. One parent reported concern about a second surgery:

"They suggested that we should do two because her right ear is not good, but still, I don't want to do that now, because this is her first one... because it's her brain. It's head surgery. It scares me." [parent of a 4-year-old child]

Parents did not report that the increased risks of meningitis and mastoiditis associated with the second surgery influenced their decision. However, a clinician commented that she was uncertain that parents fully understood the risks associated with the second surgery:

"Then we start talking about binaural implantation. I have a feeling that somehow, people are hiding their heads, putting their head in the sand. They're not really paying attention to those potential risks. If I had a child who was deaf, I don't know if I'd go for a binaural implant. I'd go for the first one, and I'd accept the risks. And you can't judge what people decide to do, but there is this feeling that they want the success, and they don't necessarily grasp the risks. The parents who have been through the case of mastoiditis, and meningitis have actually been quite brave about it, and have freely accepted those events, but I think we've been lucky." [clinician]

Pre-disposition to the bilateral cochlear implantation decision. Half of the interviewed parents expressed a great interest in receiving a second implant as soon as possible for their child:

"Now that I see that [the first cochlear implant] does work and I've been talking to different people about getting a second one it is something that we definitely want for our children. I feel like they should have that opportunity to have the direction finding [sound localization]." [parent of a 3-year-old].

The four parents who were still at the decision-making stage responded that they were uncertain about what they would choose for their child:

"Everybody has a different reaction to doing it. I'm kind of, I'm cautious by nature, so I'm kind of, 'Well, let's see if this is a good thing to do,' as opposed to, 'Yeah, I want to have him have that bilateral.'" [parent of a 3-year old]

One clinician also expressed her perception of parental uncertainty about the bilateral CI decision:

"Not all parents will want two implants for their kids, and that's fine. We've got... I think the decision-making is, it's going to be more variable. But we'll have to respect that. I know some parents have told me, 'Well, we're going to get one, and we'll wait until something better comes up for the second one,' or, 'Nope. We'll go for two because I've read that two is better than one, and we've got two hearing aids, we want two implants.' It depends on the parent." [clinician]

Barriers to bilateral cochlear implantation decision making. Many of the parental comments revealed barriers to bilateral cochlear implantation decision-making. In particular, they focused on their perceived lack of knowledge about the bilateral procedure. One parent who had been

actively seeking bilateral implants for her children expressed her interest in having more research available to support her family's decision:

"Even with the bilateral, we believe that it's best for them, I do wish that there was more research stating exactly, 'These are the advantages,' or, 'Hearing will improve in these ways.' The research aspect, I wish there was a lot more out there." [parent of a 2-year-old]

Another parent and a clinician expressed similar requests for additional information and support for the bilateral decision:

"I know we don't have enough experience with two implants now to have a lot of data on it, so I don't feel comfortable enough with the counselling and all because it's not there." [clinician]

"People are going ahead and doing this, they've got to line up [the bilateral information] just the same way they should line up the cochlear implant information. So that parents who are even thinking about it know that there's a resource they can go to and start looking at that." [parent of 3-year-old]

Another parent voiced concerns regarding the difficulty in making decisions for her young son without his involvement:

"We now see that bilateral implantation is possibly another decision we have to make in his lifetime. We actually hope that it will be in his lifetime as opposed to ours, but I also feel that I would like him to be able to make the decision. He's had it done once where we made the decision for him as the parent, but I like would like him, with whatever life experience he's had at that point to be able to decide whether or not he wants to do it. I would feel better about it." [parent of 3-year-old]

In making the decision for unilateral implantation, parents consistently reiterated their comfort with the decision for the CI. However, there was more uncertainty among parents with regard to the bilateral CI.

Discussion

Identification of hearing loss and early decision-making

The parents' description of the initial shock and grief about the diagnosis of hearing loss was consistent with other literature on the topic (Anagnostou et al., 2007; Kurtzer-White & Luterman, 2003). The current study identified differences in the magnitude of the parental reaction to the diagnosis depending on the child's co-existing health issues. There is no specific literature on the parental reactions to a diagnosis of hearing in parents of children with complex co-morbidities. This may be an area for further inquiry.

The families did not describe struggling with the decision about the communication approach for their child. Li et al., (2003) reported similar results in their survey regarding the attitudes, beliefs, and values of 83 parents of children with various levels of hearing loss. They reported that the second most influential factor in deciding

about the communication modality, after the degree of a child's hearing loss, was the parents' desire to use spoken communication with their child. As all the children in the current study were CI candidates or recipients with severe to profound losses, the degree of hearing loss did not differentiate between the parents in this study.

Perception of the Cochlear Implant decision

All parents emphasized that the perceived risks associated with the CI implantation were acceptable in relation to the value that they attributed to oral communication with their child. These findings were consistent with a study that examined the influence of parental values on the CI decision-making (Li et al., 2004). That study examined families from a variety of deaf communication programs: oral, sign, and total communication programs. In the 50 families that participated, 33 children proceeded with the CI surgery while the other 17 children did not. Among the 17 families who decided against the CI, the authors found that their attitude toward communication could be used as a statistical predictor for their final decision. The authors emphasized that a CI is often emotionally loaded for some families. Identifying the value that parents place on oral rather than manual communication may be important in identifying those parents who will have difficulty with the CI decision-making process.

Options available

In this study, the parents of children who had begun AVT and were already progressing in their oral language development before the CI decision arose, did not perceive sign language as a viable option. In contrast, the families that had to make the CI decision immediately after their child's diagnosis perceived the decision as being a decision between CIs and sign language. The different perception of treatment options suggests that the parents of children with an early diagnosis chose the communication approach together with the CI.

Many of the advantages and disadvantages of the options listed by participants were consistent with previous findings in the literature (Sach & Whynes, 2005; Incesulu et al., 2003; Kluwin & Stewart, 2000). The primary perceived advantage of the CI option was the increased opportunity for speech and language exposure. This was followed by hopes for improved communication skills and becoming a member of the larger hearing community. It is a specific oddity of the Canadian context that a CI is fully covered by the public health care system while hearing aids are only partly funded. This was noted by one of the clinicians as an apparent benefit to parents. The influence of cost on the CI decision was not explored in the present study but may be of interest for future research.

The parents' qualms about making the CI decision for a child who might later resent that decision had been noted as a stress factor by Sach and Whynes (2005). In the survey by Incesulu et al. (2003), 6 of the 25 participating parents reported concern about later blame from their children. Parents in the current study explained that this

concern was alleviated by the fact that their children could still have the CI removed if they so chose.

Manifestations of decisional conflict

Like other studies, results of this study indicated that the parents were confident about the CI choice. Nevertheless, preparing to undergo surgery and the entire CI process was a stressful event for the families (Incesulu et al., 2003; Most & Zaidman-Zait, 2003). Identifying ways to adequately address and reduce this stress should be both a research and clinical priority.

Perception of others' opinions, practices, support, and pressures

Information about other families' decisions was reported to be the single most helpful piece of support for the CI decision. This is in agreement with the results of previous studies (Incesulu et al., 2003; Most & Zaidman-Zait, 2003). The discrepancy between parents' and clinicians' perceptions of what constituted adequate information on the decisions of other families should be noted. Notwithstanding the small sample size in the present study, it might be worthwhile to explore additional ways to put parents in touch with other families to share information and emotional support (Most & Zaidman-Zait, 2003).

Apart from the contact to other families, the contact with audiologists, auditory-verbal therapists and surgeons was perceived as important during the decision-making process. The multi-disciplinary team provides an important support mechanism for parents of children with hearing loss (Fitzpatrick, Angus, Durieux-Smith, Graham, & Coyle, 2008; Most & Zaidman-Zait, 2003).

Resources to Make Decisions

The need for additional information is often closely associated with the particular clinical profile of a child. In this study, the parents of children with auditory neuropathy and children with progressive loss requested additional information and resources for decision-making. Kluwin and Stewart (2000) interviewed 35 families who had undergone cochlear implantation with their children. They identified that most families were satisfied with the information they received. However, eight families felt that they would have liked more information on the surgery and rehabilitation process. While the majority of parents appeared content overall with the available resources, there may be a need for more information for some families. Based on a series of case studies, Neuss (2006) described families' search for information before deciding for the CI. The results were similar to the current study. Most parents stated that they supplemented the information from clinicians with additional research on the internet or with discussions with other parents.

The parents' preferences for information in brochure format as well as on the internet was consistent with a national survey on the decision-making needs of Canadians (O'Connor, Drake et al., 2003). In addition, like the respondents in the national survey, the parents

and clinicians interviewed in this study preferred that the materials be created and disseminated by medical and health-care specialists. In an examination of the internet resources available to parents making decisions about unilateral cochlear implantation for their children, Zaidman-Zait and Jamieson (2004) found that the majority of articles available for parents were from medical departments, consumer organizations, CI manufacturers, and health care providers. The researchers qualitatively evaluated the information provided on these websites and concluded that the available evidence for parents was neither peer-reviewed nor evidence-based, and that the creators of the sampled websites rarely referred parents to research that is available in the public domain. A recent survey of parents by Sorkin and Zwolan (2008) found a perceived lack of bias-free information on CI.

Bilateral Cochlear Implantation

The parental responses to the question of bilateral CIs indicated that the decision was more difficult than for the unilateral CI. The parents were uncertain about the potential benefits and about the value of these benefits to their child or their family. At the time of this study, bilateral CIs were relatively new to this clinical setting and did not constitute the standard of care. In contrast to the unilateral CI, the value that the parents placed on the second CI does not appear consistent. The bilateral procedure may have been perceived as elective because a second device provides secondary improvements in sound localization and speech intelligibility compared to the speech and language development associated with a CI.

As the bilateral clinical treatment option was relatively new, parents and clinicians perceived a lack of information and resources. These findings indicate a need to develop more information in user-friendly formats to support families in their deliberations of the bilateral CI option.

Planning for decision-support

Including patients in decisions about their health by providing research information is an important component of knowledge translation (Holmes-Rover et al., 2001; Coulter, 1997). Based on the results of this study, a knowledge translation tool to help families increase their knowledge about cochlear implantation prior to and during their decision-making would appear beneficial. The need for such a tool was pronounced for the bilateral CI decision. One approach to translating knowledge for health-care consumers is through the use of patient decision aids (O'Connor & Edwards, 2001). Decision aids are "tools designed to help people participate in decision making about health care options. They provide information on the options and help patients clarify and communicate the personal value they associate with different features of the options" (International Patient Decision Aid Standards, 2008).

Decision aids can be particularly helpful in situations where a choice between two or more treatments options is available and no clear standard of care is available based

on evidence (O'Connor & Edwards, 2001). They have been shown to improve the decision-making quality and process, to decrease anxiety, and to create more realistic expectations of outcomes (O'Connor et al., 2002). Currently, no decision aid exists for the decision to undergo paediatric unilateral or bilateral cochlear implantation (Cochrane Inventory of Patient Decision Aids, 2008).

Limitations

By interviewing only parents after their CI decision there would have been potential for the parental perceptions to have been influenced by recall bias, decisional regret, and parents' need to appear content with their decision. This was addressed by including interviews of parents involved in prospective decision-making. We attempted to purposefully sample families who had chosen not to undergo cochlear implantation but these families chose not to participate.

The sample size for this study was relatively small. As only 20-24 children are implanted each year in the study CI centre, only 30-36 children were eligible to participate based on the inclusion criteria. The participant pool was further reduced because approximately 20% of the population in this clinic was French speaking and the interviews were only conducted in English. During the interviews, similar themes emerged from the parents indicating that sufficient data saturation was achieved even with the small sample.

Some demographic information was not collected from the participants. This included socioeconomic status, family support, and immigration status. These factors may also have had an impact on the decision-making of families. The clinical characteristics that were included and explored in the study (i.e., child's age at identification, co-existing health issues, and aetiology of hearing loss) could not be generalized to the entire population of families due to the small sample size in this study. Future research should explore the influence of all of these factors in a larger sample of families.

Only a single CI site was included in this study. This centre has a strong emphasis on auditory-verbal therapy as the dominant treatment option for children and families. Families and clinicians from other centres may have different perceptions of the CI decision-making process.

Conclusions

The interviewed parents reported that their decision to undergo cochlear implantation for their children with severe to profound hearing loss was related to the value that their family placed on oral communication. Comprehensive information on the risks and benefits associated with cochlear implantation should be offered to all families. Parents also benefit from their interactions with, and the support offered by, families who have already made their choice. While the choice for a single CI appeared to be a value-based and presented little decisional conflict, the situation was more complex for parents contemplating a bilateral CI. Bilateral CI decision-

making should be addressed systematically in future research to further understand and support parents of children with bilateral severe to profound hearing losses.

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Appendix: Cochlear Implant Needs Assessment Semi-Structured Interview Guide

1) Can you tell me about the first few days and weeks after you found out about your child's hearing loss? What were the most important decisions that you faced early on?

2) Let's focus on the cochlear implant decision. How were you introduced to the topic of cochlear implants?

3) Can you describe your experience in making the decision to implant or not?

4) How did you feel when you had to make this decision? Were you:

- ☐ unsure about what to do ☐ worried what could go wrong ☐ distressed or upset
☐ constantly thinking about the decision ☐ wavering between choices or changing your mind ☐ delaying the decision
☐ questioning what is important to you ☐ feeling physically stressed—tense muscles, racing heartbeat, difficulty sleeping

5) What made this decision difficult to make? Were you?

- ☐ lacking information about options, pros and cons ☐ lacking information on the of benefits and harms
☐ unclear about what is important to you ☐ lacking information on what others decide ☐ feeling pressure from others
☐ lacking support from others ☐ not feeling ready to make a decision ☐ lacking the ability to make this type of decision

6) Thinking about the cochlear implant decision, which options were there for your family?

7) What do you see as the main advantages and disadvantages of these options?

8) Who was most involved in helping you make this decision?

9) Thinking about the clinic staff you encountered, how were they usually involved in making this decision? Did they:

- ☐ make the decision for you, ☐ share the decision with you,
☐ providing support or advice for you to make the decision on your own

10) How did you go about making such a decision? Did you:

- ☐ get information on choices ☐ get information on how likely the choices are ☐ consider how important choices are,
☐ get information on how others decide ☐ find ways to handle pressure ☐ get support from others

11) What helped you to make this decision?

12) What gets in the way of making this decision?

13) What else is needed?

14) I will list possible ways to help people with decisions, which ones do you think may be useful for you?

- ☐ Counseling from health practitioner ☐ Discussion groups of people facing the same decisions,
☐ Information materials If yes, type of medium----> ☐ booklets, pamphlets ☐ videos ☐ CD ROMS ☐ Internet
☐ other, specify _____

15) Who do you think should prepare information about this decision?

- ☐ health societies ☐ expert medical and health practitioners ☐ government ☐ consumer associations
☐ cochlear implant companies

16) Bilateral cochlear implants are now emerging as an option for children with bilateral hearing loss. Is there anything you would like to add about this issue?

Book Review/ Évaluation de livre

Aphasia Rehabilitation: the impairment and its consequences

Edited by Nadine Martin, Cynthia K. Thompson and
Linda Worrell (2008)

Publisher: Plural Publishing Inc., San Diego, California

Reviewer: Jennifer Cupit, M.Sc.

Affiliation: University of Toronto, Toronto, Ontario
Canada

This book is the product of a meeting of the minds, involving a number of prominent researchers in aphasia rehabilitation. The underlying premise of the book is that there is a competition (real or perceived) in the field of aphasia rehabilitation between proponents of impairment-level treatment and proponents of the 'consequences approach'. The term 'consequences approach' incorporates treatments that have previously been called 'functional', 'social', 'life participation' or 'psychosocial'. Fifteen experts in aphasia rehabilitation were invited to participate in two meetings to discuss this dichotomy in aphasia treatment. As a result of these discussions, they wrote this book, with the goal of teaching each other their respective approaches and treatment philosophies.

The book includes a preface and seven sections. The first section, written by Cynthia Thompson and Linda Worrall, serves as an introduction, and includes a history of the two different approaches to aphasia rehabilitation. The following five main sections consist of four chapters each. The first chapter in each section is a case description of a patient with aphasia. In the following two chapters, a researcher representing each of the two approaches presents a complete assessment and treatment plan, including the appropriate outcome measures. The final chapter of each of these five sections summarizes the similarities and differences in the two approaches of the treatment plans for the given client. It should be noted that the treatment plans are hypothetical in nature, meaning that the presented treatments were not actually provided to the five patients described in the book. Some may see this as a flaw, however the book was not written to directly contrast the effectiveness of the two treatment approaches, but rather to "clarify the real differences and similarities between the two approaches" (p.x). In general, the proposed treatments have been evaluated in the aphasia literature, and the relevant references are provided. The final section of the book serves as a summary of the lessons learned by the various researchers involved in the project.

Across the five main sections, the reader is presented with assessment and treatment plans for patients with fluent aphasia, apraxia with aphasia, nonfluent aphasia, agrammatism, and letter-by-letter reading. The treatment

plans are quite detailed, including information such as timelines, treatment intensity, and word lists, such that a clinician would be able to implement the suggested interventions for a client on her caseload. In most cases, the authors have incorporated the realities of clinical life into their plans. As an example, in the chapter by Anna Basso, she acknowledges the limited time clinicians may have for assessment, and derives the diagnostic impression from the limited initial case description, without further testing. A side benefit, derived especially from the impairment approach chapters, is the level of explanation provided regarding the assessment and diagnostic processes. Most of the authors describe very systematically how they arrived at their diagnoses, generally adhering to a cognitive neuropsychological model. This means that the authors have effectively provided a tutorial on the use of such a model in the assessment of aphasia, which many practicing clinicians or students may find valuable. As the authors work in different countries (including Canada, Australia, England, Italy and the US), the book also provides an interesting glimpse into the care for people with aphasia in different health care systems.

The final section of the book attempts to summarize the current state of affairs regarding the co-existence of the impairment and consequences approaches in aphasia treatment. This may have been a difficult task given the relative novelty of this collaboration. Indeed, this seems to be the weakest section of the book, as though the authors were not clear how to present their case. Nevertheless, the authors reach two main conclusions. The first conclusion is that most of the researchers involved in this project practice treatments that fall within both approaches, which is evident in the treatment plans provided in the preceding five sections. Their second conclusion is that "helping individuals with aphasia requires both [approaches]" (p. 266). This claim is less well substantiated because the question of the relative contributions and/or combination of the two approaches is not addressed. Perhaps this comment is meant as an indication that we shall see continued collaboration on this question.

Practicing clinicians may not be as polarized on the matter of their treatment philosophy for aphasia rehabilitation as the researchers in the book have depicted the field to be. Nevertheless, this book provides an interesting insight into the motivations of experts in the field regarding their preferred approach to treatment. The case presentation format provides the reader with a unique view of the two approaches. Overall, this book can serve as a great resource for any clinician who provides assessment and treatment for people with aphasia, given the wide array of ideas provided within both the impairment and consequences approaches.



Neuroimaging in communication sciences and disorders

Roger J. Ingham, Editor (2008)

Publisher: Plural Publishing Inc., San Diego, California**Reviewer:** Deryk S. Beal, M.H.Sc., S-LP(C),
Reg. CASLPO - Speech-Language Pathologist
and Doctoral Candidate**Affiliation:** University of Toronto, Toronto, Ontario
Canada**Cost:** \$139.50

The book *Neuroimaging in communication sciences and disorders* is a summary of the relevant literature covering the emerging use of neuroimaging in the fields of speech-language pathology and audiology. The editor, Roger J. Ingham, states that the objective of the book is to provide a "knowledge base (that) can provide for our discipline's science and its quest for the alleviation of communication disorders." In his introduction to the volume he makes an impassioned argument that advances in neuroscience are greatly influencing our field and that it is crucial that researchers and clinicians improve their understanding of these influences in order to better serve our patient populations. It is a timely argument and one that is difficult to disagree with given the increasing evidence that most communication disorders are intertwined with the central nervous system.

The book is intended for anyone who is concerned with the current state of neuroimaging in the communication sciences and its disorders. In order to make the information accessible to a wide audience, each chapter summarizes the background of neuroscience relevant to its subject matter (e.g., speech production, aphasia, etc.) and then quickly transitions to more advanced discussions of the developments in the area related to neuroimaging, pertinent methodological issues and advances that will influence future research in the area. The early chapters do a reasonable job of orienting novice readers to neuroimaging jargon and some of the current controversies. Readers new to neuroscience may find that they require this background information to understand later chapters.

The book is organized into six chapters, each covering neuroimaging contributions to a specific area of practice in the communication sciences. A very thorough and well-written review of the neuroimaging of normal speech production, written by Dr. Frank Guenther, comprises the first chapter. This review discusses the historical theories of brain function, the development of neuroscience, and ends with a critical integration of lesion studies and recent research involving structural and functional neuroimaging at both the cellular and the systems levels. Along the way, Guenther poses important questions for future investigations of both normal and disordered speech production.

The next chapter, by Dr. Roger Ingham et al., opens with a brief review of neurophysiological findings and their impact on theorization in developmental stuttering. The review of functional neuroimaging studies is held to a suitably brief summary as more complete reviews of this literature have been published elsewhere (see De Nil, 2004, Ingham, 2003). The authors discuss how advances in neuroimaging techniques have furthered our understanding of developmental stuttering. The authors conclude with description of their own research on cortical folding.

The third chapter, by Dr. Christy Ludlow et al., is a detailed and thorough assessment of the state of neuroimaging of voice, swallowing, and other upper airway functions. The authors do an excellent job of reviewing and critiquing broad content areas, including some with very little available research evidence. The outline of each upper airway function is followed by a summary of the current knowledge gleaned from lesion studies. The chapter then methodically describes a wide range of neuroimaging techniques and the challenges the study of upper airway function presents for each one. The authors make a critical distinction between learned and innate upper airway functions and go on to explain what neuroimaging has taught us about the neural control of phonation, singing, laughter, crying, shrieking, coughing, sniffing, sneezing, throat clearing, nose blowing, and swallowing. Ludlow et al. discuss how neuroimaging can be used to provide evidence for therapeutic interventions via the study of neural plasticity.

Chapter 4 by Dr. Don Robin et al., discusses neuroimaging related to apraxia of speech. The authors outline the ongoing controversy over the definition of apraxia of speech. They state that some of the earlier lesion and neuroimaging studies of apraxia of speech must be interpreted with caution, as participant selection based on less-than-ideal determinants of apraxia of speech may have implications for the results. The chapter concludes with a review of structural and functional brain imaging studies of speech production in adult speakers with either acquired or neurodevelopmental apraxia of speech.

The fifth chapter of the book addresses the role of neuroimaging in aphasiology and is written by Dr. Amy Ramage et al. The most interesting aspects of this chapter cover our evolving understanding of the long-term reorganization of language areas and the recovery of language function after treatment. The chapter concludes with a review of promising neuroimaging techniques including perfusion and diffusion-weighted imaging, and the use of transcranial magnetic stimulation to emulate lesions or to increase activation in otherwise inactive areas in brain-damaged patients.

The book concludes with a chapter by Frank Musiek on auditory neuroscience and the advances of brain imaging related to clinical audiology. The authors describe the neuroanatomical organization of the auditory cortex into core, belt, and parabelt regions. This argument is supported

with evidence from human studies utilizing non-invasive neuroimaging techniques such as functional magnetic resonance imaging and electroencephalography. Unlike the previous chapters that focused on cortical motor control of the speech mechanism, this chapter is able to draw on a wealth of information on both subcortical and cortical anatomy and function of the auditory pathway.

In summary, the book is an excellent summary of the status of neuroimaging within the field of speech-language pathology and audiology. The chapters are authored by some of the most eminent researchers in the chosen topic areas. Each chapter guides the reader quickly from a basic review of introductory material on the relevant topic area to advanced discussions of the current controversies. The book, however, is not without its weaknesses. A chapter exploring the use of neuroimaging in the study of children with language disorders is an obvious omission that is acknowledged by the editor, and an appropriate reference for further reading is provided. Also missing are chapters summarizing infant language development and the communication disorders associated with autism, epilepsy, and traumatic brain injury. In addition, an additional introductory chapter explaining the basics of the main neuroimaging techniques could be considered for future editions. This would allow the contributors to avoid repetition in the introductory sections of their chapters. The book is a valuable contribution to our field and an indispensable reference for researchers and clinicians specializing in neuroimaging.

References

De Nil, L. F. (2004). Recent developments in brain imaging research in stuttering. In B. Maassen, H. F. M. Peters & R. Kent (Eds.), *Speech motor control in normal and disordered speech. proceedings of the fourth international speech motor conference* (pp. 150-155). Oxford: Oxford.

Ingham, R. J. (2003). Brain imaging and stuttering: Some reflections on current and future developments. *Journal of Fluency Disorders*, 28(4), 411-420.



Auditory Processing Disorders: Assessment, Management and Treatment

Editors - Donna Geffner, PhD, CCC-SLP/A,

Deborah Ross-Swain, EdD, CCC-SLP

Foreword by Charles Berlin, PhD, CCC-A, CCC-SLP

Publisher: Plural Publishing Inc., 2007, San Diego, California

Reviewer: Marie Heintzman, M.S., Reg. CASLPO, F.A.A.A.

Affiliation: Director, Child Development Centre of Oakville - Family Audiology Clinic, Oakville, Ontario Canada

This 25 chapter, 576-page text is a pleasure to read. The relatively short chapters and current hot topics of interest make it easy for the reader to become immersed. The book lends itself to be picked up for a quick read over lunchtime. The generous use of figures and tables adds visual appeal. Each chapter starts with an overview and ends with a bulleted 'Key Points Learned' section, making it easy for the reader to peruse all of the chapters first before settling in for more serious reading.

The text is a compilation of the current perspectives of renowned audiologists and speech-language pathologists, including many well-known researchers in the field of auditory processing disorders (APD). The book is divided into 3 sections: I. Identification and Assessment; II. Management; and III. Treatment and Intervention. Overall, the text provides a comprehensive look at this complex and controversial body of study. The main premise of the text is that the assessment and treatment of auditory processing disorders should be a collaborative effort involving both audiologists and speech-language pathologists. The authors argue that clinicians are often too narrow in their focus, thus losing sight of the big picture. This in turn can lead to an inaccurate diagnostic impression and ineffective or inappropriate intervention.

Of particular interest in the first section on identification and assessment are Hamaguchi's chapter on the co-morbidities of APD and Rance's chapter on CAPD vs Auditory Neuropathy/ Auditory Dysynchrony. The assessment and diagnosis of APD is a challenge that faces both audiologists and speech-language pathologists. Richard's chapter on the continuum of auditory processing and Burns' chapter on the APD and literacy link add more substance to the need for an interdisciplinary approach.

The second section on management will be a valuable read for graduate students and new clinicians, but more of a review for experienced audiologists. Some of the assistive devices described in Geffner's chapter are already obsolete. Also confusing is Geffner's inclusion of personal FM-transmitters for hearing impaired children in a text focusing on APD. Kelly's chapter on parenting a child with APD provides good practical information (including a

resource list of websites and chat lines) to pass along to parents, although the legal references pertain exclusively to US law and are mostly irrelevant to Canadians.

The last half of the text is devoted to 'Treatment and Intervention'. The authors (in most cases, the actual developers) provide extensive detail about the better-known programs. There is also a description of some unconventional, alternative approaches that are currently available. Of particular interest are Medwetsky's chapter on the use of computer software aimed at CAPD and Burn's chapter on the neuroscientific approach to treatment. Both authors address the controversy surrounding the much-publicized 'Fast ForWord' program. The Canadian reader will gain little from Lipp's chapter on educational implications, as it is restricted to a discussion of the U.S. education laws. Particularly disappointing is Ross-Swain's chapter on sample reports, which recommends a format that I found difficult to wade through. The text ends with an excellent appendix on web references and resources, which will be very useful to the reader.

Having read this text from beginning to end, I am in agreement with Charles Berlin, the author of the foreword, who praises the text by stating that... "Compiling this book was a serious undertaking, fraught with sturm and drang, hidden pitfalls, internal contradictions, turf wars, and even some physiologic and anatomic data. The reflective reader will appreciate with me the inherent problems involved and the sincerity of the authors in their attempts to bring more order and more solid framework to this and related fields when the professions of audiology and speech-language pathology may once again work in concert for the benefit of our CAPD as well as AN/AD patients."

I have found this text to be extremely useful for my own practice. I would recommend the book to graduate students in both audiology and speech-language pathology programs, new and established clinicians, and related professionals such as psychologists, occupational therapists, educators, and school administrators.



Scope of Practice for Speech-Language Pathology

Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA)

Statement of Purpose

This document provides a general description of the scope of practice for the profession of speech-language pathology in Canada, highlighting the broad range of services that it provides. The document is intended as a resource for audiologists, speech-language pathologists, health care professionals, regulatory bodies, government agencies, third party insurers, educators, consumers and the general public.

The scope of practice document is not intended to be an exhaustive list of activities and some may not fall into the exclusive domain of a speech-language pathologist. Practice activities that are related to emerging clinical, technological and scientific developments are not precluded from consideration as part of the scope of practice of a speech-language pathologist and such innovations and advances will result in periodic revision of this document. It is recognized that individual providers may limit their practice by age or type of disorder. Additionally, professionals may have the expertise to provide services that do not appear in this document. In some provinces/territories where the profession is regulated, controlled acts limit the scope of practice and practice guidelines have been developed. Speech-language pathologists are ethically bound to provide services that are consistent with the scope of their competence, education and experience.

Definition

Speech-language pathologists are autonomous professionals who have expertise in typical development and disorders of communication and swallowing, as well as assessment and intervention for these areas. In some provinces/territories, speech-language pathologists are governed by a regulatory body and must meet regulatory requirements to practice.

Speech-language pathologists are involved in a number of different activities to promote effective communication and swallowing for the individuals they serve. These activities may include:

- Assessment of communication and swallowing disorders, which may involve: screening, identification, evaluation, and diagnosis.
- Intervention for communication and swallowing disorders, which may involve: promotion, prevention, counseling, treatment, consultation, management, (re)habilitation, and education.
- Education and supervision of students and professionals, including supportive personnel.
- Consultation with and referral to other professionals.
- Research.
- University and/or college education and training.
- Administration, management and policy development.

Speech-language pathologists may work directly with clients, and/or with their caregivers or other persons who regularly interact with them (e.g. friends, relatives, professionals, colleagues, supportive personnel etc.), for the purpose of creating environments that promote optimal communication and swallowing.

Educational Requirements

A Master's degree in speech-language pathology (or equivalent) is the current entry to practice requirement in all jurisdictions in Canada.



Roles and Responsibilities

Speech-language pathologists may work alone or as part of an interprofessional team to help individuals of all ages to communicate effectively and to swallow safely and efficiently. As such, they provide a broad range of services and related activities including:

- Clinical and/or instrumental screening, assessment, identification, diagnosis, treatment, and management of:
 - **Speech delays and disorders** including articulation, phonology, motor speech.
 - **Language delays and disorders** including expression and comprehension in oral or non-verbal modalities.
 - **Fluency disorders** including stuttering.
 - **Voice and resonance disorders.**
 - **Swallowing and feeding disorders** in adult and paediatric populations including oral-motor function.
 - **Cognitive-communicative disorders** including social communication skills, reasoning, problem solving, and executive functions.
 - **Preliteracy and literacy skills** including phonological awareness, decoding, reading comprehension, and writing.
 - **Communication and swallowing disorders in the context of other diagnoses or impairments** including but not limited to hearing impairments, traumatic brain injury, dementia, developmental, intellectual or genetic disorders, and neurological impairments.
- Assessment, selection, and development of augmentative and alternative communication systems and devices for individuals who are limited in their ability to communicate verbally, and provision of education and training in their use.
- Promotion, prevention, counseling, and education services to clients, families, caregivers, other professionals, and the public regarding all aspects of human communication, and disorders of communication and swallowing.
- Advocacy on behalf of individuals with communication and swallowing disorders and those who are at-risk.
- Enhancement of speech and language proficiency and communication effectiveness including accent modification.
- Screening of hearing and other factors for initial identification and referral to audiologists, educators, and to other health and/or school-based professionals.
- Consultation with and referral to other professionals.
- Interprofessional collaboration.
- Case management and coordination of service delivery.
- Supervision and training of supportive personnel.
- Education, supervision, and mentoring of students.
- Research related to communication sciences and disorders and swallowing.
- University and/or college education and training related to communication sciences and disorders and swallowing.
- Administration, management and policy development.

Practice Settings

Speech-language pathologists work in a variety of settings, including but not limited to: hospitals, rehabilitation centres, mental health facilities, nursing homes, childcare facilities, early intervention programs, schools, universities, colleges, research centres, private and group homes, and private practice.

Énoncé

Le présent document fournit une description générale du champ de pratique de l'orthophonie au Canada, et met en lumière le vaste éventail de services offerts. Il sert de ressource pour les orthophonistes, les audiologistes, les professionnels des soins de santé, les organismes de réglementation, les organismes gouvernementaux, les sociétés d'assurance responsabilité civile, les éducateurs, les consommateurs et le grand public.

Ce document ne vise pas à dresser une liste exhaustive d'activités et il inclut parfois des activités qui ne sont pas l'apanage des orthophonistes. Les activités professionnelles découlant de nouveautés cliniques, technologiques et scientifiques pourraient être incluses dans le champ de pratique des orthophonistes après évaluation. En fait, ces innovations et ces percées mèneront à la révision périodique du présent document. Il est reconnu que chaque professionnel peut limiter sa pratique à un groupe d'âge ou à un type de trouble. De plus, un professionnel peut posséder un savoir-faire qui ne figure pas dans ce document. Dans certaines provinces et certains territoires où la profession d'orthophoniste est réglementée, les actes autorisés peuvent restreindre le champ de pratique et il peut y avoir des lignes directrices pour la pratique. Les orthophonistes sont liés par un code de déontologie stipulant que les services qu'ils offrent doivent correspondre à leur compétence, à leur éducation et à leur expérience.

Définition

Les orthophonistes sont des professionnels autonomes qui possèdent une expertise du développement normal et des troubles de communication et de déglutition ainsi que de l'évaluation et de l'intervention dans ces domaines. Dans certaines provinces et certains territoires, les orthophonistes sont régis par un organisme de réglementation et doivent satisfaire à des exigences réglementaires.

Les orthophonistes pratiquent différentes activités pour favoriser la communication et la déglutition efficaces chez les personnes qu'ils desservent. Ces activités comprennent :

- l'évaluation des troubles de communication et de déglutition, notamment le dépistage, l'identification, l'évaluation et le diagnostic;
- l'intervention liée aux troubles de communication et de déglutition, notamment la promotion, la prévention, le counselling, le traitement, la consultation, la prise en charge, la réadaptation et la formation;
- la formation et la supervision d'étudiants et de professionnels, y compris du personnel de soutien;
- la consultation avec d'autres professionnels et l'aiguillage vers d'autres professionnels;
- la recherche;
- l'enseignement à l'université ou au collège et la formation;
- l'administration, la gestion et l'élaboration de politiques.

Les orthophonistes peuvent travailler directement auprès des clients ou avec les personnes soignantes et les autres personnes qui interagissent régulièrement avec ceux-ci (p. ex. : amis, famille, professionnels, collègues, personnel de soutien, etc.) afin de créer un contexte favorable optimal pour la communication et la déglutition.

Niveau d'instruction requis

Une maîtrise en orthophonie (ou l'équivalent) constitue actuellement l'exigence minimale pour exercer dans toutes les régions du Canada.



Rôles et responsabilités

Les orthophonistes peuvent travailler seuls ou au sein d'une équipe interdisciplinaire pour aider des personnes de tout âge à communiquer efficacement et avaler de façon adéquate et sécuritaire. À ce titre, ils offrent un vaste éventail de services et d'actes connexes, dont :

- de façon formelle ou informelle : le dépistage, l'évaluation, l'identification, le diagnostic, le traitement et la prise en charge des :
 - **retards et troubles de la parole**, incluant l'articulation, la phonologie et les fonctions motrices de la parole;
 - **retards et troubles du langage**, incluant l'expression et la compréhension dans les modalités orales et non verbales;
 - **troubles de fluidité**, incluant le bégaiement;
 - **troubles de la voix et de la résonance**;
 - **troubles de la déglutition et de l'alimentation** chez les populations adultes et pédiatriques, incluant les habiletés motrices oropharyngées;
 - **troubles de communication cognitive**, incluant la communication sociale, le raisonnement, la résolution de problèmes et les fonctions exécutives;
 - **habiletés en prélecture et en écriture**, incluant la conscience phonologique, le décodage, la compréhension en lecture et l'écriture;
 - **troubles de communication et de déglutition en présence d'un autre diagnostic ou d'un autre handicap**, incluant notamment un trouble auditif, un traumatisme crânio-cérébral, une démence, un trouble développemental, intellectuel, génétique ou neurologique;
- l'évaluation, la sélection et la conception de systèmes de communication suppléante et alternative et de dispositifs pour les personnes qui ont des habiletés de communication limitées à l'oral, ainsi que les instructions et une formation pour savoir comment utiliser ces appareils;
- des services de promotion, de prévention, de counselling et de sensibilisation pour les clients, les familles, les personnes soignantes et les autres professionnels ainsi que le public concernant tous les aspects de la communication ainsi que des troubles de communication et de déglutition;
- la défense des intérêts des personnes qui ont un trouble de communication ou de déglutition ainsi que des personnes à risque;
- l'amélioration des compétences de la parole et du langage ainsi que de l'efficacité de la communication, y compris la modification de l'accent;
- le dépistage initial des troubles auditifs et d'autres facteurs, et l'aiguillage vers un audiologiste, un spécialiste ou un autre professionnel de la santé ou professionnel en milieu scolaire;
- la consultation avec d'autres professionnels et l'aiguillage vers d'autres professionnels;
- la collaboration entre professionnels;
- la gestion de cas et la coordination de la prestation de services;
- la supervision et la formation du personnel de soutien;
- l'enseignement, la supervision et l'encadrement d'étudiants;
- la recherche liée aux sciences et aux troubles de communication et de déglutition;
- l'enseignement à l'université ou au collège et la formation dans le domaine des sciences et des troubles de communication et de déglutition;
- l'administration, la gestion et l'élaboration de politiques.

Milieus de pratique

Les orthophonistes travaillent dans divers milieux, notamment les hôpitaux, les centres de réadaptation, les établissements psychiatriques, les maisons de soins infirmiers, les services de garde, les programmes d'intervention précoce, les écoles, les universités, les collèges, les centres de recherche, les résidences, les foyers de groupe et les cabinets privés.

Scope of Practice for Audiology

Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA)

Statement of Purpose

This document provides a general description of the scope of practice for the profession of audiology in Canada, highlighting the broad range of services it provides. The document is intended as a resource for audiologists, speech-language pathologists, health care professionals, regulatory bodies, government agencies, third party insurers, educators, consumers and the general public.

The scope of practice document is not intended to be an exhaustive list of activities and some may not fall into the exclusive domain of an audiologist. Practice activities that are related to emerging clinical, technological and scientific developments are not precluded from consideration as part of the scope of practice of an audiologist and such innovations and advances will result in periodic revision of this document. It is recognized that individual providers may limit their practice by age or type of disorder. Additionally, professionals may have the expertise to provide services that do not appear in this document. In some provinces/territories where the profession is regulated, there are controlled acts that limit the scope of practice and practice guidelines have been developed. Audiologists are ethically bound to provide services that are consistent with the scope of their competence, education and experience.

Definition

Audiologists are hearing health professionals who identify, diagnose and manage individuals with peripheral or central hearing loss, tinnitus and balance disorders. In some provinces/territories, audiologists are governed by a regulatory body and must meet regulatory requirements to practice.

Audiologists provide a number of different services related to hearing, tinnitus and balance for the individuals they serve. These services may include:

- Assessment of hearing and balance disorders, which may involve screening, identification, evaluation and diagnosis.
- Intervention for hearing and balance disorders, which may involve promotion, prevention, counselling, treatment, consultation, management, (re)habilitation and education.
- Education and supervision of students and professionals, including supportive personnel.
- Consultation with and referral to other professionals.
- Research.
- University and/or college education and training.
- Administration, management and policy development.

Educational Requirements

A master's degree in audiology (or equivalent) is the current entry to practice requirement in all jurisdictions in Canada.



Roles and Responsibilities

Audiologists may work alone or as part of an inter-professional team to help individuals of all ages to maximize their hearing health. As such, they provide a broad range of services that include the following activities:

- Clinical and/or instrumental screening, assessment, identification, diagnosis and treatment of:
 - Hearing disorders in infants, children and adults involving both peripheral and central pathways of hearing;
 - Auditory processing disorders;
 - Tinnitus, hyperacusis and misophonia; and
 - Balance disorders.
- Assessment, selection, dispensing, validation, verification and servicing of hearing aids.
- Assessment, selection and development of other appropriate hearing assistive and (re)habilitative strategies for individuals with hearing impairment, auditory processing, balance dysfunction, tinnitus and/or related disorders. This could include cochlear implants, assistive technology such as FM systems, speech reading classes, tinnitus re-training and vestibular (re)habilitation.
- Intraoperative monitoring.
- Promotion of hearing health.
- Prevention, counselling and education services to clients, families, caregivers, other professionals and the public regarding all aspects of hearing and balance function.
- Advocacy on behalf of individuals with hearing, auditory processing, tinnitus and balance disorders and populations that are at risk.
- Consultation, assessment and management of educational, workplace and other public acoustical environments.
- Consultation with government, industry and community agencies regarding improvements to noise legislation and implementation of environmental and occupational hearing conservation programs.
- Consultation with worker's compensation boards and Veterans Affairs Canada regarding criteria and determination of pension/benefits for individuals with hearing loss and related disorders.
- Medical legal consultation including forensic audiology.
- Consultation with and referral to other professionals.
- Inter-professional collaboration.
- Case management and coordination of service delivery.
- Supervision and training of supportive personnel.
- Education, supervision and mentoring of students.
- University and/or college education and training related to hearing, balance and other related disorders.
- Research in the areas of hearing, balance and other related disorders.
- Screening for speech and language development for the purpose of hearing evaluation and/or the identification of individuals with other communication disorders that may require intervention.
- Cerumen management.

Practice Settings

Audiologists work in a variety of health and education settings, including but not limited to hospitals, public health units, community health centres, schools, private practice, industrial settings, hearing-aid and cochlear implant manufacturers, professional associations, universities, colleges and nursing homes. Audiologists may function independently or within an inter-professional framework, collaborating with other professionals such as speech-language pathologists, physicians, nurses, teachers, occupational therapists, physiotherapists and psychologists as well as supportive personnel.

Énoncé

Le présent document fournit une description générale du champ de pratique de l'audiologie au Canada, et met en lumière le vaste éventail de services offerts. Il sert de ressource pour les audiologistes, les orthophonistes, les professionnels des soins de santé, les organismes de réglementation, les organismes gouvernementaux, les sociétés d'assurance, les éducateurs, les consommateurs et le grand public.

Ce document ne vise pas à dresser une liste exhaustive d'activités et il inclut parfois des activités qui ne sont pas l'apanage des orthophonistes. Les activités professionnelles découlant de nouveautés cliniques, technologiques et scientifiques ne sont pas exclues du champ de pratique des audiologistes. En fait, ces innovations et ces percées mèneront à la révision périodique du présent document. Il est reconnu que chaque professionnel peut limiter sa pratique à un groupe d'âge ou à un type de trouble. De plus, un professionnel peut posséder un savoir-faire qui ne figure pas dans ce document. Dans certaines provinces et certains territoires où la profession d'audiologiste est réglementée, les actes autorisés peuvent restreindre le champ de pratique et il peut y avoir des lignes directrices pour la pratique. Les audiologistes sont liés par un code de déontologie stipulant que les services qu'ils offrent doivent correspondre à leur compétence, à leur éducation et à leur expérience.

Définition

Les audiologistes sont des professionnels autonomes de l'audition qui diagnostiquent les personnes atteintes d'une perte auditive périphérique ou centrale, d'acouphène ou d'un trouble de l'équilibre, qui déterminent leur condition par un diagnostic et qui les prennent en charge. Dans certaines provinces et certains territoires, les audiologistes sont régis par un organisme de réglementation et doivent satisfaire à des exigences réglementaires.

Les audiologistes fournissent à leur clientèle divers services touchant l'audition, l'acouphène et l'équilibre. Ces services comprennent :

- l'évaluation des troubles de l'audition et de l'équilibre, ce qui peut comprendre le dépistage, l'identification, l'évaluation et le diagnostic;
- l'intervention liée aux troubles de l'audition et de l'équilibre, ce qui peut comprendre la promotion, la prévention, le counselling, le traitement, la consultation, la prise en charge, la réadaptation et la sensibilisation;
- la formation et la supervision d'étudiants et de professionnels, y compris du personnel de soutien;
- la consultation avec d'autres professionnels et l'aiguillage;
- la recherche;
- l'enseignement à l'université ou au collège et la formation;
- l'administration, la gestion et l'élaboration de politiques.

Niveau d'instruction requis

Une maîtrise en audiologie (ou l'équivalent) constitue actuellement l'exigence minimale pour exercer dans toutes les régions du Canada.

Rôles et responsabilités

Les audiologistes peuvent travailler seuls ou au sein d'une équipe interdisciplinaire pour aider des personnes de tout âge à maximiser leur santé auditive. À ce titre, ils offrent un vaste éventail de services, dont :



- le dépistage clinique ou à l'aide d'outils, l'évaluation, l'identification, le diagnostic et le traitement :
 - des troubles de l'audition touchant les voies auditives périphériques et centrales chez les nourrissons, les enfants et les adultes ;
 - d'un troubles de traitement auditif;
 - de l'acouphène, de l'hyperacousie et de la misophonie;
 - des troubles de l'équilibre;
- l'évaluation, la sélection, la distribution, la validation, la vérification et l'entretien d'appareils auditifs;
- l'évaluation, la sélection et l'élaboration d'autres stratégies appropriées d'aide à l'audition et de réadaptation pour les personnes atteintes d'un trouble de l'audition ou du traitement auditif, d'un dysfonctionnement de l'équilibre, d'acouphène ou d'autres troubles connexes. Ces stratégies peuvent comprendre des implants cochléaires, une technologie d'aide telle que les systèmes à modulation de fréquence, des cours de lecture labiale, le réentraînement pour modifier la perception de l'acouphène et la réadaptation vestibulaire;
- la surveillance peropératoire;
- la promotion de la santé auditive;
- les services de prévention, de counselling et de sensibilisation pour les clients, les familles, les personnes soignantes et les autres professionnels ainsi que le public concernant tous les aspects de la fonction auditive et de l'équilibre;
- la défense des intérêts des personnes qui ont des troubles de l'audition, du traitement auditif, d'acouphène et de l'équilibre ainsi que des personnes à risque;
- la consultation, l'évaluation et la gestion d'environnements acoustiques en milieu scolaire ou de travail ou dans des lieux publics;
- la consultation d'organismes gouvernementaux, communautaires et de l'industrie concernant les améliorations à apporter aux mesures législatives sur le bruit et à la mise en œuvre de programmes de préservation de l'audition dans l'environnement et en milieu de travail;
- la consultation auprès d'organismes de sécurité au travail et du ministère des Anciens combattants concernant les critères d'admission à des prestations ou à des indemnités pour les personnes atteintes d'une perte auditive ou d'un trouble connexe;
- la consultation médico-légale, y compris l'audiologie médico-légale;
- la consultation d'autres professionnels et l'aiguillage;
- la collaboration entre professionnels;
- la gestion de cas et la coordination de la prestation de services;
- la supervision et la formation du personnel de soutien;
- l'enseignement, la supervision et l'encadrement d'étudiants;
- l'enseignement à l'université ou au collège et la formation dans le domaine des troubles de l'audition, de l'équilibre et des troubles connexes;
- la recherche liée aux troubles de l'audition et de l'équilibre, et aux troubles connexes;
- le dépistage des troubles du développement de la parole et du langage afin de faire une évaluation de l'audition ou d'identifier les personnes atteintes d'un trouble de la communication nécessitant une intervention;
- l'exérèse du cérumen.

Milieus de pratique

Les audiologistes travaillent dans divers milieux de la santé et de l'éducation, notamment les hôpitaux, les services de santé publique, les centres de santé communautaires, les écoles, les cabinets privés, les milieux industriels, les fabricants d'appareils auditifs et d'implants cochléaires, les associations professionnelles, les universités, des collèges et les foyers de soins infirmiers. Les audiologistes peuvent travailler seuls ou au sein d'une équipe interprofessionnelle et collaborer avec d'autres professionnels tels que des orthophonistes, des médecins, des infirmières, des enseignants, des ergothérapeutes, des physiothérapeutes et des psychologues ainsi que du personnel de soutien.

Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA)

Vision, Mission & Values

Vision

The Canadian Association of Speech-Language Pathologists and Audiologists ... the national voice and recognized resource for speech-language pathology and audiology.

Mission

The Canadian Association of Speech-Language Pathologists and Audiologists...supporting and empowering our members to maximize the communication and hearing potential of the people of Canada.

Values

The Canadian Association of Speech-Language Pathologists and Audiologists is:

- Accountable - Board decisions are fiscally responsible and transparent.
- Evidence-based - Decisions are based on the best available information and research.
- Inclusive - The diversity of members' cultures, locations and practices are considered.
- Member-driven - Decisions reflect the priorities of members.
- Responsive - The strategic plan allows flexibility to respond to new opportunities and to minimize the impact of external challenges.
- Visionary - Decisions are guided by long-term needs of members and the public, and informed by social and political forecasts and trends.



Canadian Association of Speech-Language Pathologists & Audiologists
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Approved November 2008

Association canadienne des orthophonistes et audiologistes (ACOA)

Vision, mission et valeurs

Vision

L'Association canadienne des orthophonistes et audiologistes : porte-parole national et ressource renommée dans les domaines de l'orthophonie et de l'audiologie.

Mission

L'Association canadienne des orthophonistes et audiologistes appuie et habilite ses membres en vue de maximiser le potentiel en communication et en audition des Canadiens.

Valeurs

L'Association canadienne des orthophonistes et audiologistes :

- est responsable – les décisions du conseil d'administration sont équitables sur le plan financier et transparentes.
- se fonde sur des données probantes – ses décisions sont fondées sur les meilleures connaissances et recherches disponibles.
- est inclusive – elle tient compte de la diversité des cultures, des lieux et des pratiques de ses membres.
- est axée sur ses membres – ses décisions reflètent les priorités de ses membres.
- est réceptive – le plan stratégique offre la souplesse voulue pour réagir aux nouvelles possibilités et pour minimiser l'incidence des défis externes.
- est visionnaire – ses décisions sont guidées par les besoins à long terme de ses membres et du grand public, et sont fondées sur les prévisions et tendances sociales et politiques.



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approuvé novembre 2008

Information for Contributors

The Canadian Journal of Speech-Language Pathology and Audiology (CJSLPA) welcomes submissions of scholarly manuscripts related to human communication and its disorders broadly defined. This includes submissions relating to normal and disordered processes of speech, language, and hearing. Manuscripts that have not been published previously are invited in English and French. Manuscripts may be tutorial, theoretical, integrative, practical, pedagogic, or empirical. All manuscripts will be evaluated on the basis of the timeliness, importance, and applicability of the submission to the interests of speech-language pathology and audiology as professions, and to communication sciences and disorders as a discipline. Consequently, all manuscripts are assessed in relation to the potential impact of the work on improving our understanding of human communication and its disorders. All categories of manuscripts submitted will undergo peer-review to determine the suitability of the submission for publication in CJSLPA. The Journal recently has established multiple categories of manuscript submission that will permit the broadest opportunity for dissemination of information related to human communication and its disorders. New categories for manuscript submission include:

Tutorials: Review articles, treatises, or position papers that address a specific topic within either a theoretical or clinical framework.

Articles: Traditional manuscripts addressing applied or basic experimental research on issues related to speech, language, and/or hearing with human participants or animals.

Clinical Reports: Reports of new clinical procedures, protocols, or methods with specific focus on direct application to identification, assessment and/or treatment concerns in speech, language, and/or hearing.

Brief Reports: Similar to research notes, brief communications concerning preliminary findings, either clinical or experimental (applied or basic), that may lead to additional and more comprehensive study in the future. These reports are typically based on small “*n*” or pilot studies and must address disordered participant populations.

Research Notes: Brief communications that focus on experimental work conducted in laboratory settings. These reports will typically address methodological concerns and/or modifications of existing tools or instruments with either normal or disordered populations.

Field Reports: Reports that outline the provision of services that are conducted in unique, atypical, or nonstandard settings; manuscripts in this category may include screening, assessment, and/or treatment reports.

Letters to the Editor: A forum for presentation of scholarly/clinical differences of opinion concerning work previously published in the Journal. Letters to the Editor may influence our thinking about design considerations, methodological confounds, data analysis and/or data interpretation, etc. As with other categories of submissions, this communication forum is contingent upon peer-review. However, in contrast to other categories of submission, rebuttal from the author(s) will be solicited upon acceptance of a letter to the editor.

Submission of Manuscripts

Contributors should send a file containing the manuscript, including all tables, figures or illustrations, and references in MS word or WordPerfect format via e-mail to the editor at: tim.bressmann@utoronto.ca. Sending manuscripts by e-mail is the preferred method of submission. However, manuscripts may still be submitted by sending five (5) hard copies to:

Tim Bressmann, PhD
Editor in Chief,
Canadian Journal of Speech-Language Pathology and Audiology
Department of Speech-Language Pathology
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160 - 500 University Avenue
Toronto, Ontario M5G 1V

Along with copies of the manuscript, a cover letter indicating that the manuscript is being submitted for publication consideration should be included. The cover letter must explicitly state that the manuscript is original work, that has not been published previously, and that it is not currently under review elsewhere. Manuscripts are received and peer-reviewed contingent upon this understanding. The author(s) must also provide appropriate confirmation that work conducted with humans or animals has received ethical review and approval.

Failure to provide information on ethical approval will delay the review process. Finally, the cover letter should also indicate the category of submission (i.e., tutorial, clinical report, etc.). If the editorial staff determines that the manuscript should be considered within another category, the contact author will be notified.

All submissions should conform to the publication guidelines of the *Publication Manual of the American Psychological Association* (APA), 5th Edition. A confirmation of receipt for all manuscripts will be provided to the contact author prior to distribution for peer review. CJSLPA seeks to conduct the review process and respond to authors regarding the outcome of the review within 90 days of receipt. If a manuscript is judged as suitable for publication in CJSLPA, authors will have 30 days to make necessary revisions prior to a secondary review.

The author is responsible for all statements made in his or her manuscript, including changes made by the editorial and/or production staff. Upon final acceptance of a manuscript and immediately prior to publication, the contact author will be permitted to review galley proofs and verify its content to the publication office within 72 hours of receipt of galley proofs.

Organization of the Manuscript

All copies should be typed, double-spaced, with a standard typeface (12 point, noncompressed font) on high quality 8 ½ X 11 paper. All margins should be at least one (1) inch. An original and four (copies) of the manuscript should be submitted directly to the Editor. Author identification for the review process is optional; if blind-review is desired, three (3) of the copies should be prepared accordingly (cover page and acknowledgments blinded). Responsibility for removing all potential identifying information rests solely with the author(s). All manuscripts should be prepared according to APA guidelines. This manual is available from most university bookstores or is accessible via commercial bookstores. Generally, the following sections should be submitted in the order specified.

Title Page: This page should include the full title of the manuscript, the full names of the author(s) with academic degrees, each author's affiliation, and a complete mailing address for the contact author. An electronic mail address also is recommended.

Abstract: On a separate sheet of paper, a brief yet informative abstract that does not exceed one page is required. The abstract should include the purpose of the work along with pertinent information relative to the specific manuscript category for which it was submitted.

Key Words: Following the abstract and on the same page, the author(s) should supply a list of key words for indexing purposes.

Tables: Each table included in the manuscript must be typewritten and double-spaced on a separate sheet of paper. Tables should be numbered consecutively beginning with Table 1. Each table must have a descriptive caption. Tables should serve to expand the information provided in the text of the manuscript, not to duplicate information.

Illustrations: All illustrations included as part of the manuscript must be included with each copy of the manuscript. All manuscripts must have clear copies of all illustrations for the review process. High resolution (at least 300 dpi) files in any of the following formats must be submitted for each graphic and image: JPEG, TIFF, AI, PSD, GIF, EPS or PDF. For other types of computerized illustrations, it is recommended that CJSPLA production staff be consulted prior to preparation and submission of the manuscript and associated figures/illustrations.

Legends for Illustrations: Legends for all figures and illustrations should be typewritten (double-spaced) on a separate sheet of paper with numbers corresponding to the order in which figures/illustrations appear in the manuscript.

Page Numbering and Running Head: The text of the manuscript should be prepared with each page numbered, including tables, figures/illustrations, references, and if appropriate, appendices. A short (30 characters or less) descriptive running title should appear at the top right hand margin of each page of the manuscript.

Acknowledgments: Acknowledgments should be typewritten (double-spaced) on a separate sheet of paper. Appropriate acknowledgment for any type of sponsorship, donations, grants, technical assistance, and to professional colleagues who contributed to the work, but are not listed as authors, should be noted.

References: References are to be listed consecutively in alphabetical order, then chronologically for each author. Authors should consult the APA publication manual (4th Edition) for methods of citing varied sources of information. Journal names and appropriate volume number should be spelled out and italicized. All literature, tests and assessment tools, and standards (ANSI and ISO) must be listed in the references. All references should be double-spaced.

Potential Conflicts of Interest and Dual Commitment

As part of the submission process, the author(s) must explicitly identify if any potential conflict of interest, or dual commitment, exists relative to the manuscript and its author(s). Such disclosure is requested so as to inform CJSPLA that the author or authors have the potential to benefit from publication of the manuscript. Such benefits may be either direct or indirect and may involve financial and/or other nonfinancial benefit(s) to the author(s). Disclosure of potential conflicts of interest or dual commitment may be provided to editorial consultants if it is believed that such a conflict of interest or dual commitment may have had the potential to influence the information provided in the submission or compromise the design, conduct, data collection or analysis, and/or interpretation of the data obtained and reported in the manuscript submitted for review. If the manuscript is accepted for publication, editorial acknowledgement of such potential conflict of interest or dual commitment may occur when publication occurs.

Participants in Research Humans and Animals

Each manuscript submitted to CJSPLA for peer-review that is based on work conducted with humans or animals must acknowledge appropriate ethical approval. In instances where humans or animals have been used for research, a statement indicating that the research was approved by an institutional review board or other appropriate ethical evaluation body or agency must clearly appear along with the name and affiliation of the research ethics and the ethical approval number. The review process will not begin until this information is formally provided to the Editor.

Similar to research involving human participants, CJSPLA requires that work conducted with animals state that such work has met with ethical evaluation and approval. This includes identification of the name and affiliation of the research ethics evaluation body or agency and the ethical approval number. A statement that all research animals were used and cared for in an established and ethically approved manner is also required. The review process will not begin until this information is formally provided to the Editor.

Renseignements à l'intention des collaborateurs

La Revue canadienne d'orthophonie et d'audiologie (RCOA) est heureuse de se voir soumettre des manuscrits de recherche portant sur la communication humaine et sur les troubles qui s'y rapportent, dans leur sens large. Cela comprend les manuscrits portant sur les processus normaux et désordonnés de la parole, du langage et de l'audition. Nous recherchons des manuscrits qui n'ont jamais été publiés, en français ou en anglais. Les manuscrits peuvent être tutoriels, théoriques, synthétiques, pratiques, pédagogiques ou empiriques. Tous les manuscrits seront évalués en fonction de leur signification, de leur opportunité et de leur applicabilité aux intérêts de l'orthophonie et de l'audiologie comme professions, et aux sciences et aux troubles de la communication en tant que disciplines. Par conséquent, tous les manuscrits sont évalués en fonction de leur incidence possible sur l'amélioration de notre compréhension de la communication humaine et des troubles qui s'y rapportent. Peu importe la catégorie, tous les manuscrits présentés seront soumis à une révision par des collègues afin de déterminer s'ils peuvent être publiés dans la RCOA. La Revue a récemment établi plusieurs catégories de manuscrits afin de permettre la meilleure diffusion possible de l'information portant sur la communication humaine et les troubles s'y rapportant. Les nouvelles catégories de manuscrits comprennent :

Tutoriels : Rapports de synthèse, traités ou exposés de position portant sur un sujet particulier dans un cadre théorique ou clinique.

Articles : Manuscrits conventionnels traitant de recherche appliquée ou expérimentale de base sur les questions se rapportant à la parole, au langage ou à l'audition et faisant intervenir des participants humains ou animaux.

Comptes rendus cliniques : Comptes rendus de nouvelles

procédures ou méthodes ou de nouveaux protocoles cliniques portant particulièrement sur une application directe par rapport aux questions d'identification, d'évaluation et de traitement relativement à la parole, au langage et à l'audition.

Comptes rendus sommaires : Semblables aux notes de recherche, brèves communications portant sur des conclusions préliminaires, soit cliniques soit expérimentales (appliquées ou fondamentales), pouvant mener à une étude plus poussée dans l'avenir. Ces comptes rendus se fondent typiquement sur des études à petit « n » ou pilotes et doivent traiter de populations désordonnées.

Notes de recherche : Brèves communications traitant spécifiquement de travaux expérimentaux menés en laboratoire. Ces comptes rendus portent typiquement sur des questions de méthodologie ou des modifications apportées à des outils existants utilisés auprès de populations normales ou désordonnées.

Comptes rendus d'expérience : Comptes rendus décrivant sommairement la prestation de services offerts en situations uniques, atypiques ou particulières; les manuscrits de cette catégorie peuvent comprendre des comptes rendus de dépistage, d'évaluation ou de traitement.

Courrier des lecteurs : Forum de présentation de divergences de vues scientifiques ou cliniques concernant des ouvrages déjà publiés dans la Revue. Le courrier des lecteurs peut avoir un effet sur notre façon de penser par rapport aux facteurs de conception, aux confusions méthodologiques, à l'analyse ou l'interprétation des données, etc. Comme c'est le cas pour d'autres catégories de présentation, ce forum de communication est soumis à une révision par des collègues. Cependant, contrairement aux autres catégories, on recherchera la réaction des auteurs sur acceptation d'une lettre.

Présentation de manuscrits

On demande aux collaborateurs de faire parvenir par voie électronique un fichier électronique incluant leurs manuscrits, y compris tous les tableaux, figures ou illustrations et références, en format MS Word ou WordPerfect à : tim.bressmann@utoronto.ca. L'envoi des manuscrits par voie électronique est la méthode préférée pour la soumission, pourtant les manuscrits peuvent toujours être soumis en envoyant 5 copies imprimées à :

Tim Bressmann, PhD
Rédacteur en chef, Revue canadienne d'orthophonie et d'audiologie
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On doit joindre aux exemplaires du manuscrit une lettre d'envoi qui indiquera que le manuscrit est présenté en vue de sa publication. La lettre d'envoi doit préciser que le manuscrit est une œuvre originale, qu'il n'a pas déjà été publié et qu'il ne fait pas actuellement l'objet d'un autre examen en vue d'être publié. Les manuscrits sont reçus et examinés sur acceptation de ces conditions. L'auteur (les auteurs) doit (doivent) aussi fournir une attestation en bonne et due forme que toute recherche impliquant des êtres humains ou des animaux a fait

l'objet de l'agrément d'un comité de révision déontologique. L'absence d'un tel agrément retardera le processus de révision. Enfin, la lettre d'envoi doit également préciser la catégorie de la présentation (i.e. tutoriel, rapport clinique, etc.). Si l'équipe d'examen juge que le manuscrit devrait passer sous une autre catégorie, l'auteur-contact en sera avisé.

Toutes les présentations doivent se conformer aux lignes de conduite présentées dans la publication *Manual of the American Psychological Association (APA)*, 5^e Édition. Un accusé de réception de chaque manuscrit sera envoyé à l'auteur-contact avant la distribution des exemplaires en vue de la révision. La RCOA cherche à effectuer cette révision et à informer les auteurs des résultats de cette révision dans les 90 jours de la réception. Lorsqu'on juge que le manuscrit convient à la RCOA, on donnera 30 jours aux auteurs pour effectuer les changements nécessaires avant l'examen secondaire.

L'auteur est responsable de toutes les affirmations formulées dans son manuscrit, y compris toutes les modifications effectuées par les rédacteurs et réviseurs. Sur acceptation définitive du manuscrit et immédiatement avant sa publication, on donnera l'occasion à l'auteur-contact de revoir les épreuves et il devra signifier la vérification du contenu dans les 72 heures suivant réception de ces épreuves.

Organisation du manuscrit

Tous les textes doivent être dactylographiés à double interligne, en caractère standard (police de caractères 12 points, non comprimée) et sur papier 8 ½" X 11" de qualité. Toutes les marges doivent être d'au moins un (1) pouce. L'original et quatre (4) copies du manuscrit doivent être présentés directement au rédacteur en chef. L'identification de l'auteur est facultative pour le processus d'examen : si l'auteur souhaite ne pas être identifié à ce stade, il devra préparer trois (3) copies d'un manuscrit dont la page couverture et les remerciements seront voilés. Seuls les auteurs sont responsables de retirer toute information identificatrice éventuelle. Tous les manuscrits doivent être rédigés en conformité aux lignes de conduite de l'APA. Ce manuel est disponible dans la plupart des librairies universitaires et peut être commandé chez les libraires commerciaux. En général, les sections qui suivent doivent être présentées dans l'ordre chronologique précisé.

Page titre : Cette page doit contenir le titre complet du manuscrit, les noms complets des auteurs, y compris les diplômes et affiliations, et l'adresse complète de l'auteur-contact. Une adresse de courriel est également recommandée.

Abrégé : Sur une page distincte, produire un abrégé bref mais informateur ne dépassant pas une page. L'abrégé doit indiquer l'objet du travail ainsi que toute information pertinente portant sur la catégorie du manuscrit.

Mots clés : Immédiatement suivant l'abrégé et sur la même page, les auteurs doivent présenter une liste de mots clés aux fins de constitution d'un index.

Tableaux : Tous les tableaux compris dans un même manuscrit doivent être dactylographiés à double interligne sur une page distincte. Les tableaux doivent être numérotés consécutivement, en commençant par le Tableau 1. Chaque tableau doit être accompagné d'une légende et doit servir à compléter les renseignements fournis dans le texte du manuscrit plutôt qu'à reprendre l'information contenue dans le texte ou dans les tableaux.

Illustrations : Toutes les illustrations faisant partie du manuscrit doivent être incluses avec chaque exemplaire du manuscrit. Chaque manuscrit doit contenir des copies claires de toutes les illustrations pour le processus de révision. Il faut envoyer un fichier électronique pour chaque image et graphique en format JPEG, TIFF, AI, PSD, GIF, EPS ou PDF, compression minimale 300 ppp. Pour les autres types d'illustrations informatisées, il est recommandé de consulter le personnel de production de la RCOA avant la préparation et la présentation du manuscrit et des figures et illustrations s'y rattachant.

Légendes des illustrations : Les légendes accompagnant chaque figure et illustration doivent être dactylographiées à double interligne sur une feuille distincte et identifiées à l'aide d'un numéro qui correspond à la séquence de parution des figures et illustrations dans le manuscrit.

Numérotation des pages et titre courant : Chaque page du manuscrit doit être numérotée, y compris les tableaux, figures, illustrations, références et, le cas échéant, les annexes. Un bref (30 caractères ou moins) titre courant descriptif doit apparaître dans la marge supérieure droite de chaque page du manuscrit.

Remerciements : Les remerciements doivent être dactylographiés à double interligne sur une feuille distincte. L'auteur doit reconnaître toute forme de parrainage, don, bourse ou d'aide technique, ainsi que tout collègue professionnel qui ont contribué à l'ouvrage mais qui n'est pas cité à titre d'auteur.

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