CANADIAN JOURNAL OF SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY

CJSLPA · RCOA

REVUE CANADIENNE D'ORTHOPHONIE ET D'AUDIOLOGIE

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CANADIAN JOURNAL OF SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY

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The Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA) is the only national body that supports and represents the professional needs of speech-language pathologists, audiologists and supportive personnel inclusively within one organization. Through this support, CASLPA champions the needs of people with communications disorders. The association was founded in 1964 and incorporated under federal charter in 1975. CASLPA's periodical publications program began 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.

The *Canadian Journal of Speech-Language Pathology and Audiology* is supported by a grant in Aid to Scholarly Journals, provided by the Canadian Social Sciences and Humanities Research Council (grant # 651-2008-0062), for the period January 2009 to December 2011.

CASLPA Vision and Mission

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.

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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

La Revue canadienne d'orthophonie et d'audiologie est appuyée par une subvention d'Aide aux revues savantes accordée par le Conseil de recherches en sciences humaines du Canada (subvention no. 651-2008-0062), pour la période de janvier 2009 à décembre 2011.

ACOA : VISION ET MISSION

Vision

L'Association canadienne des orthophonistes et audiologistes : porte-parole national et ressource reconnue dans le domaine 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 de la population canadienne.

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Les articles et les archives de la RCOA sont maintenant disponibles au publique à www.cjslpa.ca

Publicité

Toutes les demandes visant à faire paraître de la publicité dans la RCOA doivent être adressées au Bureau national. L'acceptation d'une annonce publicitaire ne signifie absolument pas que l'ACOA fait la promotion du produit, du service ou de la compagnie. L'ACOA se réserve le droit de rejeter une annonce si le message, l'organisation, le produit ou le service n'est pas compatible avec la mission, la vision ou les valeurs de l'ACOA. L'ACOA n'assume pas la responsabilité de l'exactitude des déclarations des annonceurs.

Réviseurs de la RCOA 2010

Michael Kiefte, Christiane Séguin, Natasha Trudeau, Elena Nicoladis, Joanne Deluzio, Robert Harrison, Kai Uus , André Lafargue, Frank Russo, Andrea Macleod, Audette Sylvestre, Elizabeth Crais, Claude Vincent, Francois Bergeron, Anita McGinty, Lori Skibbe, Michel Habib, Jean-Pierre Gagné, Marianne Pouplier, Sharynne McLeod, Carol To, Lydia So, (Barbara) May Bernhardt, Caroline Bowen, Nicole Mueller, Glenda Mason,, Peter Flipsen Jr., Melanie Campbell, Denise Hayward, Lori Swanson, Laurent Motron, Carole Sénéchal, Margaret Cheesman, Cory Portnuff, Phaedra Royle, Renée Béland, Glen Nowell, Francois Bergeron, Lendra Friesen

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TABLE OF CONTENTS

TABLE DES MATIÈRES

From the Editor

WINTER ISSUE

This issue of the *Canadian Journal of Speech-Language Pathology and Audiology* (CJSLPA) completes my four years as editor. Next year, the new editor of the CJSLPA will be Elizabeth Fitzpatrick, Ph.D., of the University of Ottawa. Elizabeth was the associate editor for audiology submissions from 2008-2010, so she is already well acquainted with the CJSLPA. I wish her best success for this new undertaking.

Editing and publishing a journal is a great team effort, and I am deeply indebted to all my colleagues at the CJSLPA. I was fortunate to have the support of an outstanding team of associate editors, consisting of (in alphabetical order): Vince Gracco (Speech – English, 2009-2011), Benoît Jutras (Audiology – French, 2008-2011), Andrea McLeod (Language – English, 2011), Joël Macoir (Language and Speech – French, 2008-2011), Jana Rieger (Speech – English, 2008-2009), Navid Shahnaz (Audiology – English, 2011) and Jeff Small (Language – English, 2008-2010). The associate editors do a lot of the heavy lifting during the review process and the importance of their contribution for the content and quality of the journal cannot be overstated. I could not have wished for a better team of associate editors and I would like to thank them all for their unwavering support, their hard work and their valuable input.

At the *Canadian Association of Speech-Language Pathologists and Audiologists* (CASLPA), Ms. Angie D'Aoust, Director of Communications, was a constant support and resource regarding the operational aspects of the journal. I am equally grateful to the managing editors (in chronological order) Judy Gallant, Alicia Weiss, Natalie Dunleavy and Olga Novoa for all their help and their expertise in turning a collection of word documents into a proper journal issue. I would like to thank the editorial assistants (in chronological order) Rebecca Fleming, Sophie Kuziora, Sarah Baxter, Patrick Fothergill and Suzi Dumetrescu for coordinating the reviews and generally keeping me on track.

Finally, I would like to thank the peer reviewers that have contributed to the vetting and the quality control of the submitted articles. Peer review is an integral part of scientific publishing, and the reviewers are volunteering considerable time and effort to this task. The reviewers' contributions are highly appreciated by the authors and the editors of the journal.

It has been interesting and rewarding to see the inner workings of scientific publishing from up close. A scientific journal is a dynamic and ever-changing entity. Over the last four years, the CJSLPA has transitioned from a mostly-paper to an online-only publishing format. The creation of the new journal website and the transition to a completely open access publishing model have been courageous moves by the CASLPA. The CJSLPA will benefit from being better visible and accessible for an international readership. The implementation of the new journal archive and other improvements have been made possible by a grant by the Social Sciences and Humanities Research Council of Canada that we were fortunate to obtain in 2008 and that enabled us to make the journal open access.

I thank the CASLPA for the opportunity to serve in the capacity of CJSLPA editor. This was a great opportunity for professional and personal growth as well as a wonderful chance to get to know colleagues and association members all over the country. And, of course, I had the wonderful opportunity to attend the CASLPA meetings in Kananaskis (AB), London (ON), Whitehorse (YK) and Montréal (QC) in this role.

The first article in this issue was contributed by Jessica Lamont, Luigi Girolametto, Carla J. Johnson, Xi Chen and Patricia L. Cleave and is entitled "Emergent Literacy Skills of Preschoolers with Language Disorders: Monolingual English versus Dual Language Learners." The authors studied parental reports and direct measures of literacy skills in 16 families of children with specific language impairment.

The second paper is called "Évaluation de neuf synthèses vocales françaises basée sur l'intelligibilité et l'appréciation" and was written by Patricia Côté-Giroux, Natacha Trudeau, Christine Valiquette, Ann Sutton, Elsa Chan and Catherine Hébert. This study investigated the speech intelligibility of different synthetic francophone voices with three groups of listeners of different ages.

Christine Meston, Mary Beth Jennings and Margaret Cheesman undertook a research study about "Older adult's views of their communication difficulties and needs while driving in a motor vehicle." Based on a series of group discussions, the authors explore communication issues related to hearing in a car.

The fourth paper entitled "Word Recognition by English Monolingual and Mandarin-English Bilingual Speakers in Continuous and Interrupted Noise' was contributed by Jianliang Zhang, Andrew Stuart and Shannon Swink. The

authors investigated word recognition in quiet and noise with Mandarin-English bilingual and American English monolingual young adults.

Patricia L. Cleave, Elizabeth Kay-Raining Bird and Derrick C. Bourassa report on a study entitled "Developing phonological awareness skills in children with Down syndrome", which describes the effects of a specific therapy program for children with Down syndrome.

The sixth and last paper in the current issue was authored by Rhonda L. Rubin, Joan B. Flagg-Williams, Catherine E. Aquino-Russell and Tim P. Lushington and has the title "The Classroom Listening Environment in the Early Grades." In this study, the listening and learning environment of 60 kindergarten to grade 3 classrooms was investigated with a special focus on possible benefits of sound field amplification.

There are two book reviews in this issue of the *Canadian Journal of Speech-Language Pathology and Audiology*. Gillian de Boer reviews "Building a Research Career" by Christy L. Ludlow and Raymond D. Kent, and Susan Harper reviews the fourth edition of Leonard L. LaPointe's "Aphasia and Related Neurogenic Language Disorders."

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Mot du rédacteur en chef

NUMÉRO D'HIVER

Cette édition de la *Revue canadienne d'orthophonie et d'audiologie* (RCOA) marque la fin de mon mandat de quatre ans en tant que rédacteur en chef. Cette année, la nouvelle rédactrice en chef de la RCOA sera Elizabeth Fitzpatrick, Ph.D., de l'Université d'Ottawa. Elizabeth a été la rédactrice adjointe des articles d'audiologie de 2008 à 2010; elle connait donc déjà le fonctionnement de la RCOA. Je lui souhaite le plus grand succès dans ses nouvelles fonctions.

La rédaction et la publication d'une revue nécessitent un excellent travail d'équipe, et je tiens à transmettre ma gratitude à tous mes collègues de la RCOA. J'ai eu la chance d'avoir l'appui d'une équipe de rédacteurs adjoints remarquables, formée des membres suivants (en ordre alphabétique) : Vince Gracco (parole – anglais, 2009-2011), Benoît Jutras (audiologie – français, 2008-2011), Andrea McLeod (langage – anglais, 2011), Joël Macoir (langage et parole – français, 2008-2011), Jana Rieger (parole – anglais, 2008-2009), Navid Shahnaz (audiologie – anglais, 2011) et Jeff Small (langage – anglais, 2008-2010). Les rédacteurs adjoints accomplissent une large part du travail pendant le processus d'examen, et leur contribution au contenu et à la qualité de la revue est cruciale. Je n'aurais pu demander une meilleure équipe de rédacteurs adjoints, et j'aimerais les remercier pour leur appui inébranlable, leur travail acharné et leurs contributions précieuses.

À l'Association canadienne des orthophonistes et audiologistes (ACOA), Mme Angie D'aoust, directrice des communications, a été une source constante d'appui et de soutien en ce qui a trait aux aspects opérationnels de la revue. Je suis également reconnaissant envers les rédacteurs administratifs (en ordre chronologique), Judy Gallant, Alicia Weiss, Natalie Dunleavy et Olga Novoa, pour leur aide et leur expertise concernant la façon de transformer une pile de documents en une publication. J'aimerais également remercier les adjoints à la rédaction (en ordre chronologique), Rebecca Fleming, Sophie Kuziora, Sarah Baxter, Patrick Fothergill et Suzi Dumetrescu, qui ont coordonné les examens et se sont assurés que je reste sur le bon chemin.

Enfin, j'aimerais remercier les lecteurs critiques qui ont contribué à l'examen approfondi et au contrôle de la qualité des articles soumis. L'examen par les pairs réviseurs fait partie intégrante du processus de publication scientifique, et les lecteurs consacrent une part considérable de leur temps et de leur énergie à cette tâche. Les contributions des lecteurs sont fortement appréciées par les auteurs et les rédacteurs de la revue.

J'ai trouvé intéressant et enrichissant de voir de près les engrenages internes du processus de publication. Une revue scientifique est un objet dynamique, en changement constant. Au cours des quatre dernières années, la RCOA est passée d'une publication largement sur papier à un format de publication en ligne seulement. La création du nouveau site Web de la revue et la transition à un modèle de publication libre-accès ont constitué des choix courageux pour l'ACOA. Grâce à ces mesures, la RCOA sera davantage visible et plus facile à consulter pour les lecteurs internationaux. La création des nouvelles archives de la revue et autres améliorations ont été rendues possibles par une subvention du Conseil de recherches en sciences humaines du Canada, que nous avons eu la chance d'obtenir en 2008 et qui nous a permis d'ouvrir l'accès à la revue.

Je remercie l'ACOA de m'avoir permis d'agir comme rédacteur en chef de la RCOA. J'ai pu grandir sur les plans professionnel et personnel, et j'ai eu la merveilleuse chance de connaître mes collègues et des membres de l'association partout au Canada. Et évidemment, grâce à ce rôle, j'ai pu participer aux rencontres de l'ACOA à Kananaskis (AB), à London (ON), à Whitehorse (YK) et à Montréal (QC).

Le premier article de ce numéro, soumis par Jessica Lamont, Luigi Girolametto, Carla J. Johnson, Xi Chen et Patricia L. Cleave, est intitulé « Habiletés de littératie émergente chez les enfants d'âge préscolaire avec un trouble du langage : apprenants unilingues anglais et bilingues ». Les auteurs ont examiné, grâce à des rapports de parents et à des mesures directes, les habiletés de littératie de 16 enfants avec un trouble du langage et leurs familles.

Le deuxième article est intitulé « Assessment of nine French synthesized voices based on intelligibility and quality » et a été rédigé par Patricia Côté-Giroux, Natacha Trudeau, Christine Valiquette, Ann Sutton, Elsa Chan et Catherine Hébert. Cette étude évalue l'intelligibilité de la parole produite par diverses synthèses vocales en français pour trois groupes d'auditeurs de différents âges.

Christine Meston, Mary Beth Jennings et Margaret Cheesman ont effectué une étude concernant le « Point de vue d'adultes plus âgés concernant leurs difficultés et besoins de communication pendant la conduite automobile ». Grâce à

une série de discussions de groupe, les auteurs explorent les problèmes de communication liés à l'audition en voiture.

Le quatrième article, intitulé « Reconnaissance des mots dans le bruit continu et le bruit interrompu par des locuteurs unilingues anglais et des locuteurs bilingues mandarin-anglais », a été soumis par Jianliang Zhang, Andrew Stuart et Shannon Swink. Les auteurs ont étudié la reconnaissance des mots dans les milieux silencieux et bruyants par des adultes bilingues mandarin-anglais et des adultes unilingues parlant l'anglais américain.

Patricia L. Cleave, Elizabeth Kay-Raining Bird et Derrick C. Bourassa rapportent les résultats d'une étude intitulée « Développement des habiletés de conscience phonologique chez des enfants avec le syndrome de Down », qui décrit les effets d'un programme de thérapie précis pour les enfants avec le syndrome de Down.

Le dernier article de ce volume a été rédigé par Rhonda L. Rubin, Joan B. Flagg-Williams, Catherine E. Aquino-Russell et Tim P. Lushington et s'intitule « Le milieu d'écoute en salle de classe au premier cycle du primaire ». Dans cette étude, les auteurs examinent les milieux d'écoute et d'apprentissage de 60 salles de classe de la maternelle à la troisième année, en portant une attention particulière aux avantages potentiels d'une amplification de champ.

Ce numéro de la *Revue canadienne d'orthophonie et d'audiologie* comprend également deux critiques de livres. Gillian de Boer contribue une critique de *Building a Research Career* par Christly L. Ludlow and Raymond D. Kent et Susan Harper offre une critique de la quatrième édition de l'ouvrage de Leonard L. LaPointe intitulé *Aphasia and Related Neurogenic Language Disorders*.

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Emergent Literacy Skills of Preschoolers with Language Disorders: Monolingual English versus Dual Language Learners

Habiletés de littératie émergente chez les enfants d'âge préscolaire avec un trouble du langage : apprenants unilingues anglais et bilingues

KEY WORDS
EMERGENT LITERACY
INTERVENTION
CHILDREN WITH SLI
ENGLISH LANGUAGE LEARNERS

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Abstract

This exploratory study investigated parental report and direct measures of children's emergent literacy skills. The participants were 16 families of children with specific language impairment, of whom nine were dual language learners. All children were, on average, 51 months of age and had normal sensory, socio-emotional, and nonverbal cognitive skills. The dual language learners were English dominant and had been exposed to English for an average of two years. The children participated in three standardized tests of emergent literacy skills, which included print knowledge, phonological awareness, and narrative production. Parents completed an early literacy questionnaire asking for information about their children's literacy skills and their own facilitative practices. There were no significant differences between the monolingual and dual language learning groups on any formal or informal measures of emergent literacy. Parents' ratings on five categories of the early literacy questionnaire were significantly and positively correlated with the standardized measures of emergent literacy. The results provide preliminary indications for the usefulness of an early literacy parent questionnaire in assessment protocols for preschoolers with language impairment.

Abrégé

Cette étude exploratoire a utilisé des rapports de parents et des mesures directes pour examiner les habiletés de littératie émergente d'enfants. Les participants étaient 16 familles d'enfants avec un trouble du langage, dont neuf apprenaient deux langues. Les enfants avaient en moyenne 51 mois et des capacités sensorielles, socio-émotionnelles et cognitives non-verbales normales. Les enfants bilingues étaient dominants en anglais et avaient été exposés à l'anglais depuis en moyenne deux ans. Les enfants ont participé à trois tests standardisés de leurs habiletés de littératie émergente, y compris la connaissance des lettres écrites, la conscience phonologique et la production narrative. Les parents ont rempli un questionnaire sur la littératie précoce, dont les questions portaient sur les habiletés de leurs enfants et leurs propres pratiques de facilitation. Nous n'avons trouvé aucune différence significative entre les groupes d'enfants unilingues et bilingues lors des mesures formelles ou informelles de la littératie émergente. Les évaluations des parents dans cinq catégories du questionnaire sur la littératie précoce avaient une corrélation significative et positive avec les mesures standardisées de la littératie émergente. Ces résultats fournissent des renseignements préliminaires sur l'utilité d'un questionnaire pour les parents au sujet de la littératie émergente dans le cadre des protocoles d'évaluation des enfants d'âge préscolaire avec un trouble du langage.

INTRODUCTION

A solid foundation in reading and writing is critical for children's future academic, social and vocational success. The acquisition of literacy skills develops along a continuum that begins in the preschool years, prior to formal schooling (Whitehurst & Lonigan, 1998). Emergent literacy skills include oral language, print concepts, alphabet knowledge, and phonological awareness and are normally acquired during responsive interactions with adults, such as in shared book reading or incidental conversations about print in the environment (Lonigan, Burgess, & Anthony, 2000; Paul, 2007). Two common risk factors for delays in the development of emergent literacy skills include language impairment and exposure to English as a second language (e.g., McGinty & Justice, 2009; Skibbe, Justice, Zucker, & McGinty, 2008). Consequently, speech-language pathologists require information about the literacy skills in children with language impairment who also come from homes where another language is spoken. The primary purpose of the present study was to examine emergent literacy skills in children with specific language impairment (SLI) using parent report and standardized literacy tests. A secondary purpose of this study was to examine the correlations between indirect and direct measures of emergent literacy skills. The participating children with language impairment included a group of monolingual English-speaking children and a group of dual language learners. For the purposes of this study, the term dual language learners refers to children who are learning English subsequent to learning another language in the home and may refer to simultaneous or sequential learners of English (Genesee, Paradis, & Crago, 2004). In the current study, the dual language learners were judged by their parents to be English dominant and had been exposed to English for an average of two years.

CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT

It is estimated that 7.4% of children have SLI (Tomblin et al., 1997). These children have difficulty developing expressive and/or receptive language in the absence of a delay in other areas of development and without any known underlying cause such as a syndrome, hearing impairment, or brain injury (Pennington & Bishop, 2009). Typically, children with SLI have persistent difficulties in acquiring morphosyntax, particularly verb morphology (Charest & Leonard, 2004; Leonard, Eyer, Bedore, & Grela, 1997; Rice & Wexler, 1996; Rice, Wexler, & Hershberger, 1998). Children with SLI may also experience delays in the development of phonological awareness skills, knowledge of letter names, and print concepts in comparison to typically developing peers (Skibbe et al., 2008). As children with SLI enter elementary school, it is estimated that 52 to 75% of these children exhibit problems learning to read and write (Nithart et al., 2009).

One important context in which children learn emergent literacy skills is the home environment (Boudreau, 2005). During these early experiences, many children receive their first exposure to concepts of print, letters, and sounds. In addition, through shared book reading with adults, children are exposed to narratives and how they are formed. Skibbe et al. (2008) reported that these factors, including prior exposure to print and shared book reading, greatly influence the development of children's emergent literacy skills. The importance of home literacy experiences is underscored by the finding that early experiences with reading and writing strongly predict later reading ability (e.g., Colligan, 1976; Senechal, 2006). Unfortunately, children with SLI have been reported to display limited orientation to literacy during book reading, including significantly less compliance (i.e., willingness to follow mother's directions during shared book reading), participation in fewer literacy-related activities, and a trend toward being less persistent (i.e., focusing their attention to a book) in comparison to typically developing peers (Boudreau, 2005; Skibbe et al., 2008). In turn, their parents may engage in fewer literacy practices due to their children's perceived disinterest (Boudreau, 2005). Consequently, many children with SLI may receive less than optimal exposure to literacy, contributing further to their delays in emergent literacy development.

DUAL LANGUAGE LEARNING AND EMERGENT LITERACY SKILLS

Studies focusing on dual language learners provide contradictory findings concerning the relationship between dual language learning and the acquisition of emergent literacy skills, such as letter and sound knowledge. Some studies suggest that children learning two languages may be at an initial disadvantage in acquiring emergent literacy skills. For example, dual language learning children have performed below the norm on standardized early literacy measures (Bialystok & Herman, 1999; Hammer, Miccio, & Wagstaff, 2003; Paez, Tabors, & Lopez, 2007). Other studies suggest that speaking more than one language may support the development of literacy skills (Bialystok & Herman, 1999; Hammer & Miccio, 2006). Paez et al. (2007) found that children learning Spanish and English outperformed monolingual Spanish children on phonological awareness

tasks. In a study by Kovelman and colleagues (2008), monolingual English children attending a bilingual school program performed better on a phonological awareness task than their English-speaking peers attending an English-only school program. Narrative ability is another emergent literacy skill in which contradictory findings have been reported. No differences have been found between the narrative content of stories told by monolingual children and dual language learners (Cleave, Girolametto, Chen, & Johnson, 2010; Minami, 2008; Serratrice, 2007). Where differences have been reported, the differences may be due to the influence of language and culture on narrative discourse (Fiestas & Peña, 2004). For example, bilingual English and Spanish-speaking children aged 4 to 6; 11 included more initiating event and attempt elements in their Spanish versions of a narrative based on a wordless picture book and more consequence events when telling the same story in English (Fiestas & Peña, 2004). Japanese narratives placed more emphasis on temporal action sequencing whereas English narratives emphasized evaluative comments and emotional information (Minami, 2008). Taken together, these studies indicate that dual language learners may perform similarly to monolingual children in terms of narrative skills, letter names, and phonological awareness. However, the evidence base is limited to a small number of studies and replication is needed. Moreover, while these results are suggestive of positive impact of two languages on emergent literacy skills in school age children, it is not clear whether they apply to dual language learners who are preschool age.

The current study employs an early literacy questionnaire completed by parent report to supplement information obtained from direct language testing of children's emergent literacy skills. Parent report measures are useful for gathering information that would otherwise take additional time and resources during a diagnostic language assessment. They are relatively easy to use, time and cost effective, and less sensitive than formal testing to contextual or task effects because they reflect the child's ability in a broad range of naturalistic contexts (Boudreau, 2005; Marchman & Martínez-Sussmann, 2002; Sachse & Von Suchodoletz, 2008). Parent report instruments have been used extensively to examine children's oral language skills, such as the MacArthur-Bates Communicative Development Inventory (M-BCDI), a normed questionnaire that is completed by parents to gather information about their children's vocabulary, gestures, and early language development (Fenson et al., 1993). The results of the M-BCDI have been found to be moderately correlated with objective language measures (Thal, O'Hanlon, Clemmons, & Fralin, 1999). A study examining the use of the German version of the M-BCDI concluded that parents were able to judge their toddler's expressive language development as accurately as objective tests (Sachse & Von Suchodoletz, 2008).

Parent report has also been used to collect information about the frequency of literacy-related practices in the home. Bus, van Ijzendoorn, and Pellegrini (1995) found that regardless of socioeconomic status, the reported frequency of book reading had a small but significant correlation with children's emergent literacy skills and reading achievement. Several studies found that the reported frequency of letter-based home activities predicted performance on measures of phonological awareness and letter knowledge in Kindergarten (Evans, Shaw, & Bell, 2000) and written language development in Kindergarten and Grade 1 (Senechal, LeFevre, Thomas, & Daley, 1998). Higher reported frequencies of home literacy practices (e.g., reading, pointing out print) were also significantly and positively correlated with preschooler's print knowledge (Bennett, Weigel, & Martin, 2002), receptive and expressive language development (Bennett et al., 2002), vocabulary (Griffin & Morrison, 1997) and reading in school age children (Griffin & Morrison, 1997). Although a growing number of studies have provided evidence to support the relationship between parental ratings of literacy practices and formal literacy measures, not all studies converge. For example, Evans et al. (2000) found that the frequency of shared book reading did not significantly contribute to emergent literacy skills in kindergarteners. Also, Skibbe et al. (2008) found that maternal report of literacy practices did not accurately predict print-related knowledge in monolingual English-speaking children with and without SLI, when controlled for maternal education, a measure of SES. Variation in parent report instruments may account for these disparate findings.

A parent report instrument designed specifically for families of children with language impairment was used by Boudreau (2005) to examine the emergent literacy skills of 37 monolingual preschoolers with and without language impairment between the ages of 55 – 70 months. Additionally, the study examined the concurrent validity of parent report with standardized tests to assess emergent literacy skills. Parents completed the Early Literacy Parent Questionnaire (Boudreau, 2005) that consisted of items pertaining to five constructs of children's emergent literacy knowledge and two additional categories regarding parents' facilitative behaviours and children's orientation toward literacy. Scores on four out of five of the early literacy knowledge constructs were significantly and positively correlated to formal assessment measures for children with language impairment. In comparison, weaker correlations were found for children who had typically developing language.

The current study differed from Boudreau (2005) in that it sought to use the Early Literacy Parent Questionnaire with two groups of children with SLI. One group of children consisted of monolingual English speakers and the second group of children consisted of dual language learners. In contrast with Boudreau's study, the children in the current study were younger and and consequently different standardized tests of emergent literacy were selected in order to be suitable for younger children.

This exploratory study extends the previous literature by examining the literacy skills of dual language learners using a parent questionnaire developed specifically for children with language disorders (Boudreau, 2005). The first question of this study investigated whether there were any differences in emergent literacy skills between monolingual and dual language learning children on a formal measure of letter/sound knowledge and two narrative tests. It was predicted that the dual language learners would have better letter and sound knowledge than the monolingual group. The rationale for this prediction was derived from the results of studies suggesting that children learning more than one language have phonological awareness skills that are better developed than those of monolingual speakers (Bialystok & Herman, 1999; Hammer & Miccio, 2006; Paez et al., 2007). It was also predicted that the monolingual children would outperform the bilingual children on measures of narrative ability on the two narrative tests. The rationale for this hypothesis is derived from studies demonstrating a linguistic advantage for monolingual children in vocabulary (Bialystok & Herman, 1999), complex syntax, and morphosyntactic accuracy (Pearson, 2002). The second question of this study examined whether there were differences between the two groups of children on parental ratings on an early literacy questionnaire. The predictions for this measure were that the dual language learners would outperform the monolingual children for the same reasons given above. The third question examined the relationship between parent report of children's emergent literacy skills on an early literacy questionnaire and objective data on literacy skills derived from formal test measures. It was predicted that there would be a significant correlation between indirect and direct assessment measures of emergent literacy. This prediction is based on Boudreau's (2005) study indicating that parental ratings of emergent literacy skills were significantly and positively correlated with the results of formal measures of emergent literacy skills in monolingual children with language impairment. This study is exploratory in nature due to the small sample size and because there is currently very little information available on dual language learners with SLI and their emergent literacy skills.

METHOD

Participants

Sixteen preschool-aged children with language disorders and their parents participated in this study. The families were recruited from active caseloads or waiting lists for language intervention offered by preschool speech and language services in two large metropolitan cities in central (n = 13) and eastern Canada (n = 3). All children participated in a larger study examining the efficacy of an emergent literacy intervention for preschoolers with SLI. This subgroup was selected because their parents also completed an early literacy questionnaire, which was the basis for investigation in the current study. Only the children's pretest data, collected prior to any intervention, were examined. Seven children came from homes where English was the only language heard and spoken while the remaining nine children came from homes where another language was heard and spoken 20 hours or more per week.

All children in the study had nonverbal cognitive abilities within normal limits (i.e., standard score greater than 80), as measured by the Columbia Mental Maturity Scale (CMMS) (Burgemeister, Hollander Blum, & Lorge, 1972), and a language disorder as defined by a score at least one standard deviation below the mean on the core language composite of the Clinical Evaluation of Language Fundamentals – Preschool 2 (CELF-P2; Wiig, Secord, & Semel, 2004). The latter test was administered by the referring clinicians and was used as the primary criterion for referring a child to the research project. Although not employed as selection criteria, two other measures were used to describe further the language abilities of our sample. The Structured Photographic Expressive Language Test – Preschool 2 (SPELT P2, Dawson et al., 2005) was administered to assess morphosyntactic skills. Participants earned an average standard score of 67.5 (*SD* = 13.8) on this test. In addition, based on 20-minute language samples taken at pretest, all children had a mean length of utterance in morphemes that was at least one standard deviation below the mean for their age (Miller, 1981). None of the children had sensory disabilities, oral motor problems, overt neurological problems, or socio-emotional difficulties as determined informally by the referring speech-language pathologist. For dual language learners, the diagnosis of a language disorder was also based on parental concern and report of a concomitant delay in the child's first language acquisition. The length of time the dual language learners had been speaking English to communicate averaged 25.6 months, with a range of 10.6 to 40.6 months. The home languages of these children included: Cantonese (2), Mandarin (1), Russian (1), Sinhala (1), Somali (1), Spanish (1), and Tagalog (2).

Parents reported that all dual language-learning children were dominant in English at the time of the study.

The characteristics of the children in each group are displayed in Table 1. The group consisted of 5 females and 11 males. The average age of the children was 51 months (4 years; 3 months), and ages ranged from 46 to 57 months. Most of the participants in the current study (i.e., 14) were enrolled in half- or full-day Junior Kindergarten programs at the time of the study. These programs are intended for 4-year olds and are offered by public schools in Ontario, in addition to Senior Kindergarten programs designed for 5-year olds. The hearing abilities of the children were tested by an audiologist or screened by clinic staff at the referring agency. All but one child had hearing within normal limits. This child, who was in the monolingual English group, had a screening result that was consistent with conductive hearing loss and was referred to a physician and audiologist for follow-up. Exclusion of this child's data did not make a difference to the findings and this child was included in the sample.

Table 1

Summary Variables for Children's Demographic Characteristics and Intake Measures

Child Characteristics		EL Group (*n* = 7)	DL Group (*n* = 9)
Sex	# Males / # Females	5 / 2	6 / 3
Age (mos)	Mean (SD)	51.0 (4.8)	50.8 (3.2)
	Min-Max	46-57	46-55
CMMS Standard Score	Mean (SD)	100.3 (11.8)	104.7 (8.0)
	Min-Max	82-111	95-115
CELF-P2 Core Language Standard Score	Mean (SD)	77.7 (5.4)	73.7 (7.6)
	Min-Max	71-86	57-83
SPELT – P2 Standard Score	Mean (SD)	70.4 (15.2)	65.2 (13.1)
	Min-Max	42-86	51-94
Mean Length of Utterance in Morphemes	Mean (SD)	2.6 (0.66)	2.6 (0.38)
	Min-Max	1.6-3.4	1.9-3.0

Note: EL = monolingual English-speaking children; DL = dual language learning children; CMMS = Columbia Mental Maturity Scales; CELF-P2 = Clinical Evaluation of Language Fundamentals – Preschool 2; SPELT-P2 = Structured Preschool Expressive Language Test – Preschool 2.

Table 2 summarizes the demographic characteristics of the families in terms of the parents' age, education, employment, and family composition. There were no significant differences between the monolingual English children and dual language learners for their age, CELF-P2 Core Language standard score, SPELT-P2 standard score, MLU in morphemes, mother's age, mothers' education, or father's education, *U*s = 20.5-31, *p*s = 0.232–1.0. In addition, the sex of the children was evenly distributed between the two groups, X^2 (1, N = 16) = 2.25, p = 0.134. However, there was a significant group difference for the father's age, U = 10.5, p = .040. The fathers in the dual language learner group were older than the fathers in the monolingual English group by a mean of 4.9 months.

Design and Procedures

Cognitive, language, and emergent literacy test data were obtained during two test sessions of approximately 1 hour each. During the first test session, a research assistant administered the CMMS (Burgemeister et al., 1972), the Test of Preschool Early Literacy, Subtest 1 (TOPEL; Lonigan, Wagner, Torgensen, & Rashotte, 2007), and the Renfrew Bus Story (Cowley & Glasgow, 1994). A 10-minute parent-child interaction was videotaped focusing on storybook reading. Parents received a questionnaire about the child's developmental and family history and a second questionnaire about emergent literacy practices in the home (Boudreau, 2005) to complete and return at the second test session. All questionnaires were completed in English. During the second test session, scheduled one week later, the questionnaires were collected and a research assistant administered the SPELT-P2 (Dawson et al., 2005). A second 10-minute parent-child interaction was videotaped, focusing on free play with play dough. The two 10-minute interactions were combined and transcribed to yield an estimate of the child's MLU in

Table 2

Parents' Demographic Characteristics

Child Characteristics		EL Group (*n* = 7)	DL Group (*n* = 9)
Mother's Age (Years)	Mean (SD)	34.4 (3.1)	36.9 (6.9)
	Min-Max	29-38	29-45
Father's Age (Years)	Mean (SD)	35.1 (4.0)	40.0 (4.4)
	Min-Max	30-43	34-49
Mother's Education	# High school	0	4
	# College/some university	4	2
	# University degree	3	3
Father's Education	# High school	0	3
	# College/some university	4	2
	# University degree	3	3
# Hours Non-English Language Spoken at Home	Mean (SD)	0 (0)	41.6 (11.6)
	Min-Max	0-0	26-56

Note: EL = monolingual English-speaking children; DL = dual language learning children; Father's education and age could not be collected from 1 family in the EL2 group.

morphemes. Finally, a spontaneous narrative sample was elicited using Story A3 from the Edmonton Narrative Norms Instrument (ENNI; Schneider, Dubé, & Hayward, 2005).

Measures

The Early Literacy Parent Questionnaire (Boudreau, 2005) consists of seven categories of items that examine children's emergent literacy skills and home literacy practices. The first five categories examined children's behaviours and included: *Interaction with Books*, which consisted of questions regarding behaviours shown during shared book reading (5 items); *Response to Environmental Print,* which examined children's questions and responses to signs, logos, and words in the environment (2 items); *Letter/Sound Knowledge,* which asked about children's ability to identify and/or name letters or sounds (3 items); *Phonological Awareness,* which asked about children's ability and interest in noticing or producing rhymes (4 items); and *Writing,* which consisted of items asking about children's abilities and interest in writing letters or words (5 items). Two additional categories examined: *Parents' Facilitative Behaviors,* which included what parents do to facilitate early literacy development (4 items), and *Children's Orientation to Literacy,* which consisted of questions that tapped children's interest in literacy activities (5 items). Parents were required to answer each questionnaire item by assigning a score using a 5-point Likert scale, with 1 indicating a low frequency and 5 indicating a high frequency of occurrence. A detailed description of each category is available in Boudreau (2005) who found that Cronbach's alpha for the six of the seven subscales yielded reliability coefficients of .64 - .83. The subscale containing items about what parents do to support literacy development had weak internal consistency (i.e., .38) and any results related to this subscale must be interpreted with caution.

The TOPEL (Lonigan et al., 2007), Subtest 1, Print Knowledge has 36 items that measure early knowledge about written language conventions and form, as well as letter/sound knowledge. The subtest consists of three parts. Part A contains 12 items that measure print concepts

(e.g., location of print on a page, discrimination of letters from numbers), Part B contains 10 items that measure alphabet letter and sound knowledge (e.g., names of letters and sounds that letters make), and Part C contains 14 items that measure phonological awareness. The test manual reports Cronbach's alpha for this subtest at 0.95 and test-retest reliability at 0.89.

The Renfrew Bus Story (Cowley & Glasgow, 1994) was used to elicit a story retelling from each participant. The examiner used pictures to tell a story to the child, who was then asked to retell that story. Each narrative was scored for key content elements, as per the test manual, to derive a raw Information Score.

Story A3 of the Edmonton Narrative Norms Instrument (Schneider et al., 2005) was used to elicit a spontaneous narrative from each participant. Fourteen sequenced pictures that illustrated a story were presented to the child, who then used the picture cues to generate a novel story for the examiner. This task yielded a raw score for Story Grammar elements (e.g., setting, characters, problem, resolution), determined according to the test instructions.

Transcription and Scoring. A research assistant transcribed both the ENNI and Bus Story narratives produced by the children using the Systematic Analysis of Language Transcripts (SALT; Miller & Chapman, 2002). The following reliability figures include transcripts for all 37 children with SLI participating in the parent study. Twenty percent of the narratives for both the ENNI and the Bus Story were randomly selected and transcribed by a second research assistant for reliability purposes. Both research assistants were blind with regards to the group assignment of the children and purpose of the study. Interrater reliability was calculated at the utterance boundary level (i.e., was the segmentation of utterances accurate?) and at the word level (i.e., was each word correctly transcribed?). Reliability was calculated using the following formula: number of agreements / (the number agreements + disagreements) x 100 (Sackett, 1978) and yielded 91.5% for words (n = 1929 words) and 92.2% for utterance boundaries (n = 487 utterances) for the ENNI transcripts and 91.4% for words (n = 2007 words) and 96.5% for utterance boundaries (n = 511 utterances) for the Renfrew Bus Story transcripts.

A research assistant subsequently scored the ENNI narratives for story grammar elements, according to the instructions provided by the test developers for Story A3 (Schneider et al., 2005). The Renfrew Bus Story narratives were similarly scored for information units, according to the instructions in the test manual (Cowley & Glasgow, 1994). Twenty percent each of the ENNI narratives and The Renfrew Bus Story narratives were then randomly selected and rescored by a second research assistant to provide reliability estimates. Both scorers were blind to the group assignment of the children and purpose of the study. Reliability was calculated using the same formula and the inter-rater reliability was 92% (n = 713 items) for the ENNI Story Grammar raw scores and 89% (n = 413 utterances) for the Renfrew Bus Story Information raw scores. The Kappa reliability coefficients were 0.84 for the ENNI Story Grammar raw scores and 0.77 for the Renfrew Bus Story Information Scores.

RESULTS

The results are presented in three sections. First, we provide a descriptive summary of parents' ratings on the family literacy questionnaire. Second, we compare the monolingual English children and the dual language learners to examine whether there are any group differences in parent report on the early literacy questionnaire. Also, we compare the monolingual English children and the dual language learners using a range of formal measures of emergent literacy. Third, we calculate correlations between the parents' subjective ratings on the early literacy questionnaire and objective measures of children's emergent literacy skills (e.g., print concepts, sound awareness and narrative skills). This study is exploratory in nature given the small sample sizes. Thus, the results may be used for generating hypotheses for future studies of dual language learners and may not be generalizable to all dual language-learning children receiving speech and language services.

Descriptive Summary of Questionnaire Data

The questionnaire results are first described for all families, combining the monolingual English children and the dual language learners. Descriptive statistics for the seven categories derived from the early literacy parent questionnaire are displayed in Table 3. As can be seen in Table 3, parents gave higher ratings to four categories of emergent literacy (i.e., *Book Interaction, Letter/ Sound Knowledge, Parents' Facilitative Behaviours, and Children's Orientation to Literacy*) with mean values of 3.5, 3.1, 3.4, and 3.0, respectively. These values correspond to frequency values of "occasionally" or "weekly". Parents gave lower ratings to items belonging to the category *Phonological Awareness*, which received a group mean of less than 2.0 (i.e., "rarely"). Additionally, parents also gave lower ratings to the categories *Response to Environmental Print and Writing*, with mean ratings ranging from 2.1 - 2.8 (i.e., "on occasion"). Thus, for this group of 4 – 5-year-old children, parents reported engaging in a high frequency of literacy interactions involving book reading and letter/ sound knowledge but engaged in less frequent interactions involving phonological awareness and written language.

Table 3

Summary Statistics for the Questionnaire Categories, by Group and Combined

Questionnaire Category	**EL Group** (*n*=7) Mean (SD)	**DL Group** (*n*=9) Mean (SD)	**Combined** (*n*=16) Mean (SD)
# Hours/week of book reading	3.7 (2.2)	4.3 (2.7)	4.0 (2.4)
Interaction with Books	3.5 (0.4)	3.4 (0.5)	3.5 (0.5)
Response to Environmental Print	2.6 (0.7)	2.8 (1.2)	2.7 (1.0)
Letter/Sound Knowledge	3.1 (0.9)	3.1 (1.2)	3.1 (1.0)
Phonological Awareness	1.5 (0.7)	2.1 (1.2)	1.9 (1.0)
Writing	2.1 (0.5)	2.8 (0.6)	2.5 (0.6)
Parents' Facilitative Behaviours	3.6 (0.9)	3.3 (0.7)	3.4 (0.8)
Orientation to Literacy	2.8 (0.7)	3.3 (0.7)	3.1 (0.7)

Note: EL = monolingual English-speaking children; DL = dual language learning children; Ratings of 1 = lowest frequency and 5 = highest frequency.

Group Comparisons of Children's Emergent Literacy Skills, as Assessed by Parent-Ratings

Parental ratings for monolingual English children and dual language learners were compared using a series of Mann-Whitney non-parametric tests. Non-parametric tests were used because the ratings on the 5-point rating were not parametrically distributed and the sample size was small. In response to an item on the number of hours of shared reading, parents indicated that the monolingual children participated for an average of 3.7 hours per week whereas the dual language children participated for an average of 4.3 hours per week. This difference was not significant. There also were no significant differences between the two groups on parental ratings of any of the seven emergent literacy categories. However, one category, namely *Writing*, showed a trend towards a group difference, (p = .070). In this case, more dual language learners achieved high ratings (i.e., ranging from 2.2 to 3.8) in comparison to monolingual children (i.e., ranging from 1.4 to 2.8). However, due to the small sample size, this trend in the data must be interpreted with caution.

Group Comparisons of Children's Emergent Literacy Skills, as Assessed by Standardized Measures

Next, comparisons between monolingual English children and dual language learners on a series of formal emergent literacy measures were performed using a series of Mann-Whitney non-parametric tests. In this case, non-parametric tests were used because the sample size was small and histograms revealed that the data were not normally distributed. Descriptive statistics and corresponding p values are displayed in Table 4. The results indicated no significant difference between the two groups of children for the Renfrew Bus Story

Table 4

Summary Statistics for Standardized Tests of Emergent Literacy Skills by Group

		EL Group (n = 7)	**DL Group** (n = 9)	***U*** and ***p*** levels
TOPEL Raw Score	Mean (SD)	9.71 (9.2)	13.7 (6.0)	U = 48.0
	Min-Max	4-30	4-26	p = .080
ENNI Story Grammar	Mean (SD)	6.6 (6.1)	12.3 (3.5)	U = 47.5
	Min-Max	0-16	9-19	p = .089
Bus Story Information	Mean (SD)	6.9 (2.8)	7.9 (2.1)	U = 43.5
	Min-Max	3-12	4-12	p = .199

Note: two-tailed p values; EL = monolingual English-speaking children; DL = dual language learning children; TOPEL = Test of Preschool Early Literacy; ENNI Story Grammar = Edmonton Narrative Norms Inventory Raw Score; Bus Story Information = Renfrew Bus Story Information Raw Score.

Information Score. There were trends noted for both the TOPEL ($U = 48.0, p = .080$) and the ENNI Story Grammar ($U = 47.5, p = .089$). In both cases, there were more dual language learners with high scores in comparison to the monolingual group. However, given the small sample size, it is important to exercise caution in interpreting these trends in the data.

Correlations between Formal Tests and Parent-Reported Literacy Skills and Practices

Next, correlations between the seven categories of the early literacy parent questionnaire and formal measures of emergent literacy skills were examined. The monolingual English and dual language learner groups were collapsed for these analyses because there were no significant group differences for parent ratings or formal measures, as described above. Spearman's rank correlation coefficients were used because the ratings on the Likert scale could not be assumed to be parametrically distributed. One-tailed tests were used because the hypotheses were directional and they preserved power to detect significant correlations. Table 5 displays the *r* and *p* values for these correlations.

Table 5

Spearman Rank Order Correlations between Parent's Ratings of Early Literacy and Standardized Tests of Emergent Literacy Skills

Questionnaire Categories[1]	TOPEL	ENNI	Bus Story
Interaction with Books	*r* = .009	*r* = .321	*r* = .456
	p = .487	*p* = .113	*p* = .038*
Response to Environmental Print	*r* = .380	*r* = .307	*r* = .625
	p = .073	*p* = .124	*p* = .005**
Letter/Sound Knowledge	*r* = .440	*r* = -.102	*r* = .011
	p = .044*	*p* = .353	*p* = .484
Phonological Awareness	*r* = .084	*r* = 482	*r* = .419
	p = .379	*p* = .029*	*p* = .053
Writing	*r* = -.004	*r* = .391	*r* = .186
	p = .493	*p* = .067	*p* = .245
Orientation to Literacy	*r* = .567	*r* = .198	*r* = .250
	p = .011*	*p* = .232	*p* = .176

N = 16; * one-tailed $p < .05$; ** one-tailed $p < .01$

[1] Parents' Facilitative Behaviours were not entered into the correlations due to weak internal consistency (Boudreau, 2005).

Note: TOPEL = Test of Preschool Early Literacy, Subtest 1 Raw Score; ENNI = Edmonton Narrative Norms Inventory Story Grammar Raw Score; Bus Story = Renfrew Bus Story Information Raw Score.

Several of the parental rating scale categories were associated significantly with some of the children's literacy skills as measured by standardized tests. For example, the parents' ratings for *Letter/Sound Knowledge* and *Orientation to Literacy* were positively and significantly correlated to the TOPEL ($r = .440, p = .044, R^2 = .194$ and $r = .567, p = .011, R^2 = .321,$). By standards of behavioural research, the correlation coefficients represented medium and large effect sizes, respectively, showing that the parents' ratings and the formal test measure shared 19% and 32% of their variance (Cohen, 1988). Parent reports of their children's phonological awareness skills "(i.e.,

rhyming) were positively and significantly correlated with the ENNI story grammar scores were also positively and significantly correlated with the ENNI story grammar scores (r =.482, p = .029, R^2 = .232). The correlation coefficient for this result is considered to be a medium effect size (Cohen, 1988) and showed that the two measures shared approximately 23% of their variance. Finally, parents' ratings concerning *Interactions with Books* and *Response to Environmental Print* were both significantly and positively correlated with the results of the Renfrew Bus Story Information raw score (r = .465, p = .038, R^2 = .216 and r = .625, p = .005, R^2 = .391). The two effect sizes were medium and large (Cohen, 1988), indicating shared variance of 22% and 39%, respectively. Thus, parental ratings of their children's literacy skills were related to objective measures of the children's proficiency in literacy activities.

Discussion

The first purpose of the current study was to examine the emergent literacy skills of monolingual and dual language-learning children with SLI using direct and indirect measures. Although it was hypothesized that the dual language-learning children would have stronger emergent literacy skills as measured by the TOPEL, the results did not indicate any significant differences between these two groups of preschool children on this test measuring print, letter, and sound knowledge. Moreover, the group comparisons using an indirect measure of emergent literacy, the Early Literacy Parent Questionnaire (Boudreau, 2005), were in general agreement with the results of the TOPEL and did not yield any significant group differences in children's emergent literacy skills or parental behaviours that facilitate literacy. It should be noted that many of the parent report items on the questionnaire received low ratings (see Table 3), which may reflect the children's young ages (i.e., 46 – 57 months of age) and lack of formal exposure to literacy. In comparison, the children in Boudreau's study (2005), for whom the questionnaire was devised, were somewhat older (55 to 70 months of age). Given the young ages of the children in the current study, the emergent literacy measures also differed from those used by Boudreau to be suitable to a younger age group. Thus, it is possible that group differences between dual language learners and monolingual children may emerge as children's experiences with formal literacy instruction increase. Of interest, there were two trends in the data. The overall TOPEL raw score and ratings for one questionnaire category, *Writing*, showed trends approaching significance that favoured the dual language learners. These data and the results of prior work showing advantages for dual language learners (e.g., Cardenas-Hagan, Carlson, & Pollard-Durodola, 2007; Paez et al., 2007) suggest that future research investigating the letter/ sound knowledge of these two groups of children is warranted.

The second hypothesis was that the monolingual children would have better narrative skills than the dual language learners as measured by two narrative tests. This hypothesis was not substantiated in either the story retelling task (Renfrew Bus Story) or the narrative generation task (ENNI). The lack of significant differences in narrative ability between the two groups of children in this study replicates findings in two previous studies that investigated narrative skills in dual language learners and monolingual children, although the participants in both these studies had typically developing language (Lofranco, Peña, & Bedore, 2006; Pearson, 2002). These results are also in line with those of Cleave et al. (2010), who reported no differences in the narratives of dual language learners with SLI and monolingual children with SLI. All of the dual language learners in the present study were English dominant at the time of testing, according to parent report. Thus, it appears that dual language learners with SLI who are English dominant may not be at a disadvantage when asked to produce English language narratives in comparison to a monolingual group. Of interest was a trend for the dual language learners to perform better on the ENNI story generation task only. A post hoc analysis of the parent report questionnaire was conducted to determine if there were differences between the two groups on an item that relates to story-telling ability. A significant group difference favouring dual language learners was revealed in the ratings for Item 6 concerning the frequency in which children in both groups made up stories and told them (U = 13.5, p = .040). This finding suggests that the dual language-learning children may have had more prior experience at home with the type of story generation activity required by the ENNI. If this trend is confirmed in future research, one possible hypothesis may be that story formulation in the child's two cultures and languages may lead to more complete story productions.

The second objective of this study was to examine correlations among formal and informal measures of emergent literacy skills. Five questionnaire categories yielded significant relationships with at least one of the standardized literacy tests, suggesting the potential usefulness of this parent report measure for providing information on children's emergent literacy skills. Variation in parental ratings of *Letter/ Sound Knowledge* and *Orientation to Literacy* reflected differences in TOPEL scores. The items in *Orientation to Literacy* included interest in books, requests for help in reading,

and requests for help writing, which may reflect the child's interest in letters and sounds. Letter and sound knowledge are skills that are directly assessed by items on the TOPEL. Ratings of *Interactions with Books* and *Response to Environmental Print* were positively correlated with the Bus Story Information raw score. Sample items in *Interactions with Books* included talking about pictures and making up stories, which may speak directly to the child's ability to tell a story. Items in *Response to Environmental Print* refer to the child's ability to read sight words in books and identify words on signs, which indicate an interest in reading. Indirectly, this latter category on the questionnaire may reflect a higher level of experience with storybooks and storytelling. In contrast to these findings, Boudreau (2005) found weak evidence of a relationship between the parent questionnaire and a story-retelling task. The difference may be due to the children's ages and the tasks used. The Bus Story is shorter and may be less difficult than the wordless picture book used by Boudreau (2005). Finally, variation in the average rating for *Phonological Awareness* items (i.e., rhyming) was positively correlated with the ENNI Story Grammar raw score. This association is puzzling but may be explained by an underlying factor not tapped by this study, such as cognitive processing ability or working memory skills. Both rhyming and story generation are more difficult, advanced tasks for preschool-aged children. *Writing* was not related in any significant way to the results of the standardized tests. Ratings for *Writing* were uniformly low, presumably because the preschool children in this study were not yet learning to write. The category concerned with parents' facilitative behaviours achieved low internal consistency in Boudreau's study (2005) and was not entered into the correlational analyses. In summary, the observed pattern of results provides preliminary support for using parent report of literacy and is consistent with previous findings reported by Boudreau (2005), who found similar relationships between parental ratings and children's letter/ sound knowledge. Boudreau noted that questionnaire categories focusing on phonological awareness, response to print in the environment and alphabet knowledge were highly correlated with examiner-administered measures of emergent literacy. The results of this study provide additional support for the use of parent report. The Early Literacy Parent Questionnaire is promising, not only for assessment purposes, but also because parents who are observant of their children's emergent literacy skills may be in a better position to support their children's further literacy development.

Limitations of the Study

Several limitations should be noted in interpreting these findings. First, the sample size of this study was small, reducing the study's ability to detect significant differences. A larger sample size might have revealed larger group differences and additional correlations between parental report and direct testing. Conversely, some of the observed trends and significant correlations may not be replicated with a larger sample. Particular caution must be used in interpreting any trends in the data as they apply to dual language and monolingual preschoolers with SLI.

Second, the dual language learners in the current study were dominant in English and had been speaking English for approximately two years. The length of time the dual language learners had been exposed to English was highly variable, from 10 to 40 months. Moreover, all parents were able to read and complete the parent questionnaire without the assistance of a translator or interpreter. It is possible that clearer group differences would emerge in a more cohesive group of dual language learners with different characteristics (e.g., less exposure to English) or home backgrounds.

Third, the addition of a group of typically developing children would have provided a valuable reference group for comparison to the children with SLI. This would have helped to create a more complete snapshot of the literacy skills of the monolingual and dual language children with SLI.

Clearly, more research is needed to investigate the literacy skills of dual language and monolingual preschoolers. Future studies need to replicate and extend the pattern of correlations between the early literacy parent questionnaire and standardized tests of literacy. In addition, it will be important to examine the emergent literacy skills of monolingual and bilingual children using larger sample sizes to determine similarities and differences in their literacy profiles.

Clinical Implications

The parent rating scale used in this study to assess home literacy practices and children's emergent literacy skills shows promise as an assessment procedure. The pattern of correlations in the current study, together with the data from Boudreau (2005), suggests that parents provide useful information about their children's early literacy skills. Future research in using the scale should investigate the ability of this rating scale to capture outcomes of treatment.

CONCLUSION

In conclusion, the Early Literacy Parent Questionnaire (Boudreau, 2005) provided valuable information

about the emergent literacy skills of monolingual and dual language learning children with SLI. When used in conjunction with formal measures, it may provide additional insight on preschool children's home literacy environments and emergent literacy skills. For clinicians working with multicultural clients, having tools that they can administer to monolingual and bilingual families to collect emergent literacy data is valuable for capturing children's abilities in their home environments.

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MOTS CLÉS
TROUBLE SÉVÈRE DU LANGAGE
SUPPLÉANCE À LA COMMUNICATION ORALE
SYNTHÈSES VOCALES FRANCOPHONES
INTELLIGIBILITÉ
APPRÉCIATION
VOIX HUMAINE
ÂGE

Évaluation de neuf synthèses vocales françaises basée sur l'intelligibilité et l'appréciation

Assessment of nine French synthesized voices based on intelligibility and quality

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Introduction : Grâce à l'avancement de la technologie dans le domaine de la communication humaine, plusieurs synthèses de voix françaises ont vu le jour. Celles-ci sont de plus en plus recommandées par les spécialistes pour les personnes atteintes de troubles de la communication. L'objectif de ce projet est d'identifier les synthèses de voix francophones les plus intelligibles selon la condition de production (mots, phrases) et d'évaluer l'appréciation de ces différentes voix. Méthode : Soixante et un participants répartis en trois groupes d'âge (14-20 ans, n = 20; 21-40 ans, n = 20; 41-60 ans, n = 21) ont été recrutés. La tâche consistait 1) à identifier des mots (isolés et contenus dans des énoncés) produits par neuf synthèses vocales et par une voix humaine dans deux conditions (mots isolés et mots en contexte) et 2) à donner leur appréciation globale pour chaque synthèse vocale. Résultats : Les résultats des analyses statistiques démontrent qu'il n'y a pas d'effet de genre ou d'âge sur l'intelligibilité et l'appréciation des synthèses vocales. La performance est plus élevée pour les mots en contexte (90%) comparativement aux mots isolés (71%). De plus, les résultats révèlent que deux synthèses vocales en condition de mots isolés (> 84%) et cinq en condition de mots en contexte (> 92%) sont aussi intelligibles que la voix humaine. Une différence significative a été trouvée entre les niveaux d'appréciation attribués aux synthèses vocales. Il existe également une corrélation positive entre l'intelligibilité des productions de mots et l'appréciation subjective de ces productions. Conclusion : Cette étude met en évidence une hiérarchie de l'intelligibilité et du niveau d'appréciation des différentes synthèses vocales francophones permettant aux professionnels d'obtenir des balises objectives pouvant les guider lors de l'attribution de systèmes et logiciels de communication relatifs à chaque client.

Abstract

Introduction: Technological advancements in human communication have led to the development of several French synthesized voices, which specialists are recommending more and more often to people with communication disorders. This study aimed to determine which French synthesized voice was the most intelligible in various productions (words, sentences), and to assess people's ratings of these voices. Method: We recruited sixty-one participants and split them into three age groups (14-20 years, n = 20; 21-40 years, n = 20; 41-60 years, n = 21). The task consisted of 1) identifying words (in isolation and utterances) produced by nine synthesized voices, as well as words produced by one human voice (in isolation and in context); and 2) giving an overall rating to each synthesized voice. Results: Statistical analysis shows no effect of sex or age on intelligibility or voice rating. The best performance was noted with words in context (90%) as compared to isolated words (71%). In addition, results indicate that two synthesized voices producing words in isolation (> 84%) and five synthesized voices producing words in context (> 92%) were equally as intelligible as the human voice. We noted a significant difference between the rating levels given to the synthesized voices. There was also a positive correlation between the intelligibility of the produced words and the subjective ratings given to these productions. Conclusion: This study outlines a hierarchy in the intelligibility and rating levels of various French synthesized voices, which will give professionals objective benchmarks to guide decision-making when they recommend communication systems and software to their clients.

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INTRODUCTION

Une synthèse vocale (ou voix synthétique) implique un processus informatique de composition sonore permettant la transformation d'un texte en voix artificielle (Dutoit, Couvreur, Malfrère, Pagel, & Ris, 2002). Plusieurs générations de synthèses vocales (TTS; text-to-speech synthesizer) ont vu le jour depuis quelques décennies (Klatt, 1987; Mirenda & Beukelman, 1990; Breen, 1992). La première, appelée « synthèse vocale par formant », fit son entrée dès 1965 et demeura populaire jusqu'au milieu des années 80. En s'appuyant sur des algorithmes, cette technique permet de générer un signal sonore synthétique à l'aide des caractéristiques spectrales d'un signal de parole naturel. La deuxième génération constituée de voix de synthèse semi-synthétiques fut développée afin d'entreposer de façon permanente des bribes de parole naturelle dans une mémoire informatique. Cette méthode, plus précisément appelée « synthèse vocale par diphones, ou modèle à concaténation », consiste à unir des segments élémentaires de parole naturelle afin de former n'importe quel énoncé synthétique voulu (Dutoit et coll., 2002).

On assiste aujourd'hui à l'émergence d'une nouvelle génération de synthèse vocale à diphones élaborée avec une technique de « sélection d'unités de parole dans une grande base de données » (Hunt & Black, 1996; Dutoit, 2002). Afin de représenter le plus fidèlement possible la coarticulation et la prosodie unique à chaque voix, l'échantillonnage d'une même unité phonétique se fait à partir de plusieurs enregistrements contenant cette unité.

L'utilisation des synthèses vocales demeure une application importante dans des appareils de communication pour les personnes ne pouvant pas communiquer par la parole naturelle à cause d'un trouble moteur (ex. la paralysie cérébrale) ou langagier. Il est souvent recommandé que les appareils de suppléance à la communication intègrent une synthèse vocale (voir Beukelman & Mirenda, 2005, pour un survol du domaine). Cette pratique permet à la personne de communiquer par la modalité orale rendant ainsi sa communication plus « naturelle ». Or, l'utilité de l'appareil intégrant une voix dépend en grande partie de la qualité de la synthèse vocale. La communication par le biais de l'appareil est plus efficace si la parole produite par la synthèse vocale est comprise par l'interlocuteur et encore plus si ce dernier trouve la voix agréable à écouter. Les personnes qui souhaitent se procurer une aide technique de suppléance à la communication (SC) incluant une synthèse vocale doivent choisir parmi un large éventail de technologies. L'actualisation des données sur l'intelligibilité et l'appréciation des voix synthétiques disponibles présentement sur le marché est nécessaire afin de guider les intervenants dans la recommandation et le choix d'une synthèse vocale.

Les mots ou énoncés produits en dehors de tout contexte sont intelligibles lorsque l'interlocuteur les identifie correctement. Plus spécifiquement, l'intelligibilité correspond à la façon plus ou moins appropriée (claire et accessible) dont le signal acoustique est transmis (Drager & Reichle, 2001). L'intelligibilité des voix de synthèse s'évalue en demandant aux participants de transcrire leurs réponses dans un formulaire (Pisoni, Nusbaum, & Greene,1985; Manous, Pisoni, Dedina, & Nusbaum, 1986; Crabtree, Mirenda, & Beukelman, 1990; Mirenda & Beukelman, 1990; Hustad, Kent, & Beukelman, 1998; Gong & Lai, 2001; Roring, Hines, & Charness, 2007), de répéter le stimulus entendu (Mirenda & Beukelman, 1990; Von Berg, Panorka, Uken, & Qeadan, 2009) ou de répondre à des questions précises concernant le stimulus présenté (Pisoni et coll., 1985; Drager & Reichle, 2001).

Pour ce qui est d'évaluer l'appréciation des voix de synthèse, on demande aux participants de juger le stimulus entendu selon une échelle d'appréciation (Nass & Lee, 2001; Ratcliff, Coughlin, & Lehman, 2002; Von Berg et coll., 2009). Toutefois, apprécier globalement une voix selon une échelle numérique pourrait ne pas refléter précisément la qualité de celle-ci.

Par ailleurs, le contexte dans lequel sont présentés les stimuli influence l'intelligibilité (Mirenda & Beukelman, 1987, 1990; Winters & Pisoni, 2003, 2004). En effet, l'auditeur compenserait une faible intelligibilité des synthèses vocales en utilisant les informations linguistiques supplémentaires fournies par le contexte, ce qui n'est pas le cas lorsque des mots isolés sont entendus. Plusieurs situations d'écoute ont été utilisées dans les recherches afin de mesurer l'impact de facteurs contextuels sur l'intelligibilité de la voix humaine et des voix de synthèses. Certaines expérimentations ont été effectuées en émettant des stimuli en présence de bruit ambiant (Drager et coll., 2007), en modifiant la longueur et la complexité des énoncés entendus (Higginbotham, Drazek, Kowarsky; Scally, & Segal, 1994; Venkatagiri, 1994), en misant sur la prévisibilité des phrases (revu par Drager & Reichle, 2001) ou encore en contrôlant le débit des stimuli (mots isolés ou phrases) (Higginbotham, 1994). Les résultats de ces études ont montré à quel point le contexte dans lequel les stimuli sont présentés influence les performances des auditeurs.

Des caractéristiques de l'interlocuteur peuvent aussi influencer l'intelligibilité d'une synthèse vocale entendue. L'âge en est une chez des auditeurs adultes. Toutefois, les résultats des études n'arrivent pas aux mêmes conclusions. D'une part, certaines recherches montrent que l'âge n'est pas un facteur déterminant pour une bonne identification

de stimuli produits synthétiquement (Mirenda & Beukelman, 1990; Humes, Nelson, Pisoni, & Lively, 1993) et d'autre part, il y a celles qui concluent que l'âge joue un rôle dans la perception auditive des synthèses vocales (Kangas et Allen, 1990; Roring et coll., 2007). Certains facteurs peuvent expliquer ces divergences. D'abord, la complexité des stimuli peut avoir entraîné ces différences dans le sens où certains mots, méconnus des participants moins âgés, peuvent avoir été jugés inintelligibles. D'autre part, l'écart d'âge au sein et entre chaque groupe d'âge peut influencer les résultats. En effet, les équipes ayant comparés des groupes plus étendus en âge (enfant, adolescents, jeunes adultes et adultes plus âgés) montrent généralement moins d'effet d'âge que ceux ayant comparé seulement des adultes plus ou moins jeunes. Ceci pouvant être expliqué par d'autres facteurs tels l'audition ou le milieu socio-économique qui viennent interagir avec les performances de ces adultes et qui ont moins d'impact chez les groupes de participants plus jeunes. Roring et coll. (2007) ont montré que le contexte a une influence sur les performances des participants en fonction de leur âge. Les jeunes adultes comprenaient mieux les voix de synthèse lors de l'écoute de mots isolés que les personnes âgées. Toutefois, cette différence de performances entre les groupes n'existait plus lorsqu'un contexte était fourni (Roring et coll., 2007). De plus, Kangas et Allen (1990) ainsi que Humes, Nelson et Pisoni (1991) rapportent qu'une perte auditive chez les adultes ou personnes âgées module la perception des synthèses vocales. Ces derniers ont rapporté que l'identification adéquate des stimuli par les personnes âgées est corrélée négativement à la perte auditive. De plus, selon l'équipe de Lai (2000), une meilleure identification des productions des voix de synthèse a été observée lorsqu'elles sont écoutées par des participants ayant atteint un plus haut niveau de scolarité. Toutefois, cet effet du niveau de scolarité pourrait être dû à la méthodologie utilisée. La moitié des participants devaient prendre des notes pendant l'écoute des voix de synthèse. Une prise de note efficace pouvait être influencée par un plus haut niveau de scolarité et pouvait par le fait même contribuer à une meilleure identification des productions des voix. L'expérience antérieure avec une synthèse vocale (degré d'exposition) ainsi que l'effet d'entraînement seraient des facteurs non négligeables puisque tous deux sont corrélés positivement avec une meilleure intelligibilité des productions synthétiques (Schwab, Eileen, Nusbaum, Howard, Pisoni & David, 1985; Koul, 2003; Lai, Wood, & Considine, 2000). Finalement, le genre des participants ne serait pas associé à l'identification correcte des stimuli produits par les synthèses vocales (Gong & Lai 2001; Ellis, Spiegel, & Benjamin, 2002; Roring et coll., 2007).

Certaines études démontrent que les synthèses vocales anglaises sont moins intelligibles que la voix humaine (Mirenda & Beukelman, 1987; Koul & Allen, 1993). Cela peut être dû au fait que les synthèses vocales étudiées étaient d'anciennes générations et, par conséquent, moins intelligibles que celles qui se retrouvent maintenant sur le marché. De plus, comme les indices prosodiques de ces voix de synthèse étaient parfois absents ou peu naturels, il est possible que l'écoute de ces synthèses vocales comparée à celle de la voix humaine exigeait davantage d'attention de la part des participants. La prosodie du discours est un élément important permettant une meilleure identification des productions d'une synthèse vocale (Schroder, 2001). Elle réfère à la modulation de la hauteur (fréquence fondamentale) et de l'intensité de la voix, aux pauses, silences et hésitations de la parole ainsi qu'à la durée syllabique (Bourhis, 2010).

La majorité des études sur l'intelligibilité des synthèses vocales portent sur la langue anglaise. Toutefois, une étude de Trudeau, Chaput, Sutton, Chan et Contardo (2006) a évalué l'intelligibilité des synthèses vocales françaises utilisées à cette époque. Ces auteurs ont demandé aux participants d'écrire le mot-cible après l'avoir écouté dans deux conditions de présentation : sans contexte (mots isolés) et avec contexte (mots en fin de phrase). Le nombre de mots correctement écrits était calculé pour les deux conditions. Ces auteurs ont constaté que le nombre de bonnes réponses était plus élevé pour la voix humaine (85% - mots isolés et 96% - mots en contexte) par rapport aux voix synthétiques Pierre de L&H (76-91%), Robert (74-95%) et Cathy (69-92%) de Digalo (les trois voix les plus intelligibles). Les autres synthèses vocales à l'étude avaient une moyenne de bonnes réponses de moins de 51% pour les mots isolés et de 81% pour les mots en contexte. L'avancée technologique ayant favorisé l'émergence de nouvelles voix de synthèse, les résultats de cette étude sont maintenant jugés désuets. Les nouvelles voix de synthèse disponibles sur le marché doivent être évaluées afin de promouvoir leur utilisation auprès de la clientèle atteinte de déficience motrice ou langagière.

L'identification adéquate des mots prononcés par une synthèse vocale (son intelligibilité) ne reflète en rien l'appréciation de la voix par les interlocuteurs. En effet, une voix de synthèse peut être identifiée correctement sans pour autant être naturelle ou agréable à entendre. L'appréciation est une notion subjective dont la définition varie. Pour certains chercheurs, il s'agit du naturel d'une voix et de l'attraction qu'elle exerce sur l'interlocuteur (Nusbaum, Francis & Henly, 1995; Paris, Thomas, Gilson & Kincaid, 2000. Pour d'autres, elle se définit par la qualité des contours mélodiques du discours produit (Terken, 1993; Winters & Pisoni, 2004). Dans les études portant sur l'appréciation des synthèses vocales, les participants

devaient juger subjectivement chaque voix et ce, dans différentes conditions de présentation des stimuli : voyelles (Nusbaum et coll., 1995), mots isolés (Humes et coll., 1993), mots en contexte (Trudeau, Chaput, Sutton, Chan, & Contardo, 2006) ou en paragraphe (Crabtree et coll., 1990; Nass & Lee, 2001; Ratcliff et coll., 2002; Von Berg et coll., 2009). Les résultats de ces études convergent avec les résultats des études sur l'intelligibilité et montrent que les participants préfèrent la voix humaine aux synthèses vocales. Les travaux réalisés sur l'appréciation des voix artificielles mettent de l'avant l'importance des indices suprasegmentaux dans l'évaluation subjective des voix (Nusbaum et coll., 1995; Paris et coll., 2000).

En ce qui concerne l'appréciation des synthèses vocales françaises dans l'étude de Trudeau et coll. (2006), les participants devaient donner une cote globale représentant leur appréciation de la voix après l'écoute de chaque stimulus. Les voix artificielles se sont révélées peu appréciées des participants : tandis que la voix humaine obtenait une cote d'appréciation moyenne de 4,3 sur 5, les six synthèses vocales obtenaient des cotes beaucoup plus faibles (< 3,1). À intelligibilité semblable, une synthèse vocale peut être préférée à une autre, il est donc important de prendre aussi en considération l'appréciation lors du choix d'un appareil.

LA PRÉSENTE ÉTUDE

Bien que les études menées sur les synthèses vocales anglophones fournissent des indices à propos de leur intelligibilité et de leur appréciation, ces résultats ne sont pas directement applicables aux synthèses vocales francophones. Les deux langues ne partagent pas les mêmes structures phonologiques, syllabiques et prosodiques. De plus, puisque les produits diffèrent d'une langue à l'autre, l'utilité des données sur la qualité des voix de synthèse en anglais est faible pour les cliniciens francophones souhaitant recommander une synthèse vocale à leurs clients. L'étude de Trudeau et coll. (2006) peut servir de modèle. Pour tenir compte de facteurs pouvant influencer l'intelligibilité tels que l'âge et l'acuité auditive, les participants ont été répartis selon trois groupes d'âge (14-19 ans, 20-39 ans, 40-60 ans), équilibrés pour le genre et n'ayant pas de trouble d'audition. Les stimuli ont été présentés dans deux conditions d'écoute (mots isolés et mots en fin de phrase). De plus, nous avons bonifié la tâche d'appréciation de Trudeau et coll. (2006) pour rendre plus naturel le contexte fourni (texte continu versus phrase simple) et avons demandé aux participants d'élaborer leur appréciation en choisissant des qualificatifs pour chaque synthèse vocale, en plus de donner une cote globale.

L'objectif de la présente étude est d'identifier quelles synthèses de voix francophones (françaises et québécoises) féminines ou masculines sont les plus intelligibles et les plus appréciées. Nous croyons que l'intelligibilité varie d'une voix à l'autre, que la présence d'un contexte linguistique facilite l'identification des mots et que les participants apprécieront les voix qui sont plus intelligibles (ils devraient préférer des voix qu'ils arrivent à mieux saisir). Par contre, à intelligibilité égale, l'appréciation pourrait varier d'une voix à l'autre.

MÉTHODES

Participants

Soixante et un participants répartis en trois groupes d'âge (A : 14-19 ans, moyenne=16 ans, n=20; B : 20-39 ans, moyenne=29, n=20; C : 40-60 ans, moyenne=51, n=21), dont 25 hommes et 36 femmes ont été recrutés par des affiches posées dans des endroits publics sur un campus universitaire. Les critères d'inclusion étaient a) avoir comme langue d'usage le français; b) ne pas avoir de trouble de langage ou d'audition et c) ne pas avoir d'expérience avec des appareils de communication incorporant une synthèse vocale. Cinquante huit des soixante-et-un participants avaient comme langue maternelle le français et tous avaient le français comme langue d'usage. Afin d'évaluer le deuxième critère, le participant était soumis à un dépistage auditif sous écouteurs à 500, 1000, 2000 et 3000 Hz. Le critère d'exclusion était un seuil supérieur à 25 dB pour une fréquence aux deux oreilles. Deux participants ont obtenu des seuils entre 30 et 50 dB pour deux et trois fréquences à une oreille. Ils ont tout de même participé à l'expérimentation, puisque celle-ci se déroulait en champ libre.

Tâche d'intelligibilité

Stimuli et conditions. Les stimuli étaient les 112 mots utilisés dans l'étude de Trudeau et coll. (2006). Il s'agissait de noms communs monosyllabiques, comportant les 16 consonnes de la langue française, en position initiale et finale de mot (pour consulter la liste des stimuli, voir Trudeau et coll., 2006). Comme le nombre de synthèses incluses dans l'étude actuelle (10) est supérieure au nombre de synthèses utilisées par Trudeau et coll. (7), 48 mots on dû être répétés afin que chaque synthèse produise 16 mots (ce qui permet la production de chaque consonne en position finale et initiale de mot). Compte tenu du fait qu'il n'y avait pas d'effet de mot dans l'étude antérieure, les mots répétés ont été choisis aléatoirement et les blocs de 16 mots ont été équilibrés phonétiquement. De cette façon, toutes les consonnes du français ont été utilisées le même nombre de fois en début et en fin de mot au sein d'un même bloc. Chacune des 10 voix produisaient 16 mots isolés et 16 mots mis en contexte pour un total de

320 stimuli. La liste complète de stimuli dans les deux conditions était présentée dans un ordre aléatoire afin d'éviter un effet d'entraînement lors des séances. De plus, dix versions équivalentes de la liste ont été conçues et réparties également au sein des 61 participants afin que tous les mots puissent être dits par chaque synthèse vocale.

Matériel et équipement

Neuf voix synthétiques ainsi qu'une voix humaine québécoise ont été utilisées dans cette étude (Tableau 1) : Bruno et Louise de Acapela, Juliette de AT&T Labs Inc., Pierre de L&H, Charlotte et Olivier de Loquendo, Félix, Virginie et Sophie de Nuance RealSpeak. Les compagnies développant ces synthèses vocales sont des chefs de file européens et américains dans le domaine des communications, tant au plan médical qu'au plan informatique. Les voix de synthèse ont été choisies en fonction de leur fréquente utilisation dans le domaine des troubles du langage, de leur coût varié, de leurs différents accents (québécois et français) et de leur genre (voix d'homme ou de femme). Toutes les voix de synthèse évaluées dans cette étude sont des voix élaborées à partir d'une sélection d'unités de parole dans une grande base de données, sauf celle de Pierre. Bien que cette dernière appartienne à une génération plus ancienne de synthèses vocales, elle a été reprise dans cette étude puisqu'elle a été cotée comme étant la plus intelligible et la plus appréciée dans l'étude de Trudeau et coll. (2006). Chaque item (mot isolé ou mot dans une phrase), programmé pour être dit par chaque voix, a été enregistré dans le logiciel Goldwave (version 5.51). Ensuite, les items ont été entrés dans le logiciel SD Pro (version 6.1) ou dans le logiciel The Grid (version 2.4). Les listes de 320 stimuli ont été conçues et lus par le logiciel Windows Media Player. Les paramètres par défaut (volume et débit) de chaque synthèse vocale ont été choisis pour l'enregistrement. Toutes les manipulations reliées au projet ont été effectuées avec un ordinateur portable Toshiba Notebook.

Procédure

Après une familiarisation à la tâche, pour chaque essai, le participant écoutait le stimulus présenté en champ libre à travers les haut-parleurs de l'ordinateur et inscrivait sur la feuille réponse le mot (condition du mot isolé) ou le dernier mot de la phrase (condition du mot en contexte). L'expérimentatrice contrôlait la présentation des stimuli

Tableau 1.

Caractéristiques des synthèses vocales incluses dans l'étude

Voix/nom de la synthèse vocale	Caractéristiques		
	Compagnie	Genre	Dialecte
Humaine	N/A	M	Québécois
Louise	Acapela	F	Québécois
Virginie	Nuance (RealSpeak)	F	Français
Sophie	Nuance (RealSpeak)	F	Français
Bruno	Acapela	M	Français
Olivier	Loquendo	M	Québécois
Juliette	AT&T Labs Inc.	F	Français
Charlotte	Loquendo	F	Québécois
Félix	Nuance (RealSpeak)	M	Québécois
Pierre	L&H	M	Français

et attendait que le participant lui indique qu'il était prêt avant d'envoyer chaque stimulus.

Tâche d'appréciation

Stimuli. Quatre paragraphes inspirés de Chesneau (2007) ont été créés pour la tâche d'appréciation. Ils ont été choisis pour représenter le plus fidèlement possible un contexte naturel d'écoute entre le participant et un utilisateur d'aide technique de suppléance à la communication. Ils contenaient cinq ou six phrases pour un total de 75 à 90 mots et avaient une structure similaire (Annexe A).

Matériel et équipement. Les voix synthétiques et humaine de la tâche d'intelligibilité ont été utilisées pour la tâche d'appréciation. Chaque paragraphe, d'une durée approximative d'une minute, a été produit par chacune des 10 voix. Dix versions différentes du test ont été conçues de manière à varier l'ordre de présentation des voix et les paragraphes attribués à chaque voix. Chaque paragraphe devait être présenté au moins une fois et au plus trois fois dans chaque version du test.

Procédure. Une mise en situation a été présentée au participant : «*Imaginez-vous que la voix entendue est la voix que votre frère ou votre sœur va devoir utiliser à la suite d'un accident ou d'une chirurgie. Sur une échelle de 1 à 7, à quel point aimeriez-vous qu'il ou elle ait cette voix? 1= pas du tout, 4= moyennement et 7= beaucoup.*» Ensuite le participant écoutait le paragraphe et jugeait la voix de deux façons : premièrement en attribuant une cote globale d'appréciation sur 7 et deuxièmement, en qualifiant la voix parmi des adjectifs bipolaires tels que chaleureuse ou froide, dure ou douce, monotone ou expressive et fluide ou saccadée sur une feuille réponse préparée préalablement à cet effet.

Procédure générale

L'approbation du comité d'éthique du CHU Sainte-Justine a été obtenue avant le recrutement des participants. Tous les participants ont été vus individuellement ou en groupe de deux, dans un local isolé et calme, mais où les sources de bruits de fond étaient tout de même présentes (i.e. ventilation, corridor adjacent, ordinateur). La séance a été menée par une expérimentatrice ayant reçu une formation afin d'administrer correctement le protocole. Dès son arrivée, le participant remplissait le formulaire d'information et de consentement ainsi que deux questionnaires d'informations générales. Les participants de moins de 18 ans devaient avoir obtenu le consentement d'un parent pour participer au projet. À la suite du dépistage auditif, la tâche d'intelligibilité a été administrée, puis celle d'appréciation. Cet ordre a été choisi afin d'éviter que l'écoute des voix dans la tâche d'appréciation précède celle de l'intelligibilité, ce qui aurait pu aider à reconnaître plus clairement les voix de synthèse, contribuant ainsi à augmenter le pourcentage de bonnes réponses. Le participant a été muni de feuilles réponses préalablement conçues pour chaque tâche. À la suite de la séance, une compensation de 20$ a été remise au participant afin de couvrir les frais de déplacement.

Analyses statistiques

Intelligibilité. Les réponses correctes de chaque participant ont été codées avec un score de 1 et les réponses erronées avec un score de 0. La réponse a été considérée correcte si elle correspondait parfaitement à la cible phonétique entendue. Les fautes d'orthographe n'étaient pas considérées comme des erreurs. Le total des réponses correctes pour chaque participant (dans chaque condition et pour chacune des dix voix) a été calculé. Une analyse de variance à mesures répétées avec deux facteurs inter-sujet (groupe et genre) et deux facteurs intra-sujet (conditions et voix) a été effectuée afin d'évaluer l'effet de ces variables et leur interaction sur l'intelligibilité des mots et énoncés présentés.

Appréciation. Une analyse de variance à mesures répétées utilisant les mêmes facteurs inter-sujets et un seul facteur intra-sujet (voix) a été effectuée afin de comparer la cote moyenne accordée par les participants à chaque voix. De plus, des tests Khi carré ont permis d'étudier le lien entre le niveau d'appréciation et les quatre caractéristiques pouvant être attribuées aux voix. Ensuite, une analyse de corrélation bivariée a permis d'explorer la relation entre l'intelligibilité et l'appréciation des synthèses vocales.

RÉSULTATS

Les données brutes pour chaque groupe, condition et tâche sont présentées à l'annexe B. Les analyses concernant l'intelligibilité montrent une absence d'effet d'âge et de genre et un effet significatif de voix, de condition ainsi qu'une interaction entre ces deux paramètres (Figure 1 et Tableau 2).

En général, les mots en contexte sont plus intelligibles que les mots isolés (90 versus 71%). Des comparaisons par paires révèlent des regroupements de voix selon leur intelligibilité dans les deux conditions pour les scores moyens (maximum = 16). Sans contexte, les différences permettent de regrouper les voix en cinq sous-groupes, des plus intelligibles au moins intelligibles: la voix humaine (14,31) et Louise (14,25) sont significativement plus intelligibles que toutes les autres voix sauf la voix Virginie (13,43); les voix Virginie, Sophie (12,51), Bruno (12,39) et Olivier (12,15) sont significativement plus intelligibles que les voix Juliette (11,18), Charlotte (10,48), Félix (8,56) et Pierre (3,95); les voix Juliette et Charlotte sont significativement plus intelligibles que les voix Félix et

Tableau 2.

Résultats de l'ANOVA pour les données sur l'intelligibilité des synthèses vocales

Variables	F	ddl	ddl erreur	p
Âge	0,36	2	46	0,69
Genre	0,11	1	46	0,74
Voix	129,03	9	414	< 0,001
Condition	525,7	1	46	< 0,001
Voix X Condition	23,05	9	38	< 0,001
Voix X Âge	0,598	18	78	0,89
Voix X Genre	1,07	9	38	0,406
Condition X Âge	0,283	2	46	0,755
Condition X Genre	0,065	1	46	0,80
Voix X Âge X Genre	0,981	18	78	0,489
Voix X Âge X Condition	0,844	18	78	0,645
Voix X Genre X Condition	0,364	9	38	0,945
Condition X Âge X Genre	0,465	2	46	0,631
Voix X Contexte X Âge X Genre	0,635	18	78	0,861

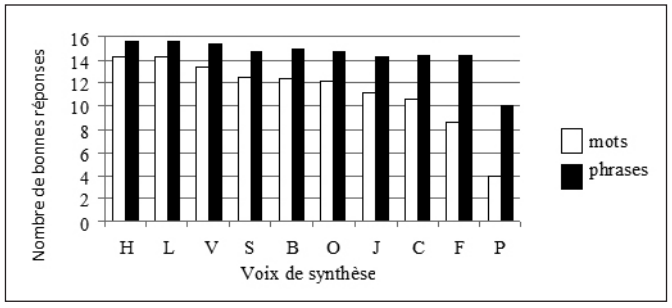

Figure 1.
Intelligibilité. Nombre moyen de bonnes réponses (maximum = 16) pour chaque voix.
Note. H = voix humaine; L = Louise; V = Virginie; S = Sophie; B = Bruno; O = Olivier; J = Juliette; C = Charlotte; F = Félix; P = Pierre

Pierre; et la voix Félix est significativement plus intelligible que la voix Pierre.

Avec contexte, les différences d'intelligibilité permettent de regrouper les voix en trois sous-groupes : la voix humaine (15,52) et les voix Louise (15,57), Virginie (15,31), Sophie (14,74) et Bruno (14,93) sont significativement plus intelligibles que toutes les autres voix sauf la voix Olivier (14,75); et les voix Olivier, Juliette (14,23), Charlotte (14,39) et Félix (14,38) sont significativement plus intelligibles que la voix Pierre (9,98). Dans les deux conditions, il y a une voix dont l'intelligibilité chevauche deux sous-groupes. Dans la condition sans contexte, la voix Virginie n'est pas significativement différente des voix les plus intelligibles (la voix humaine et Louise) ni des voix Sophie, Bruno et Olivier. Dans la condition avec contexte, la voix Olivier n'est pas significativement différente de toutes les autres voix sauf de la voix Pierre. L'apport du contexte est plus prononcé pour les voix les moins intelligibles. Une corrélation négative très forte (r = -0,94, p < 0,001) est observée entre l'augmentation du score moyen entre les deux conditions (i.e., la différence des deux scores) et le score moyen sans contexte.

Tableau 3.

Résultats de l'ANOVA pour les données sur l'appréciation des synthèses vocales

Variables	F	ddl	ddl erreur	p
Âge	1,73	2	54	0,187
Genre	0,36	2	54	0,550
Voix	62,28	9	486	< 0,001
Voix X Âge	0,968	18	76	0,504
Voix X Genre	1,516	9	37	0,179
Voix X Âge X Genre	1,105	18	76	0,421
Âge X Genre	0,595	2	54	0,556

En ce qui concerne l'appréciation, l'analyse montre l'absence d'effet d'âge et de genre ainsi qu'un effet significatif de voix (Figure 2 et Tableau 3).

Des comparaisons par paires démontrent des différences significatives des cotes moyennes (maximum 7) qui permettent de former six sous-groupes selon les résultats relatifs à l'appréciation : la voix humaine (5,74) est significativement plus appréciée que toutes les autres voix sauf la voix Virginie (5,65); la voix Virginie est

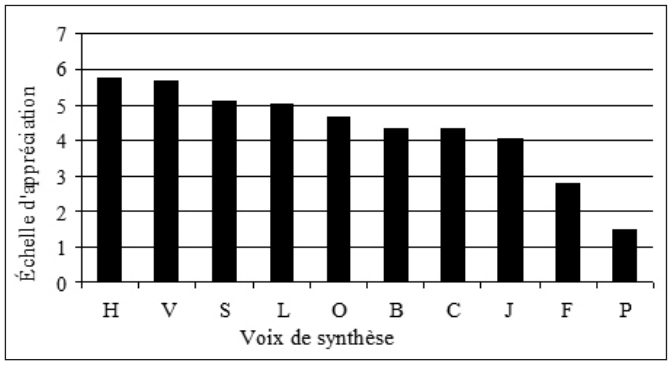

Figure 2.
Appréciation. Cote moyenne pour chaque voix (maximum = 7).
Note. H = voix humaine; V = Virginie; S = Sophie; L = Louise; O = Olivier; B = Bruno; C = Charlotte; J = Juliette; F = Félix; P = Pierre

significativement plus appréciée que toutes les autres voix sauf la voix Sophie (5,10); les voix Sophie et Louise (5,04) sont significativement plus appréciée que les voix Bruno (4,34), Charlotte (4,33), Juliette (4,07), Félix (2,81) et Pierre (1,48) mais pas la voix Olivier (4,64); les voix Olivier, Bruno, Charlotte et Juliette sont significativement préférées aux voix Félix et Pierre; et la voix Félix est significativement préférée à la voix Pierre (1,48). Il y a donc trois voix (Virginie, Sophie, et Olivier) dont l'appréciation chevauche les cotes de plus d'un sous-groupe.

Nous avons ensuite exploré la relation existant entre l'appréciation subjective globale et les caractéristiques des voix. Pour ce faire, les sept échelons d'appréciation ont été regroupés en trois niveaux : appréciation faible (cotes 1, 2), moyenne (cotes 3, 4, 5) et forte (cotes 6, 7). Un test de Khi carré s'est révélé significatif pour chacune des caractéristiques évaluées : chaleureuse ou froide [$\chi^2(2) = 128,47, p < 0,001$]; dure ou douce [$\chi^2(2) = 104,78, p < 0,001$]; monotone ou expressive [$\chi^2(2) = 119,49, p < 0,001$]; fluide ou saccadée [$\chi^2(2) = 108,49, p < 0,001$]. Ainsi, les voix peu appréciées sont jugées froides (88,5%), monotones (87,5%), saccadées (72,1%) et dures (68,3%). Les voix les plus appréciées sont douces (91,3%), fluides (85%), chaleureuses (81,5%) et expressives (79,2%) (Tableau 2).

L'analyse de corrélation bivariée de Pearson montre une corrélation positive modérée significative entre l'intelligibilité d'une voix et son appréciation : plus la voix est intelligible, plus elle est appréciée ($r = 0,429, p < 0,01$)

DISCUSSION

L'intelligibilité varie selon la voix et la condition de présentation des stimuli. Certaines synthèses vocales sont aussi intelligibles que la voix humaine et ce, dans les deux conditions d'écoute (mots présentés isolément et en contexte). En effet, les voix Virginie et Louise sont aussi intelligibles que la voix humaine avec et sans contexte. Toutefois, bien que d'autres synthèses vocales ne soient pas aussi intelligibles que la voix humaine, le contexte augmente grandement leur intelligibilité. Avec contexte, trois voix sont devenues aussi intelligibles que la voix humaine, et le score moyen d'une seule voix (Pierre) était

Tableau 4.

Distribution des jugements (en pourcentage) des caractéristiques selon le niveau d'appréciation attribué à la voix par chaque participant

Caractéristiques	Très appréciée	Appréciée	Peu appréciée
Chaleureuse/	81,5	51,8	11,5
Froide	18,5	48,2	88,5
Dure/	8,7	37,3	68,3
Douce	91,3	62,7	31,7
Monotone/	20,8	53,9	87,5
Expressive	79,2	46,1	12,5
Fluide/	85,0	43,8	27,9
Saccadé	15,0	56,2	71,1

en bas du taux d'intelligibilité de 75 %.

Le résultat montrant que certaines voix, même sans contexte, sont aussi intelligibles que la voix humaine ne concorde pas avec les résultats des études antérieures (Nye & Gaitenby, 1973; Mirenda & Beukelman, 1987, 1990; Koul & Allen, 1993; Trudeau et coll., 2006). Trudeau et coll. (2006) ont observé un effacement de la différence d'intelligibilité de la voix humaine (96%) et la voix Pierre (91%), mais seulement pour la condition avec contexte. De plus, ils ont trouvé un taux d'intelligibilité pour les mots isolés avec la voix Pierre de 76%. Ces pourcentages concernant la voix Pierre sont nettement supérieurs à ceux de notre étude (24%, n = 16, pour les mots isolés et 63%, n = 16, pour les mots en contexte). Cette différence d'intelligibilité pourrait être engendrée par les synthèses vocales avec lesquelles la voix Pierre a été comparée. En effet, toutes les voix de synthèses évaluées dans l'étude de 2006 étaient de l'ancienne génération donc étaient de qualité semblable ou inférieure à la voix Pierre. L'écoute des stimuli produits par la voix Pierre demandait alors moins d'effort attentionnel relativement aux autres synthèses présentées et provoquait par le fait même une augmentation de l'intelligibilité réelle de la voix Pierre. Dans l'étude actuelle, les autres voix de synthèse (de nouvelles générations) étaient plus faciles à comprendre que la synthèse Pierre, ce qui a pu influencer les attentes et le niveau d'attention des participants (entendre des voix très intelligibles), rendant l'écoute de la voix Pierre plus difficile. Une autre explication possible de ce résultat est que les conditions de présentation n'étaient pas les mêmes, soient la qualité des haut-parleurs, le niveau d'intensité et la vitesse de présentation des stimuli. Dans les deux études, les paramètres par défaut des logiciels et des synthèses vocales ont été utilisés. Ainsi, puisque les logiciels n'étaient pas les mêmes, certains paramètres ajustés différemment ont pu influencer la qualité des enregistrements.

De plus, la voix humaine n'a pas entraîné de reconnaissance parfaite des mots et énoncés. Ceci peut être dû aux bruits ambiants tels le système de ventilation ou l'ordinateur. Cependant, le bruit ambiant ne remet pas en cause les résultats puisqu'il était subtil et constant tout au long des séances, reflétant ainsi la conversation dans un environnement calme.

L'effet du contexte sur l'intelligibilité retrouvé dans la présente étude concorde avec des études antérieures (Mirenda & Beukelman, 1987, 1990; Hoover et coll., 1987). Toutes voix confondues, le pourcentage de mots identifiés correctement passe de 71% pour les mots sans contexte à 90% pour les mots avec contexte. À prime abord, on constate que l'augmentation absolue la plus importante survient pour les voix les moins intelligibles (Pierre; 24 à 63% et Félix; 54 à 90%). Toutefois, puisque la condition de présentation des mots isolés engendre un effet plafond pour certaines voix, une augmentation des pourcentages était virtuellement impossible pour celles-ci. Il pourrait donc être plus adéquat d'évaluer le taux d'amélioration engendré par l'utilisation du contexte (i.e. l'augmentation observée en fonction de l'augmentation possible). Par exemple, pour Pierre, avec un taux pour les mots isolés de 24%, une augmentation de 76% était possible. Or, avec un taux en contexte de 63%, on constate donc une augmentation observée de 39%, montrant un effet du contexte qui correspond à 51% de l'effet possible. On se rend alors compte qu'en appliquant cette formule, le pourcentage d'amélioration possible varie entre 51 et 78%. Le moins bon pourcentage étant attribué à la voix Pierre. On stipule donc que les participants ont profité de 51% du contexte pour identifier les mots avec la voix Pierre tandis qu'ils ont profité davantage du contexte avec plusieurs autres voix et ce de façon assez constante.

Toutes voix de synthèse confondues, le taux d'intelligibilité des mots sans contexte s'étend de 24% à 89%. Ceci indique une performance maximale considérablement élevé (voix humaine 89%). L'équipe de Trudeau et coll. (2006) avait montré un plafond du niveau d'intelligibilité plus faible, soit de 75% (voix humaine : 85%). Cette augmentation d'intelligibilité de synthèses vocales françaises depuis 2006 reflète une avancée rapide de la technologie dans le domaine des communications. Il est intéressant de noter que, malgré l'absence de contexte (mots isolés), deux voix de synthèse distinctes apparaissent aussi intelligibles (> 84%) que la voix humaine, et pour cinq autres voix de synthèse, un contexte limité (courts énoncés) augmente leur intelligibilité à un niveau semblable (> 92%) à celui de la voix humaine. Ce résultat conduit à un optimisme certain quant à l'utilisation des synthèses vocales dans diverses situations de la vie courante.

Les résultats confirment que certaines voix sont plus appréciées que d'autres. La voix humaine et la synthèse Virginie sont les préférées (cote moyenne 5,76 et 5,61, respectivement), et les deux voix de synthèse Pierre et Félix ont obtenu des évaluations négatives (inférieures à 3 sur l'échelle de 7). En général, les voix synthétiques évaluées dans cette étude sont plus appréciées que celles de l'étude de Trudeau et coll. (2006), qui avaient trouvé que la voix humaine était la seule à obtenir une cote nettement positive. Les résultats de la présente étude montrent que les voix les plus appréciées (voix humaine, Virginie) sont souvent les plus intelligibles dans les deux contextes tandis que celles les moins appréciées (Félix, Pierre) sont aussi les moins intelligibles. Tel que l'ont montré Sangsue et coll. (1997), l'utilisation des

adjectifs bipolaires hautement contradictoires pour qualifier les voix forçait le participant à plus de précision et ainsi opter un peu plus pour l'un ou pour l'autre des adjectifs. Les résultats révèlent que l'appréciation globale reflète certaines caractéristiques des voix. En effet, plus l'évaluation subjective était positive, plus il était probable que la voix soit jugée chaude, douce, expressive et fluide. Trois participants ont ajouté des commentaires sur leur feuille-réponse à propos des voix Pierre (robotique, peu compréhensible, parle sur le bout de la langue), Juliette (timbre très apprécié) et de la voix humaine (accent québécois prononcé, très naturelle). S'il est difficile de définir «le naturel» d'une voix (Nusbaum et coll., 1995), les adjectifs choisis pour qualifier les différentes synthèses vocales ont permis une juste évaluation de leur qualité dans le contexte où les participants devaient s'imaginer que les voix appartenaient à un proche.

Bien que le but de l'étude ne visait pas à faire une comparaison directe des voix de synthèse québécoises et françaises, les résultats montrent que des quatre voix les plus intelligibles en contexte, deux sont québécoises (voix humaine et Louise) et deux sont françaises (Bruno et Virginie) et que des deux voix les plus appréciées, Virginie est française et la voix humaine est québécoise. En condition de mots isolés, deux des trois voix les plus intelligibles sont québécoises. Les particularités propre à chaque dialecte (ex : affrication, diphtonguaison, régionalismes lexicaux, etc.) ne semblent pas influencer l'intelligibilité ou l'appréciation des synthèses vocales. Ceci peut être attribuable au fait que les participants, de nationalités multiples et résidents à Montréal, sont amenés à côtoyer quotidiennement des personnes parlant d'autres dialectes de la langue française. Bien qu'aucune étude ne l'indique, il serait intéressant d'évaluer l'impact des particularités de chaque dialecte sur l'intelligibilité et l'appréciation de différentes voix de synthèse.

Les résultats de cette étude mettent en évidence une hiérarchie des différentes synthèses vocales francophones tant du point de vue de l'intelligibilité que de l'appréciation. Nos résultats suggèrent une très bonne intelligibilité et appréciation des voix Acapela (Bruno et Louise), Nuance-Realspeak (Virginie), SAPI 4,0 (Sophie) et Loquendo (Olivier). La voix L&H (Pierre) s'est toutefois avérée peu intelligible et faiblement appréciée. Ceci révèle des progrès récents dans le domaine des voix artificielles et montre l'importance de ce type d'études afin de mieux guider les professionnels des troubles du langage dans l'attribution des systèmes de suppléance à la communication. De plus, le coût des voix de synthèse ne semble pas être un facteur déterminant dans le choix des voix à intégrer dans les appareils car toutes les voix coûtent moins de 50$, indépendamment du niveau d'intelligibilité.

D'autres recherches sont nécessaires pour explorer l'intelligibilité et l'appréciation des synthèses vocales françaises dans d'autres contextes (ex. conversation, au téléphone), par d'autres interlocuteurs (ex. utilisateurs de synthèses vocales et leurs proches) et avec d'autres types de stimuli (ex. messages sociaux; informations précises; vocabulaire moins fréquent) afin de mieux préciser les éléments et caractéristiques qui feront en sorte que les voix de synthèse répondent le mieux possible aux besoins des utilisateurs.

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ANNEXE A

Paragraphe 1

Laura a senti l'avion s'élever rapidement. C'était une magnifique journée ensoleillée, un vent léger finissait de disperser la brume qui couvrait la ville plus tôt en matinée. Le pilote a annoncé que l'avion se dirigeait vers le nord-ouest pour contourner ensuite l'Angleterre en direction du Groenland. De là, il ne restait que quelques heures pour atteindre sa destination : New York. Laura a regardé à travers le hublot. Elle pouvait entendre la pluie s'abattre sur la fenêtre.

Paragraphe 2

Martin a senti avec joie l'auto prendre de la vitesse. Cette nouvelle voiture répondait parfaitement bien aux sollicitations du chauffeur. Il faisait un temps splendide, idéal pour rouler, une petite brise allait finir de dégager le ciel qui s'était couvert dans la journée. Sa voisine, qui connaissait le chemin, a annoncé qu'il faudrait contourner la ville par le nord puis se diriger vers l'est de la province. Alors, il ne resterait que peu de route à faire avant d'arriver sur leur lieu de vacances : Boston.

Paragraphe 3

Patrick a vérifié son billet avant de le remettre au contrôleur du train. Dans quelques heures, il serait chez sa tante, à Halifax. Il a choisi un siège confortable, baigné par les rayons du soleil, et il a attendu que le train quitte la gare. Il a sorti de son sac la lettre que sa cousine Jeanne lui avait envoyée. Son regard s'est attardé sur la photographie jointe à la lettre. Il a contemplé longuement la petite pharmacie familiale qu'il venait d'acheter là-bas. Il avait terriblement hâte d'arriver pour rencontrer ses futurs employés.

Paragraphe 4

Le vélo bleu de Marion était posé contre le mur de brique. La jeune femme avait emprunté la route en direction de Percé à l'aube. Elle ne s'était arrêtée qu'une fois trempée par la fine pluie qui ne cessait de tomber. Elle aurait voulu continuer mais une faim de loup l'en empêchait. Elle est entrée dans un petit café, pour commander une bonne soupe chaude. Tandis qu'un vieil homme préparait son repas, Marion a soudainement vu quelqu'un s'emparer de sa bicyclette.

ANNEXE B

Scores moyens des niveaux d'intelligibilité (maximum = 16), écarts-type (en parenthèses) et pourcentages équivalents pour chaque synthèse vocale dans les deux conditions (sans contexte et avec contexte) pour les trois groupes d'âge

Voix/ Nom de la synthèse vocale		Groupe								
		14-19 ans		20-39 ans		40-60 ans		Total		Total
		Sans	Avec	Sans	Avec	Sans	Avec	Sans	Avec	
Humaine	Score	14,4 (1,3)	15,4 (1,1)	14,5 (1,0)	15,5 (1,2)	14,0 (1,9)	15,7 (0,7)	14,3 (1,5)	15,5 (1,0)	14,9 (1,0)
	Pourcentage	90,0	96,3	90,6	96,9	87,5	98,1	89,4	96,9	93,1
Louise	Score	14,5 (1,6)	15,4 (0,8)	14,0 (1,3)	15,7 (0,7)	14,2 (1,2)	15,7 (0,7)	14,2 (1,3)	15,6 (0,7)	14,9 (0,9)
	Pourcentage	90,6	96,3	87,5	98,1	88,8	98,1	88,8	97,5	93,1
Virginie	Score	12,6 (3,3)	15,1 (1,6)	14,1 (1,5)	15,6 (0,6)	13,5 (1,6)	15,2 (1,3)	13,4 (2,3)	15,3 (1,2)	14,4 (1,4)
	Pourcentage	78,8	94,4	88,1	97,5	84,4	95,0	83,8	95,6	90,0
Sophie	Score	12,7 (1,8)	14,5 (1,5)	12,8 (1,7)	14,9 (1,3)	12,1 (1,8)	14,8 (1,2)	12,5 (1,8)	14,7 (1,3)	13,6 (1,3)
	Pourcentage	79,4	90,6	80,0	93,1	75,6	92,5	78,1	91,9	85,0
Bruno	Score	12,2 (1,3)	14,4 (1,7)	12,7 (1,6)	15,4 (0,8)	12,2 (1,7)	15,0 (1,0)	12,4 (1,6)	14,9 (1,3)	13,7 (1,1)
	Pourcentage	76,3	90,0	79,4	96,3	76,3	93,8	77,5	93,1	85,6
Olivier	Score	12,7 (2,5)	14,6 (1,4)	12,3 (1,7)	15,1 (1,0)	11,5 (1,9)	14,6 (1,2)	12,2 (2,1)	14,8 (1,2)	13,5 (1,4)
	Pourcentage	79,4	91,3	76,9	94,4	71,9	91,3	76,3	92,5	84,4
Juliette	Score	11,0 (2,1)	14,3 (1,4)	11,6 (1,9)	14,4 (1,2)	11,1 (2,0)	14,1 (1,2)	11,2 (2,0)	14,3 (1,2)	12,7 (1,2)
	Pourcentage	68,8	89,4	72,5	90,0	69,4	88,1	70,0	89,4	79,4
Charlotte	Score	10,0 (2,1)	14,0 (1,5)	10,9 (1,8)	14,7 (1,5)	10,6 (1,8)	14,4 (1,4)	10,5 (1,9)	14,4 (1,5)	12,4 (1,4)
	Pourcentage	62,5	87,5	68,1	91,9	66,3	90,0	65,6	90,0	77,5
Félix	Score	8,4 (2,1)	14,4 (1,8)	9,1 (2,8)	14,5 (0,9)	8,2 (1,7)	14,3 (1,2)	8,6 (2,2)	14,4 (1,3)	11,5 (1,4)
	Pourcentage	52,5	90,0	56,9	90,6	51,3	89,4	53,8	90,0	71,9
Pierre	Score	4,0 (1,7)	9,1 (2,8)	4,0 (2,2)	10,9 (2,5)	3,9 (1,5)	10,1 (2,2)	3,9 (1,8)	10,0 (2,6)	7,0 (1,6)
	Pourcentage	25,0	56,9	25,0	68,1	24,4	63,1	24,4	62,5	43,8
Total	Pourcentage							70,8	89,9	80,4

Older Adults' Views of their Communication Difficulties and Needs while Driving in a Motor Vehicle

Point de vue d'adultes plus âgés concernant leurs difficultés et besoins de communication pendant la conduite automobile

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KEY WORDS
COMMUNICATION
CAR
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DRIVING
MOTOR VEHICLE
HEARING
CONVERSATION
ATTENTION

Abstract

With an aging population the number of older drivers will continue to increase. Associated with aging are many health related factors such as hearing loss, vision loss, cognitive changes, and central processing deficits that can impact driving. Research suggests that as individuals get older they may rely more heavily on passengers while driving to help with various driving tasks. Therefore, the need for clear communication in the vehicle is important. However, little is known about what older adults consider important or necessary to hear while driving. The purpose of this exploratory study was to gain a better understanding of the specific communication difficulties older adults experience while driving in a motor vehicle as well as the communication needs of both passengers and drivers. Thirteen adults, 50-70 years of age who are frequently the driver or passenger in a motor vehicle participated in focus group sessions. Qualitative content analysis of focus group transcripts revealed four major themes related to driving, the importance of clear communication while driving in the car as well as strategies individuals use to facilitate communication. The themes identified were *concentration and focus, importance of hearing conversation, the impact of missing the conversation,* and *responses to breakdowns in communication*. We concluded that clear communication between drivers and passengers is important for both practical and social reasons. This research provides evidence for audiologists and other health care professionals to discuss in-vehicle communication difficulties with their clients.

Abrégé

Comme la population vieillit, le nombre de conducteurs automobiles âgés continue d'augmenter. Le vieillissement s'accompagne de changements dans l'état de santé, comme les pertes auditives, les pertes visuelles, les changements cognitifs et les difficultés de traitement central, qui peuvent avoir des répercussions sur la conduite. La recherche suggère que les personnes âgées se fient davantage aux passagers pour les aider à accomplir diverses tâches pendant qu'ils conduisent. C'est pourquoi il est important d'avoir une communication claire dans le véhicule. Or, on sait peu sur ce que les personnes âgées jugent important ou nécessaire d'entendre pendant qu'elles conduisent. Cette étude exploratoire visait à mieux comprendre les difficultés de communication précises que vivent les personnes plus âgées pendant qu'elles conduisent une automobile, ainsi que les besoins de communication des passagers et des conducteurs. Treize adultes âgés de 50 à 70 ans qui sont souvent le conducteur ou le passager d'une automobile ont participé à quatre groupes de discussion. L'analyse qualitative du contenu transcrit des discussions révèle quatre grands thèmes liés à la conduite, l'importance d'une communication claire pendant la conduite, ainsi que les stratégies utilisées pour faciliter la communication. Les thèmes identifiés étaient la concentration et l'attention, l'importance d'entendre la conversation, les répercussions si on manque la conversation et les réactions aux bris de communication. Nous avons conclu que la communication claire entre les conducteurs et les passagers est importante pour des raisons tant pratiques que sociales. Cette étude fournit des preuves pour aider les audiologistes et autres professionnels de la santé à discuter des difficultés de communication dans un véhicule avec leurs clients.

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INTRODUCTION

Many individuals have experienced difficulty understanding or following a conversation while driving in a motor vehicle, regardless of age or hearing ability. However, there is limited research in this area and very little information regarding specific communication difficulties individuals experience or what the specific communication needs of both passengers and drivers may be. Older adults comprise a segment of the population that may have the greatest difficulty in this situation due to the high prevalence of hearing loss as well as other age related factors.

Evidence of communication difficulties in motor vehicles was obtained in a recent adult aural rehabilitation group conducted at the National Centre for Audiology (Cheesman & Jennings, 2009). Participants in their intake interview were asked to identify difficult listening situations and to keep a journal of their experiences. Seventeen of 43 individuals spontaneously reported communication in motor vehicles as a difficult listening situation.

Vehicles provide a difficult listening environment, mostly due to interior noise of the vehicle while it is running (Hoshino, Wakita, & Takeda, 2008). The acoustic characteristics of interior noise of a vehicle are dependent on the vehicle model and driving conditions, such as road texture and wind noise, as well as the speed of the vehicle (Hoshino et al., 2008). Interior noise in the low frequencies is primarily comprised of engine and road noise (below 1000 Hz) as well as wind noise (above 500 Hz; Hoshino et al., 2008). The majority of noise present in a car is within the frequency region that masks speech for individuals with hearing loss as well as for normal hearing individuals (Klein, Mills, & Adkins, 1990).

Placement of passengers within the vehicle also contributes to communication difficulty. Instead of being able to communicate face-to-face, passengers in a car are generally positioned behind or next to each other. This configuration can make communication more difficult as it does not allow for the use of visual cues, such as facial expressions and lip movement to aid in understanding (Laurier et al., 2008). Therefore, individuals are forced to rely on auditory only information for communication purposes.

There are many factors that may contribute to the communication difficulties that older drivers experience while driving in a motor vehicle. With an aging population, there will be an increase in the number of older drivers with hearing deficits. A recent study suggests that 49% of adults 60-69 years of age have a hearing loss between 0.5 and 4 kHz and 77% have a high frequency hearing loss at 3, 4 and 6kHz (Agrawal, Platz, & Niparko, 2008). Older adults often report more difficulty understanding spoken language than younger listeners (Kiessling et al., 2003). These difficulties can be attributed, in part, to the effects of sensorineural hearing loss but may also be associated with other age-related factors. Studies have shown that older adults demonstrate poorer speech understanding, especially in noisy listening conditions compared to younger listeners when matched for hearing threshold (Kricos, 2006). When listening becomes more challenging because of either noise or age-related deficits of the auditory system, cognitive resources are reallocated to attend to the stimuli of interest. This decreases the availability of cognitive resources for central cognitive processes such as storage and retrieval functions of working memory (Kricos, 2006; Pichora-Fuller, Schneider, & Daneman, 1995). This may also be associated with the reduced ability for an individual to inhibit potential sources of interference in the environment (Wingfield, Tun, & McCoy, 2005). Difficulties that older adults experience may also be due to central auditory processing deficits (Kiessling et al., 2003). Older adults have demonstrated auditory processing deficits for degraded, competing, and altered speech and perform more poorly on temporal and frequency resolution tasks (Kricos, 2006; Wingfield et al., 2005). These types of deficits may lead to greater difficulty with communication in noisy and distracting driving environments.

Older adults have reported that navigation tasks such as route-planning and way-finding are key factors that impede their driving performance (Burns, 1999). Vrkljan and Polgar (2007) found that as individuals get older they rely more heavily on their passenger to provide support, feedback, or assistance while driving. The passenger may help with tasks such as adjusting the radio and using the temperature controls. They may also be more involved in navigation and provide verbal warnings of obstacles in the driving environment (Vrkljan & Polgar, 2007). Sharing tasks with a passenger allows for some of the cognitive demands to be alleviated so the driver can focus on driving safely. This is of particular importance as older adults are more likely to be involved in multi-vehicle crashes in complex traffic conditions and at intersections compared to younger drivers (McGwin Jr. & Brown, 1999; Preusser, Williams, & Ferguson, 1998). Higher crash rates have also been associated with hearing loss and poor visual acuity in older adults (Gallo, Rebok, & Lesikar, 1999; Ivers, Mitchell, & Cumming, 1999). In a recent study, Hickson, et al. (2010) showed that older adults with poor hearing were found to have greater difficulty with driving in the presence of auditory and visual distractors than older adults with better hearing thresholds.

The current research suggests that as adults get

older they experience more difficulty understanding communication in noisy environments, are more affected by distractions in the driving environment, and begin to rely on their passenger to aid with certain driving related activities. These changes in older drivers highlight the importance of clear communication between driver and passenger. In light of the apparent difficulties individuals with and without hearing loss experience with communicating in vehicles and the importance of communication in vehicles for both navigational and social purposes, more research on this topic is needed.

PURPOSE

The purpose of this exploratory study was to gain a better understanding of the specific communication difficulties older adults experience while driving in a motor vehicle as well as the communication needs of both passengers and drivers.

METHOD

Study Design

An exploratory study using qualitative content analysis of focus group data was conducted to identify the difficulties and needs of drivers and passengers while driving in a motor vehicle. An inductive approach to content analysis was chosen to analyse the focus group transcripts. This method is defined as a means to "provide knowledge and understanding of the phenomenon under study" (Downe-Wamboldt, 1992). This is achieved through the subjective interpretation of text data by a researcher or research team "through the systematic classification process of coding and identifying themes or patterns in the data" (Hsieh & Shannon, p. 1278). Content analysis is an appropriate method of analysis when there is limited knowledge on the topic under study and no pre-existing theories are present in the literature (Elo & Kyngäs, 2008). Ultimately, knowledge generated through the use of content analysis is grounded in the data and represents the perspectives, thoughts, and emotions of the participants involved in the study (Hsieh & Shannon, 2005).

Focus groups have been recommended as a means of data collection for content analysis (Downe-Wamboldt, 1992; Hsieh & Shannon, 2005). Group discussion can generate novel topics that may not arise in a one-on-one interview (Agan, Koch, & Rumrill Jr, 2008; Freeman, 2006).

Participants

Participants were recruited in London, Ontario and surrounding communities using newspaper advertisements and flyers distributed in the community. Participants were eligible to take part in the study if they were between 50 and 70 years of age, had recent experience as either a driver or passenger in a motor vehicle, and could communicate effectively in English. The University of Western Ontario Research Ethics Board approved the study and all participants provided written informed consent.

Thirteen participants, including 7 males (mean age of 68 years) and 6 females (mean age of 60 years) participated in this study. All participants underwent a hearing screening to determine hearing sensitivity. Otoscopy was performed and pure tone air-conduction audiometry was completed using a GSI-61 audiometer (Grason-Stadler, Eden Prairie, MN) with ER-3A insert earphones. Octave thresholds were tested between 250 and 4,000 Hz bilaterally. Hearing loss was defined as audiometric thresholds greater than 25 dB hearing level in more than two frequencies in at least one ear. Pure tone bone-conduction audiometry between 500 to 4,000 Hz was only conducted when air conduction thresholds were greater than 25 dB hearing level.

Three participants had been previously identified with hearing loss and wore hearing aids. Two of these participants wore binaural, behind-the-ear (BTE) hearing instruments. Of those with hearing loss, one participant presented with normal hearing to 1,000 Hz, sloping to a moderately severe sensorineural (SNHL) hearing loss. The second participant presented with normal hearing sloping to a moderate SNHL in the right ear and a mild, sloping to moderately severe SNHL in the left ear. The third participant presented with a severe mixed loss sloping to a profound SNHL bilaterally and wore a BTE hearing instrument in the right ear only. Of the remaining 10 participants, 5 presented with normal hearing and 5 presented with a previously undiagnosed hearing deficit. All five participants who were identified with hearing loss at the time of this study presented with normal hearing in the low to mid frequencies and elevated thresholds at 3000 Hz or above. The mean pure tone air conduction thresholds with minimum and maximum threshold values for the left and right ears of all participants are plotted in Figure 1.

Focus Groups

Three focus group sessions were held in May and June 2010 at the National Centre for Audiology at the University of Western Ontario. Focus group discussions were facilitated using an open-ended question guide (see Appendix A) that had been developed using evidence from previous research (Cheesman & Jennings, 2009) and discussion with colleagues. Probe questions were used to elicit responses when novel topics arose or more detail was required from the participant. Two groups had

four participants and one group had five participants. The size of the focus groups was kept small to allow for all participants to contribute and to provide for easier moderation of the group (Agan, et al., 2008). The same researcher facilitated all three focus groups. All focus groups lasted approximately 1.5 to 2 hours and were videotaped. After each focus group session, videotapes were reviewed to help inform and revise the question guide for the following sessions. After the third focus group session, no new themes emerged from the data, eliminating the need for further data collection.

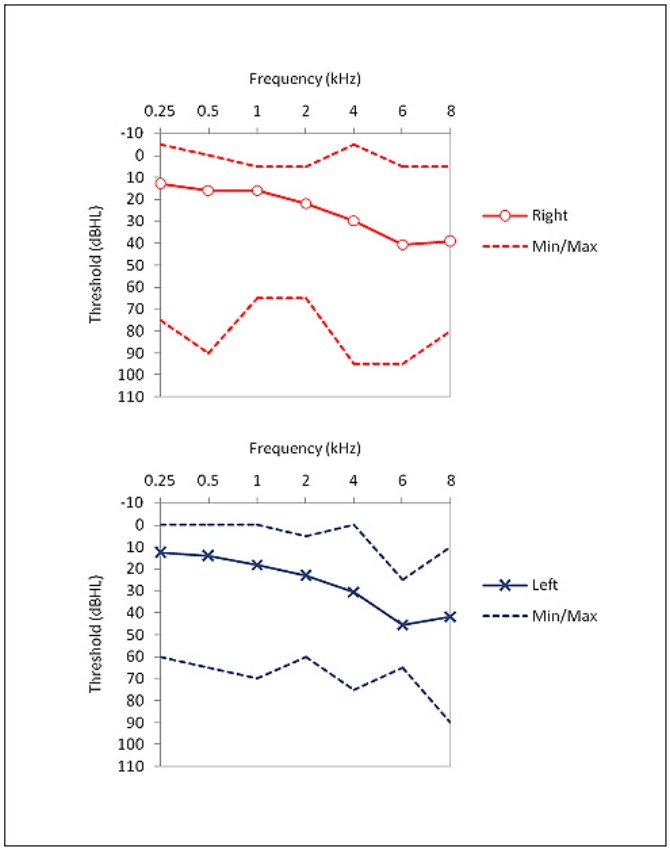

Figure 1.
Mean, minimum and maximum thresholds in dB hearing level for the right and left ears of all participants.

Analysis

Focus group videotapes were transcribed verbatim by the researcher who conducted the focus groups. The three lead investigators read each transcript individually, manually coding, and identifying categories or overarching themes within the data. The three investigators discussed their findings together and any differences were discussed and resolved. Transcripts were imported into NVivo 8 software (QSR International, Cambridge, MA) to organize the identified themes. NVivo 8 is a qualitative data analysis software package that provides a means of organizing and labelling data to assist the researcher in classifying, arranging and sorting data. Data were analyzed again by the researcher to confirm the major themes and subthemes in the data and to link the supporting quotations from the data.

FINDINGS

Participants in this study stated the importance of driving in their lives and identified driving as their primary mode of transportation as either a driver or a regular passenger. Several themes were identified from the transcripts of the three focus group sessions. The common themes were *concentration and focus, importance of hearing conversation, the impact of missing the conversation,* and *responses to breakdowns in communication.* These themes and related subthemes will be discussed in further detail below.

Concentration and Focus

A main issue participants identified was the importance of maintaining concentration and focus while driving. While the need for an increase in concentration while driving was mentioned in the context of aging, participants also felt that, generally, concentration and focus were important issues while driving. They stated that there were many distractions that occur while driving, and maintaining concentration and focus should be a priority. Participants identified noise, driving conditions and conversation in the car as distractions to driving that required an increase in concentration on the part of the driver. Subthemes identified in this category were, *conversation as a distraction to driving, challenging driving conditions and driving* and *aging.*

Conversation as a Distraction

Participants indicated that conversation in a motor vehicle, regardless of driving conditions, could be extremely distracting for the driver. In the example below, one participant commented that although he did not feel he has had difficulty understanding conversation while driving in the car, he noted that conversation can be a distraction and takes attention away from the driving task at hand.

> *I, uh, was thinking about this, and I don't know if I have difficulty hearing anybody when I'm driving, but, I think conversation can be a distraction from driving...it takes your attention away."*

Challenging Driving Conditions

Participants expressed a need for a higher level of concentration and focus in more challenging driving conditions. Participants who were drivers identified situations such as driving in traffic, driving in unfamiliar

areas or driving in bad weather (such as rain or snow) as more challenging and requiring a higher level of concentration. Some participants indicated that driving at night was another situation where driving was more challenging. In these situations, drivers stated that they needed to focus on the driving task and not engage in non-essential conversation.

But there again, when it comes into the traffic, you're into an unknown territory, everybody quiets down, the radio's down, your navigator then speaks, tells you where to go and the girls will talk quiet in the back seat or something.

This reflected comments made by several participants who noted that passengers are aware of the needs of the driver and will limit conversation when a driver needs to concentrate. In the example below, one participant commented that if a situation becomes challenging, he concentrates on the driving task at hand and ceases all conversation.

When I'm concentrating I don't want anything interfering with my concentration whether it be a bad storm, snow storm, bad traffic, whatever the conditions are I want to concentrate on that particular task and I don't want to have conversation when that's happening.

Although participants generally agreed that talking was a distraction, they did not regularly refrain from all conversation while driving. However, under conditions where they felt a higher level of concentration was needed they refrained from participating in conversation. However, all participants agreed that being able to understand a conversation with passengers in the car was important to them.

Driving and Aging

Participants commented that as they age they feel the need to be more focused or concentrate more on the driving task. As a result, they reduce conversation or eliminate unwanted distractions to allot more attention to their driving.

I find the older I get, the more I have to concentrate on my driving, not to engage in conversation, because I find it distracts more, way more than when I was younger.

Some participants noted they have more difficulty following conversation while driving in a vehicle. Participants who drove regularly with elderly passengers also commented on changes in the ease of communication and facilitating conversation.

I have a 97 year old mother in a nursing home. I drive her to a restaurant once in a while. She's got a hearing aid in each ear. So, she always rides in the front and my wife rides in the back so she can see me talk because she lip-reads a lot.

Importance of Hearing Conversation

All participants commented that the ability to understand others' speech in the vehicle was important. Participants who identified as drivers noted that it was important to hear their passengers if they were providing a warning about hazards in the driving environment or if they were acting as navigators and providing driving directions. However, participants felt the majority of conversation that occurred in a vehicle was unrelated to the driving task and could range from idle chat to important conversation. Subthemes in this category include *passengers as another pair of eyes and ears, passengers as navigator,* and *the vehicle provides an opportunity for conversation.*

Passengers as another pair of eyes and ears

All participants identified sirens from emergency vehicles and other emergency warning signals as the most important auditory signal to hear while driving in the car.

And I always try to make sure, even if I have the radio on, that I can hear outside, signals from outside; things I should be hearing, breaks screeching, or emergency vehicles, somebody calling for something…

Participants shared experiences when they had not heard emergency vehicles approaching and were slow to pull over. Many participants found these experiences caused feelings of anxiety and/or distress. Participants noted that passengers in the vehicle would act as a second set of eyes and ears to identify potential hazards in the driving environment or warning signals. One participant commented that a passenger may see something that the driver may have missed or was slow to respond to.

… your partner, the person that's with you, sometimes they might see something that you don't. They'll say "oh gosh look out for that." you know. I mean, that's happened, somebody'll say, "that guy's turning right".

Other participants shared experiences when the passenger played a key role in helping the driver identify the location of emergency vehicles.

…recently, I was driving with a friend. And, um, we were both talking and I was driving and concentrating 'cause I didn't know the way, and she was telling me how to get there. And, all of a sudden we realized there was an emergency vehicle … we could hear the sound, but we hadn't really been paying attention. So, we both had to be quiet and listen to which direction it was coming from.

Passengers as Navigator

Participants also discussed how passengers acted as navigators. Participants expressed that, as a driver, it was important to hear the passenger clearly in this situation. Passengers may be in charge of giving directions in unfamiliar areas, or may be the individual interpreting the map or the GPS system in the vehicle. One participant described the teamwork between her husband, the driver, and herself as the passenger in navigating.

> *When my husband and I drive long distances, he drives most of the time, he'll have a GPS, but I will usually have a map as well. And we'll talk about directions and so on and if it's a tricky situation in a city or something where you're trying to find something.*

This demonstrated how the passenger helps reading the map and/or GPS system in the car and provides directions for the driver. Several participants noted that having a navigator reduced stress, especially when travelling in unfamiliar locations, allowing the passenger to share the task. Another participant in the same group reiterated the importance of hearing the passenger acting as a navigator while driving in the car.

> *Oh definitely, yeah, because she'll say well, "another two miles we've got to veer to the right". Or she'll say "veer to the right". Yeah, you have to, you have to hear.*

Vehicle Provides an Opportunity for Conversation

Although it is important to hear what a passenger is saying while driving in a motor vehicle for safety or navigation purposes, participants expressed that conversation in the car could be on any topic and could vary greatly depending on the individual or individuals in the vehicle. Many participants felt the vehicle provided an opportunity for conversation and it was important for them to take part. In addition, participants indicated that conversation kept them stimulated and alert on a long drive.

> *I like a little conversation because it's comforting, you know, you're driving down to [restaurant name] for lunch and you're talking about what your grandson did or something, you know...To me, it's important to have some conversation with a person. Nothing heavy, or stressful, or arguing or, you know...nice, comfortable communication.*

When driving with family or friends, time spent in the car was a good opportunity to have a more important or intimate conversation. One participant felt the car provided her with a captive audience with her teenage children.

> *I think sometimes, the car is a great opportunity to have deep discussions... It's great to get into some deeper conversations because you have a captive audience. And you know, they often say with teenagers too, get them in the car and drive, because they can't run and hide. And then you can deal with issues.*

Similarly, another participant agreed that the car was an ideal place to have important conversations. This participant shared that she and her adult daughter have busy lives and the car was the only place where they were able to have an extended conversation without interruption.

> *I would agree, to me it's very important to be able to hear, because my daughter and I, we're busy. She's in university, I'm usually working. And so that's usually the time we connect, when we're in the car together, 'cause it's just the two of us… I think we have our best conversations in the car... And so when we're in the car, that's when I think we have our best talks. So to me it's very important to be able to hear.*

Impact of Missing the Conversation

Participants stated that they felt frustrated, embarrassed and left out when they were unable to hear a conversation while driving in the car. One participant expressed feelings of both frustration and embarrassment when she described a time when she was unable to follow a conversation her passengers were having while driving.

> *It's frustrating, especially if you're only picking up bits and pieces, you don't feel you can contribute because you can't hear the full conversation. I hate it when I sound, not that I sound stupid, but that you say something and they say, "but we just talked about that". And it's like "oops, didn't hear it". And it's almost embarrassing if you don't get the whole gist of the conversation.*

Similar sentiments of being "left-out" were expressed by a participant when she shared a story about her husband and son sitting in the front seat and trying to hear the conversation from the backseat and demonstrated how she attempted to lean forward from the backseat to hear the conversation better.

Participant: *I was in the back seat of our sedan... my son was driving... So he and his dad are talking away and I'm listening to everything. So I'm always poking my head up, I couldn't hear what they were saying. I was [saying], "What? Whaddya say, whaddya say?"*

Moderator: *How did you feel, not being able to be part...*

Participant: *I was missing out on all the important action... just talking about school and my*

son's future and what courses he's going to take. And I'm popping up, you know, and I'm thinking, "Whaddya say, what?" I had to keep asking them to repeat themselves.

Moderator: *...Were they trying to speak louder for you to hear?*

Participant: *No, no, they forgot about me.*

Response to Communication Difficulty

Participants, whether they filled the role of passenger or driver, commented on experiences when there was a breakdown in communication or when an individual had difficulty understanding the conversation while driving. All participants shared ways in which accommodations where made in these situations in response to the communication difficulty. Two subthemes identified were *tuning in* and *tuning out.*

Tuning In

Participants discussed strategies commonly employed to facilitate conversation while driving in a motor vehicle. Strategies included talking louder, repeating what was said, or asking the talker to repeat what they said. They also discussed reducing noise in the vehicle such as turning down the radio, turning off the air conditioning or heating, and closing the windows. Many participants indicated that these strategies easily repaired any breakdown in communication that occured. While strategies such as turning down the radio and closing windows lead to a consistent improvement, many participants noted that asking individuals to speak louder had inconsistent outcomes. One participant verbalized this during the focus group session.

I think people will speak up for maybe a sentence or two. And then they start to talk in the normal [volume]…and then you have to ask them again, to do it again.

Participants also discussed how seating within the vehicle plays a significant role in effective communication in the car. Participants who were drivers noted that it was harder to hear passengers sitting in the backseat. Conversely, passengers found it difficult to hear conversation in the front of the car when sitting in the backseat.

So, I'd sit in the back. And I find it's hard to hear people having the conversation in the front seat, because they're speaking forward so you just naturally can't hear as well in the back. So, I actually will lean forward to listen so I can be part of the conversation.

Several participants noted that they attempted to arrange seating in the vehicle to best accommodate certain individuals.

Yeah, and if mum's a passenger, she's fine, but if she's in the back seat, she doesn't hear that well either. So, quite often we'll try to put her, if it's the four of us in the car, we'll try to put mum in the passenger seat.

Although there is awareness among both passengers and drivers that seating configuration can improve the ability to communicate, this is not always feasible. One participant who frequently drives his elderly parent shared the following:

Yeah, my mother has a hard time hearing in the car. I think it's just road noise and you have to really speak up for her to hear you. Um, I like to put her in the front seat, but she likes to get in the backseat.

Another participant shared a similar dilemma. Due to a more severe hearing loss in his left ear, he was able to have a conversation in the car with his wife when he sat in the driver's seat. Although he was able to communicate with his wife much easier when he was the driver, this did not mean that he was always the driver.

Participant: *If I'm in the driver's seat it's easier because this ear [right ear] is the better ear.*

Moderator: *So do you try to drive more often so that your better ear…*

Participant: *No, because I know she likes to drive.*

Tuning Out

Participants identified several strategies that facilitated communication while driving in the car. However, many participants shared experiences where the solution to a communication difficulty was to not engage in conversation. Drivers were more likely to engage in this behaviour; letting the passengers in the car talk and turn their attention instead to the task of driving. Similar experiences were reported by passengers sitting in the backseat.

I've tuned out of conversations sometimes. If people are talking in the front and I didn't have to be in the conversation, I would just look out the window if I was in the backseat.

DISCUSSION

Through the course of the focus group discussions, participants provided significant insight into difficulties individuals experience with communication while driving in a motor vehicle. Although, many individuals found distractions in the driving environment to be less tolerable as they age, they agreed on the importance of

clear communication within the vehicle for social, safety, and navigation purposes.

Participants in this study were aware of changes in their driving ability as well as changes in their comfort level while driving under certain conditions as they got older. With age, they noted the need to reduce conversation or to eliminate unwanted distractions to allot more attention to their driving. They also felt they could not tolerate the same level of distractions when driving as compared to when they were younger. This resulted in a need to reduce the amount of conversation occurring in the vehicle especially when driving conditions became challenging. Several participants associated these changes to aging and in particular to changes in their eyesight. Some of these difficulties, however, may be associated with other age related changes. Hearing loss is associated with increased difficulty in speech perception, which may make it more difficult for an individual to participate in a conversation in a noisy vehicle with reduced visual cues. Changes in cognitive and central processing abilities that occur with age may contribute to older adults perceptions that they cannot tolerate as much distraction, carry on a conversation, manage challenging driving situations or drive and navigate simultaneously compared to when they were younger. This may be associated with the need to reallocate cognitive resources to attend to conversation in challenging listening conditions or can cause increased distractibility due to the inability to inhibit competing input in the environment (Pichora-Fuller et al., 1995; Wingfield et al., 2005). Age-related hearing, vision, and cognitive processing deficits could affect communication in a motor vehicle as it is a noisy environment where individuals are performing multiple, complex tasks.

The older adults in this study were aware of changes in their abilities and often adjusted their driving habits accordingly. Passengers reported that they were aware of the needs of the driver and would limit conversation when driving conditions became more challenging. Although all participants agreed that conversation could be a distraction while driving, they did note the need to engage in conversation while driving in a motor vehicle. All participants felt that being able to hear conversation while driving was extremely important, especially for navigational and safety purposes. These results support findings of previous research that suggests as drivers get older they begin to rely more on passengers to help with driving tasks (Vrkljan & Polgar, 2007). Passenger assistance in navigation activities and monitoring the driving environment may alleviate cognitive load for the driver and create a safer and more relaxed driving experience (Vrkljan & Polgar, 2007).

Nonetheless, participants reported that the majority of conversation that occurred in a vehicle was usually unrelated to driving and the vehicle became a venue for casual or intimate conversation. A common type of conversation that participants engaged in while driving was described as a social activity to share gossip or catch up with friends and family. Some participants also described engaging in deeper conversation or having important talks while driving in the car. Although participants believed that conversation posed a distraction when driving, it was an extremely important activity for them.

The impact of missing the conversation while driving in the car was identified as producing feelings of frustration with oneself or with the speaker, feelings of embarrassment or feelings of being left out or not part of the group. Although participants identified several strategies that drivers and passengers utilized when communication became difficult, often these strategies were short lived and caused more frustration.

This exploratory study looked at the communication needs and difficulties that older adults experience while driving in a motor vehicle. Older adults in this study indicated that the ability to communicate in a motor vehicle was important for social and safety purposes, despite the increased difficulties associated with aging.

This exploratory study provided first insights into communication in vehicles and may inform future research looking at older drivers, drivers with hearing loss, speech perception in cars, and driver distraction. Such research could inform automotive development to implement and improve in-vehicle noise reduction technology, car amplification systems and global positioning system technology. It could also provide insight to a variety of health care professionals, such as physicians, audiologists, occupational therapists, and social workers who work with older adults and who have to better understand their needs with regards to communication and driving. With better awareness of these issues, health care professionals may be able to provide their patients with more appropriate guidance or better answer questions that may arise. Audiologists may consider discussing in-vehicle communication difficulties with their clients and can provide information and strategies to facilitate communication in the car for their clients. Audiologists may consider their client's driving habits when choosing appropriate hearing aids and assistive technologies for their client.

Limitations of the Study

The findings from this study reflect the participants' own experiences with communication while driving in motor vehicles. The data do not reflect the experiences of

all older adult drivers and are not generalizable to other populations.

CONCLUSION

This exploratory study investigates the importance of communication in vehicles for older drivers. The study highlights that clear communication between drivers and passengers is important for both practical and social reasons. This study also discusses difficulties that aging adults experience while driving in a motor vehicle, their communication needs while driving in a car as well as strategies they are using to facilitate communication. Further research is needed to look at different populations with hearing loss in order to improve in-car communication in the future.

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APPENDIX A. Sample Question Guide

Introduction:

We are interested in finding out about your communication needs in cars, that is, what is it that *you need to hear* when travelling in the car with other people?

We are also interested in learning about the experiences you have had when communicating with others while driving in the car and the kinds of difficulties you have experienced.

Instructions:

1. I am going to ask you to tell the group about a time that you experienced difficulty understanding a conversation while driving in a car.
2. Even if you feel that someone else has shared a similar experience to yours, I would still like you to hear your story as everyone's experiences, feelings and thoughts are slightly different and can contribute significantly to what we learn here today.

Everyone will have the opportunity to speak.

Remember, we are interested in the experiences of *both* passengers and drivers. If you have more than one experience to share, please do.

Probe questions:

1. Were you the driver or passenger? Where were you sitting?
2. Who were you driving with? Age?
3. Were there other passengers in the car? Where were they sitting?
4. Where were you driving to? Is this area familiar to you? What were the conditions like?
5. What difficulties did you have?
6. Was it important for you to be able to communicate in this situation? Why or why not?
7. What did you need or want to communicate in this situation?
8. What did you do when you couldn't understand what was being said in this situation?
9. How did you feel when you couldn't understand what was being said?
10. Were you able to communicate effectively with all individuals in the vehicle? Was there more than one conversation going on in the car? How did this affect your ability to hear?

Follow-up Questions:

1. What are the most important things you need to hear while in the car?
2. Is it important for you to be able to carry on a conversation while in the car? Why or why not?
3. How does it make you feel when you are unable to understand the conversation in the car?
4. What do you usually talk about while in the car?
5. Do you prefer people not to talk while you are in the car?
6. If you are the driver do you find it distracting to carry on a conversation? Why or why not?
7. Is it important for you to hear the radio or other technology while in the car?
8. Does the weather/road conditions/unknown area/known area/highway/city driving/ country/ affect your ability to have a conversation in the car?
9. Driving during the day or night?
10. Does the type of car you are in effect your ability to have a conversation?
11. What do you or the passengers do to facilitate communication in the car? Does this help? Why or why not?
12. How did they respond to any difficulties you might have had? What do you do if you have difficulty hearing someone?
13. Who do you find most difficult to hear in while driving in the car? Where do they usually sit? Where do you usually sit?
14. What would you say causes the most difficulty for you communicating in the car? How often does this situation arise?

Summary:

Was there anything not discussed here today that you think is important and should be mentioned before we go?

Word Recognition by English Monolingual and Mandarin-English Bilingual Speakers in Continuous and Interrupted Noise

Reconnaissance des mots dans le bruit continu et le bruit interrompu par des locuteurs unilingues anglais et des locuteurs bilingues mandarin-anglais

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KEY WORDS
BILINGUAL
WORD RECOGNITION
NOISE

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Abstract

Word recognition in quiet and noise was examined with Mandarin-English bilingual and American English monolingual young adults ($N = 24$). The speech stimuli were Northwestern University Auditory Test No. 6 monosyllabic words. The competing stimuli were continuous and interrupted noises presented at three signal-to-noise ratios (i.e., 10, 0, and -10 dB). The noises had identical power spectrums and differed in their temporal continuity. In quiet, English participants performed significantly better than the bilingual participants. In noise, performance deteriorated as signal-to-noise ratio decreased and was poorer in the continuous noise. Bilinguals had poorer word recognition than monolinguals. The "release from masking" displayed by the bilinguals in interrupted noise, however, was equivalent to the monolinguals. One can infer that temporal resolution ability, as indexed with a measure of release from masking with this word recognition in noise paradigm, is independent of linguistic exposure.

Abrégé

Nous avons examiné la reconnaissance des mots dans un contexte silencieux et dans le bruit par de jeunes adultes bilingues parlant le mandarin et l'anglais et unilingues parlant l'anglais américain (N = 24). Les stimuli choisis étaient les mots monosyllabiques du Northwestern University Auditory Test No. 6. Les stimuli concurrentiels étaient des signaux de bruit continu et interrompu présentés à trois rapports signal-bruit (10, 0 et -10 dB). Les bruits avaient des spectres de puissance identiques, mais une continuité temporelle différente. Dans le contexte silencieux, les participants anglophones ont démontré un rendement significativement meilleur que les participants bilingues. Dans le bruit, la performance s'est détériorée à mesure que nous réduisions le rapport signal-bruit, et les résultats dans le bruit continu étaient inférieurs. Les personnes bilingues avaient une moins grande reconnaissance des mots dans le bruit que les personnes unilingues. Toutefois, l'effet de « relâchement du masquage » chez les personnes bilingues dans le contexte du bruit interrompu était équivalent à celui chez les personnes unilingues. On peut donc conclure que la capacité de résolution temporelle, telle que répertoriée par la mesure de l'effet du relâchement du masquage dans cette tâche de reconnaissance des mots dans le bruit, est une capacité non liée à l'exposition linguistique.

Bilingual (BL) listeners typically achieve a similar level of recognition of their second language (L2) in quiet relative to monolingual (ML) listeners. Under degraded listening conditions, both BL and ML listeners' speech recognition deteriorates. However, when perceiving L2 stimuli, BLs are disproportionately more affected by noise compared to MLs of that language (Cooke, Garcia Lecumberri, & Barker, 2008; Garcia Lecumberri & Cooke, 2006; Gat & Keith, 1978; Kang, 1998; Mayo, Florentine, & Buus, 1997; Nabelek & Donahue, 1984; Rogers, Lister, Febo, Besing, & Abrams, 2006; Shimizu, Makishima, Yoshida, & Yamagishi, 2002; Takata & Nabelek, 1990; Van Engen & Bradlow, 2007). Stationary noises and/or multi-talker babbles in the first language (L1) or L2 have been typically employed as competitors in these studies.

It has been suggested that the listening difficulty BLs experience with their L2 in noise is related to their limited linguistic exposure to the L2. Specifically, factors affecting BLs' perception of L2 include age of acquisition of L2 (Mayo et al., 1997; Meador, Flege, & Mackay, 2000), continual use of L2 in an L2 environment (Jia, Strange, Wu, Collado, & Guan, 2006; Meador et al., 2000), and L1 interference with L2 (Iverson et al., 2003; Van Engen & Bradlow, 2007). Further, speaker-independent factors (e.g., listening context and lexical frequency) may also contribute to BL listeners' difficulty in perceiving L2 (Levi, Winters, & Pisoni, 2007). Generally, early BLs (i.e., those who begin learning L2 as children) have better perception of L2 in noise than late BLs (i.e., those who begin learning L2 as adolescents or adults; Mayo et al., 1997; Meador et al., 2000). BLs with longer exposure of L2, or those that use L2 more often, perform better in recognizing L2 in noise (Gat & Keith, 1978; Jia et al., 2006). It has also been found that linguistic interference from L1 is more evident when L1 and L2 differ significantly in the listener's phonological system (Iverson et al., 2003; Tong, Francis, & Gandour, 2008; Van Engen & Bradlow, 2007).

Cutler, Weber, Smits, and Cooper (2004) suggested that compared to their L1 perception, BL listeners' L2 perception in noise is disproportionally poorer than that of native listeners because they are slower and less accurate at all speech processing levels (e.g., phoneme identification, segmentation, lexical recognition, syntactic processing, semantic processing, etc.) of L2 relative to their L1. The relative perceptual advantage for native versus non-native speech perception is believed to be a consequence of linguistic experience (i.e., years of exposure to a language) as well. That is, linguistic experience shapes an individual to perceive one's L1 with the greatest competence (e.g., Pisoni, Lively, & Logan, 1994). It is well recognized that linguistic experience mediates changes in development and maturation of the central auditory system. For example, as early as six months, infants have developed a preference for their L1 phoneme categorization (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992). In adults, BL listeners' central auditory systems are optimized (i.e., one "becomes neurally committed to a particular network structure for analyzing language;" Iverson et al., 2003, p. B55) such that acoustic signals that are characteristic of their L1 are more easily perceived than that characteristic of their L2. A number of anatomical and physiological studies have provided further evidence for the neural plasticity of the central auditory system with linguistic experience (e.g., Golestani, Molko, Dehaene, LeBihan, & Pallier, 2007; Näätänen, 2001; Näätänen et al., 1997; Poulsen, Picton, & Paus, 2007; Tremblay, Kraus, Carrell, & McGee, 1997; Winkler et al., 1999).

In investigating the effect of linguistic experience on speech perception, researchers have compared native Mandarin speakers with native English speakers (see below). Those who speak Mandarin have a unique linguistic experience relative to English speakers. Unlike English, Mandarin is a tonal language in which different pitch contours, principally carried by the vocalic part of the syllable, convey different lexical meanings (Li & Thompson, 1987). There are four tones (i.e., fundamental frequency contours) in Mandarin that can convey four different meanings. For example, the syllable /ma/ pronounced with either of the high level, high rising, low falling, or high falling tones can mean "mother," "hemp," "horse," or "to scold," respectively. Kuhl (2000) contents that "language experience changes one's discriminative abilities and listening preferences [and] it results in a 'mapping' that alters perception" (p. 11853). Hence, the linguistic experience of Mandarin speaking Chinese adults is believed to incline them to have better perception of auditory stimuli whose spectral and/or temporal properties resemble their speech. Specifically, because of their experience with their tonal language, Mandarin speakers are predisposed to perceive stimuli with tonal characteristics. Simply put, the language experience of native Mandarin speakers enhances processing of linguistically relevant tonal features in both temporal and spectral domains of acoustic input better than speakers of non-tonal languages. Conversely, listeners with different language backgrounds (e.g., English) typically show similar responses as Mandarin speakers to auditory stimuli whose spectral and/or temporal properties do not resemble tonal speech. This has been demonstrated in numerous studies outlined below with behavioral, psychoacoustic and electrophysiological measures.

Klein, Zatorre, Milner, and Zhao (2001), for example, compared native Mandarin and native English speakers'

performance in tone discrimination with monosyllabic Mandarin words. Their behavioral data revealed that the Mandarin speakers responded with more accuracy, and their positron emission tomography data indicated that the Mandarin speakers showed more activation in the left hemisphere. Bent, Bradlow, and Wright (2006) demonstrated that native Mandarin speakers outperformed native English speakers in identifying tonal information in speech signals, whereas the two groups showed similar performance in non-speech pitch discrimination tasks. Interestingly, the authors found that the two groups showed differences in non-speech pitch contour identification tasks (e.g., native Mandarin speakers made more mistakes in identifying flat and falling pitch contours). Using two-alternative-forced-choice tasks, Luo, Boemio, Gordon, and Poeppel (2007) reported that native Mandarin speakers and native English speakers showed similar performance in discriminating frequency-modulated tone sweeps. However, comparing with their data from native English speakers, native Chinese speakers were better in detecting the directions of the tone sweeps. Gandour and colleagues used various methodologies, including mismatch negativity (Chandrasekaran, Gandour, & Krishnan, 2007; Chandrasekaran, Krishnan, & Gandour, 2007a, 2007b, 2009a, 2009b), functional magnetic resonance imaging (Gandour et al., 2003), brainstem frequency following response (Krishnan & Gandour, 2009; Krishnan, Gandour, Bidelman, & Swaminathan, 2009; Krishnan, Swaminathan, & Gandour, 2009; Krishnan, Xu, Gandour, & Cariani, 2004, 2005; Swaminathan, Krishnan, & Gandour, 2008; Swaminathan, Krishnan, Gandour, & Xu, 2008; Xu, Krishnan, & Gandour, 2006), and behavioral studies (Xu, Gandour, & Francis, 2006) to examine the effect of linguistic experience on Mandarin speakers' speech perception. Their findings converge on the notions that native Mandarin listeners generally are more sensitive to pitch contours than native English listeners and this difference is reflected on both cortical and subcortical levels.

The current study investigated Mandarin-English BLs' and American English MLs' word recognition in quiet and noise utilizing a paradigm developed by Stuart and colleagues (Elangovan & Stuart, 2005; Scott, Green, & Stuart, 2001; Stuart, 2004, 2005, 2008; Stuart & Carpenter, 1999; Stuart, Givens, Walker, & Elangovan, 2006; Stuart & Phillips, 1996, 1997, 1998; Stuart, Phillips, & Green, 1995). This paradigm requires listeners to identify words presented in backgrounds of continuous and interrupted noises as a function of signal-to-noise ratio (S/N). A perceptual advantage is generally evidenced with listeners in the interrupted noise. That is, listeners demonstrate superior speech perception at equivalent S/Ns in the interrupted noise relative to continuous noise (i.e., a release from masking [RFM]). This advantage has been attributed to a listener's ability to resolve speech fragments in the silent gaps between noise bursts. Since the long-term average spectra of the two noises are the same and differ only in their temporal continuity, any RFM evidenced is a demonstration of auditory temporal resolution. One can assess auditory temporal resolution capacity among groups of listeners by examining overall performance in the interrupted noise and also by examining the amount of RFM in the interrupted noise relative to the continuous noise. In his seminal study investigating speech intelligibility in interrupted noise, Miller (1947) attributed the mechanism for this perceptual advantage to the fact that "the recovery of the ear is rapid enough, and our ability to integrate fragments of speech is great enough, that any periodic interruption of masking sounds lowers its masking effectiveness" (p. 122). It has also been suggested that listeners get "glimpses" (Miller & Licklider, 1950) or "looks" (Dirks, Wilson, & Bower, 1969) or utilize "dip listening" (Füllgrabe, Berthommier, & Lorenzi, 2006) between the gaps of noise such that information is patched together in order to identify the speech stimuli. Two phenomena responsible for the masking effect on speech intelligibility observed in interrupted noise with monosyllabic stimuli were first posited by Dirks and colleagues (Dirks & Bower, 1970; Dirks et al., 1969): Simultaneous masking occurs during noise bursts and temporal masking (i.e., forward and backward masking) during the interburst intervals. Subsequent researchers have demonstrated that both forward and backward masking influence perception of stimuli in silent gaps bound by continuous noise (Elliot, 1969; Fastl, 1976, 1977, 1979; Patterson, 1971; Pollack, 1964; Robinson & Pollack, 1973; Wilson & Carhart, 1971).

To the best of our knowledge, this was the first study that employed a non-stationary energetic masker (i.e., interrupted noise) to evaluate BL listeners' L2 word recognition. Previous researchers have employed speech competitors that are stationary energetic maskers (e.g., continuous noise; Bradlow & Bent, 2002; Cooke et al., 2008; Gat & Keith, 1978; Kang, 1998; Meador et al., 2000; Nabelek & Donahue, 1984; Rogers et al., 2006; Shimizu et al., 2002; van Wijngaarden, Steeneken, & Houtgast, 2002; von Hapsburg et al., 2004; Weiss & Dempsey, 2008) or non-stationary informational maskers (e.g., competing speech or multitalker babble; Crandell & Smaldino, 1996; Cutler et al., 2004; Garcia Lecumberri & Cooke, 2006; Lew & Jerger, 1991; Lopez, Martin, & Thibodeau, 1997; Mayo et al., 1997; Nelson, Kohnert, Sabur, & Shaw, 2005; Takata & Nabelek, 1990; von Hapsburg and Bahng, 2006). Consequently, this paradigm was well suited to examine two areas of interest. The first concerned the effect of different speech competitors on BL listeners with

non-native speech stimuli. The second area of interest concerned the effect of linguistic exposure and speech stimuli on listeners' temporal resolution ability (i.e., RFM). A number of hypotheses were formulated. In accordance with previous studies, it was hypothesized that

(1) performance in the continuous noise would be poorer than in the interrupted noise,

(2) performance would deteriorate with decreasing S/N,

(3) BLs would demonstrate more difficulty in perceiving L2 in noise compared to MLs,

(4) BLs would show similar performance in L2 perception as that of MLs in quiet,

(5) the RFM would be the same for the BLs across speech stimuli and that there would be no difference between MLs and BLs.

The final hypothesis was generated from the notion that the underlying basic temporal resolving abilities should be the same across these groups of listeners and that their language experiences should not predispose an advantage for one group over the other with this temporal resolution acuity paradigm. That is, while the BLs should have poorer perception of L2 in both noises compared to the MLs, the perceptual advantage achieved in the interrupted noise (i.e., RFM) should be the same as it can be attributed to basic underlying temporal acuity ability in all normal listeners.

METHOD

Participants

The BL group included 12 females (M = 25.7 years, range = 24 – 30) who were born in People's Republic of China. They were all East Carolina University graduate student[1] volunteers who responded to announcements soliciting participation. The BL participants completed a questionnaire that probed their linguistic profile (Grosjean, 1997; von Hapsburg & Pena, 2002). The questionnaire surveyed dimensions of language status, history, and competency of L1 and L2. Their L1 was Mandarin. They started to acquire English as their L2 at school at an average age of 11.8 years (range = 10 – 13). Therefore, they were considered as late elective BLs (von Hapsberg & Pena, 2002). They reported coming to the United States for graduate study and were considered still in the process of acquiring L2. Self-reported ratings of English proficiency were assessed with a five-point Likert scale (with 1 being poor and 5 excellent). Mean self-reported proficiencies were 3.3 (range = 3 – 4) for speaking, 3.7 (range = 3 – 5) for comprehension, and 3.5 (range = 3 – 5) for reading/writing. Self-reported ratings of speaking, comprehension, and reading/writing proficiency of Mandarin were excellent. Ten of 12 BL participants reported never speaking English at home. Eleven of 12 BL participants reported speaking English everyday at social occasions and everyday in professional situations. In contrast, 11 of 12 BL participants reported speaking Mandarin everyday at home. Eight of 12 BL participants reported speaking Mandarin everyday at social occasions. All 12 BL participants reported never speaking Mandarin in professional situations. When speaking with friends, six spoke mainly Mandarin, and six used both Mandarin and English. When speaking with coworkers, 11 of 12 BL participants used mainly English, and one used both languages. When speaking at home, 11 of 12 BL participants used mainly Mandarin and one used mainly English. When speaking at work, 11 of 12 BL participants used mainly English and one used both languages. While reading/writing for pleasure, 8 of 12 BL participants used both languages, and four used mainly Mandarin. While reading/writing for school, all used mainly English. While watching television, six of 12 BL participants viewed mainly English, five viewed both languages, and one viewed mainly Mandarin.

The ML group included 12 females (M = 20.5 years, range = 20 – 23) who spoke American English as their primary language. They were recruited from an undergraduate class in the Department of Communication Sciences and Disorders, East Carolina University, and received extra credit for their participation. ML participants also completed the same questionnaire that probed their linguistic profile. All of them reported having excellent English proficiency and used English as their primary language in all instances of daily living.

All participants presented with normal hearing sensitivity as defined by pure-tone thresholds of $\leq$ 25 dB HL (American National Standards Institute, 1996) at octave frequencies from 250 to 8000 Hz. Middle ear function was normal as defined by culturally appropriate normative data (Roup, Wiley, Safady, & Stoppenbach, 1998; Wan & Wong, 2002). Participants reported a negative history of speech, language, learning, and cognitive disorders.

Stimuli and Apparatus

The stimuli were speech test materials and custom competing background noise. The English test materials included Lists 1-4 of the Northwestern University Auditory Test No. 6 (female voice; Tillman & Carhart, 1966) released by the U.S. Department of Veteran Affairs (1991). Each list consisted of 50 monosyllabic words in consonant-vowel-consonant form. The competing stimuli were continuous or interrupted noises described in detail

elsewhere (Stuart, 2004; Stuart & Philips, 1996, 1998). Briefly, these noises had an identical power spectrum and differed only in their temporal structures. The continuous noise was a broadband white noise with a flat spectrum within 2 dB from 100 to 8,000 Hz. The interrupted noise was made from the continuous noise wave by applying a random rectangular on/off envelope with a duty cycle of 0.50. It was characterized with silent gaps between noise bursts; both the gaps and noise bursts varied randomly from 5 to 95 ms. Randomized gating of the noise eliminates any pitch precept that may possibly arise from periodic modulation of the masker which could be utilized as a cue to segregate signal and noise by the listener (Stuart & Phillips, 1996, Stuart, 2004).

Participants were tested in a double-wall sound-treated audiometric suite meeting specifications for permissible ambient noise (American National Standards Institute, 1999). The audio signals were delivered from two compact disc players (Philips Model CDR 765 K02 and JVC Model XL-FZ258BK) to a clinical audiometer (Grason Stadler GSI 61 Model 1761-9780XXE) and presented monaurally to each participant's right ear through an insert earphone (Etymotic Research Model ER-3A).

Procedure

The University and Medical Center Institutional Review Board at East Carolina University approved all experimental procedures, including recruitment and acquisition of informed consent prior to data collection. All participants provided voluntary informed consent prior to data collection. The speech stimuli were presented to the participants at 30 dB sensation level relative to their three-frequency pure-tone average (i.e., 500, 1000, and 2000 Hz). The mean presentation levels were 37.1 dB HL (*SD* = 4.5) and 39.2 dB HL (*SD* = 2.3) for the BL group and ML group, respectively. These presentation levels were not statistically different, t (22) = 1.35, p = 0.19. Participants were first tested in quiet, and then in continuous and interrupted noise at three S/Ns (i.e., 10, 0, and -10 dB). The presentation order of the noise conditions was counterbalanced using a digram-balanced Latin-Square design (Wagenaar, 1969). Participants were instructed to repeat the words presented to them and to guess if necessary. The first author, fluent in both English and Mandarin, scored participants' responses. All participants were tested in one session typically lasting one hour. Adequate rest periods were provided between tasks and whenever requested.

RESULTS

Participants' performance was scored as total word percent correct. The mean word recognition scores were 95.8% (*SD* = 3.0) and 89.0 % (*SD* = 3.5) for the ML group and BL group, respectively. Prior to inferential analyses, the data were transformed into the rationalized arcsine units (Studebaker, 1985). An independent t-test revealed that ML participants performed significantly better than the BL participants, t (22) = -4.98, $p < 0.001$, $\eta^2 = .53$.

Figure 1 illustrates word recognition performance as a function of group, noise, and S/N. A three-factor mixed analysis of variance (ANOVA) was employed to examine word recognition performance as a function of group, noise, and S/N. The summary of that analysis is presented in Table 1. As shown in Table 1, all main effects and the interaction of noise × S/N were significant ($p < 0.001$). In general, the ML group performed better than BL group; all participants performed better in interrupted noise than continuous noise; and all participants' performance decreased with decreased S/N. To explore the source of the significant noise × S/N interaction a number of post hoc analyses were performed. Two orthogonal single-df comparisons were undertaken to examine the effect of S/N in continuous noise. Two orthogonal single-df comparisons were also undertaken to examine the effect of S/N in interrupted noise. For both noises, significant differences were found between scores at all three S/N ($p < 0.001$). Three paired-samples t-tests were utilized to examine differences between performances in continuous and interrupted noises at each S/N. There was no significant differences in word recognition performance at 10 dB and 0 dB S/N ($p > 0.05$). At -10 dB S/N performance was significantly better in the interrupted noise ($p < 0.001$).

RFM was calculated by subtracting word recognition percent correct in continuous noise from interrupted

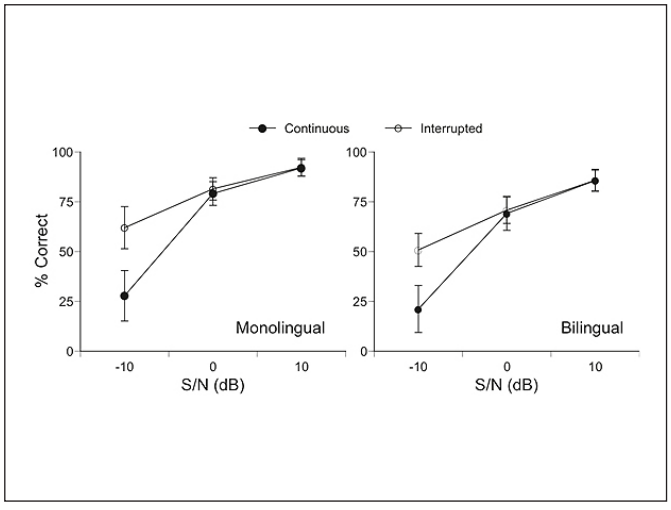

Figure 1.
Mean percent-correct word recognition as a function of group (i.e., monolingual and bilingual), noise (i.e., continuous and interrupted), and S/N. Error bars represent plus/minus one standard deviation of the mean.

noise at -10 dB S/N for each group (Stuart et al., 2006). Mean difference scores were 34.2% (*SD* = 11.1) and 29.7 % (*SD* = 9.8) for the ML group and BL group, respectively. An independent t-test revealed no significant differences between ML and BL group mean difference scores, t (22) = 0.61, p = 0.55, η^2 = .017.

Table 1

Summary of A Three-Factor Mixed Analysis of Variance Investigating Differences in Word Recognition Performance As A Function of Group, Noise, And S/N

Source	*df*	F	*p*	η^2
Group	1	14.93	0.001 *	0.40
Noise	1	113.53	< 0.001 *	0.84
S/N	2	540.23	< 0.001 *	0.96
Noise × group	1	0.48	0.50	0.02
S/N × group	2	0.21	0.81	0.01
Noise × S/N	2	110.21	< 0.001 *	0.83
Noise × group × S/N	2	0.12	0.89	0.01

Note. Effect size is indexed by η^2. Cohen (1988) classifies small, medium, and large effect size values as 0.10, 0.25, and 0.40, respectively. * Significant at p < 0.05.

DISCUSSION

Performance in Quiet

Contrary to our hypothesis, BLs in this study had significantly poorer word recognition for L2 stimulus relative to the MLs. While the majority of studies (Gat & Keith, 1978; Nabelek &. Donahue, 1984; Takata & Nabelek, 1990; Crandell & Smaldino, 1996; Mayo et al., 1997; Shimizu et al., 2002; Rogers et al., 2006) have found that BLs display native-like speech recognition like MLs, some have found the same difference as reported herein (Garcia Lecumberri & Cooke, 2006; Cooke et al., 2008). The relative differences in these studies may be attributed to differences in speech stimuli employed with the BL listeners. Average performance for adult ML English speakers with the NU-6 monosyllabic word materials is typically below 95% at presentation levels similar to that found in this study (Beattie, Edgerton, & Svihovec, 1977; Wilson, Coley, Haenel, & Browning, 1976; Wilson, Zizz, Shanks, & Causey, 1990; Stuart, Green, Phillips, & Stenstrom, 1994). The group difference in word recognition scores found in this study may simply be related to sampling error.

Performance in Noise

As hypothesized, performance improved with increasing S/N and was superior in interrupted noise relative to continuous noise at the poorest S/N. This is consistent with previous applications of this paradigm (Elangovan & Stuart, 2005; Scott et al., 2001; Stuart, 2005, 2008; Stuart & Carpenter, 1999; Stuart & Phillips, 1996, 1997, 1998; Stuart et al., 1995, 2006). As expected, the BLs perceived L2 speech stimulus poorer than MLs with both stationary and non-stationary energetic maskers. This is in agreement with previous research where poorer speech perception of L2 stimuli by BLs was observed (Bergman, 1980; Bradlow & Bent, 2002; Cooke et al., 2008; Cutler et al., 2004; Garcia Lecumberri & Cooke, 2006; Gat & Keith, 1978; Kang, 1998; Mayo et al., 1997; Nabelek & Donahue, 1984; Rogers et al., 2006; Shimizu et al., 2002; Takata, & Nabelek, 1990; Van Engen & Bradlow, 2007). This is the first demonstration of BLs' performance in a strictly non-stationary energetic masker. Some of the deficit displayed in noise can be attributed to the NU-6 stimuli as the BLs displayed a performance detriment in quiet and would therefore be expected to display at least an equivalent detriment in noise.

The differences, however, between the ML and BL participants did not increase as the S/N became less favorable, which is consistent with other researchers (Bradlow & Bent, 2002; Rogers et al., 2006). These findings appear equivocal, as others have observed that the perceptual difference between BLs and MLs becomes more pronounced when listening conditions become more degraded (Cooke et al., 2008; Crandell & Smaldino, 1996). Often listeners' performances are compared in energetic noise (i.e., white noise) to that in informational noise (i.e., multi-talker babble) and some have suggested that the native advantage in speech perception under noise may exist in both energetic and informational maskers. However, the finding of this study that the noise, group, and S/N interactions were not statistically significant (see Table 1) lead one to suggest that both stationary and non-stationary energetic maskers may not disproportionately affect native and non-native listeners' speech perception under noise. Therefore, the role of energetic and informational maskers in non-native perception (e.g., which masker contributes more to the native advantage, or non-native disadvantage) remains to be explored in speakers of different languages, between various energetic maskers, and with early and late BLs. It is also noteworthy that the results may be dependent on the stimuli used in

this experiment. Previously, Cutler et al. (2004) found that phonemic identification does not contribute to the disproportionate native advantage in general speech perception under noise; that is, although non-natives performed poorer in phoneme identification under noise, the gap between native and non-native speakers did not widen with increased noise level. Therefore, it is possible that the disproportionate native advantage in speech recognition is not easy to be distinguished at phoneme and word levels, but may become evident when other speech stimuli and maskers are employed.

Temporal Resolution - Release from Masking

Another aim of the study was to examine the impact of linguistic exposure on listeners' temporal resolution ability as assessed with word recognition in noise. As noted above, temporal resolution with this paradigm may be examined with overall performance in the interrupted noise or indexed by RFM, the relative advantage of speech perception in interrupted noise compared to continuous noise at same -10 dB S/N. The advantage or RFM that listeners experience in interrupted noise has been hypothesized to be due to the capacity to resolve speech fragments in the silent gaps between noise bursts. With respect to overall performance in the interrupted noise, the BL listeners were poorer than the ML listeners for the same stimuli (i.e., L2). We do not, however, interpret these differences as evidence for a deficit in temporal resolution experienced with L2 stimuli per se. We ascribe the difference between the two groups to poorer processing efficiency for L2 stimuli by the BL participants. Processing efficiency refers to factors besides temporal and spectral resolution that influence one's capacity to perceive acoustic signals in noise (Hartley, Hill, & Moore, 2003; Hartley & Moore, 2002; Stuart, 2008). In other words, as a consequence of poor processing efficiency BL listeners need a higher S/N for L2 stimuli than MLs to perceive at an equivalent level of word recognition. Central to that argument is the fact that no differences were found with RFM between the ML and BL groups. That is, temporal resolution was the same between the English and Chinese participants. It can be inferred from the results that the temporal resolution ability, as indexed with a measure of RFM with this word recognition in noise paradigm, is independent of linguistic exposure (as examined between BLs and MLs with English).

A similar pattern of performance was recently observed with the same cohort of participants with sentence recognition materials (Stuart, Zhang, & Swink, 2010). Reception thresholds for sentences were determined with the same competing continuous and interrupted noises. The sentence stimuli employed consisted of the *Hearing in Noise Test* and the *Mandarin Hearing in Noise Test*. The measurement properties and test characteristics of both tests are equivalent (Wong, Liu, & Han, 2008; Wong, Soli, Liu, Han, & Huang, 2007). RFM (i.e., the difference of reception thresholds for sentences S/N in interrupted and continuous noise) was examined between and within groups. There was no significant difference for the BLs' RFM with L1 versus L2 sentence materials. The ML group had significantly greater RFM for the English stimuli compared to the BLs. Stuart et al. did not interpret the latter finding as a reflection of better temporal acuity in the ML English participants. They attributed the difference to a differential masking effect on the two sentence stimuli. That is, they evidenced no significant differences in reception threshold S/Ns between groups in the interrupted noise. The ML English participants, however, had significantly higher reception threshold S/Ns in continuous noise. The lower reception threshold for sentence S/N found with the *Mandarin Hearing in Noise Test* in continuous noise was attributed above to differences in the original Mandarin and English stimuli (Wong et al., 2007). This latter difference contributed to the group difference in the RFM.

If one views the ability to resolve auditory fragments in the silent gaps between the bursts of noise as elementary temporal auditory acuity ability then the findings of equivalent RFM are understandable. First, it is difficult to posit any reason for a language/experience dependent advantage for word recognition in interrupted noise for either the English or Mandarin speaking Chinese participants. It has been demonstrated repeatedly that Mandarin speakers have better pitch representation than English speaking listeners with both speech and non-speech context evidenced in both auditory evoked responses (Chandrasekaran et al., 2007a, 2007b; Krishnan & Gandour, 2009; Krishnan, Gandour, et al. 2009; Krishnan et al., 2004, 2005, 2009; Swaminathan, Krishnan, & Gandour, 2008; Swaminathan, Krishnan, Gandour, & Xu, 2008; Xu, Krishnan, & Gandour, 2006) and psychoacoustic measures (Bent et al., 2006; Francis & Ciocca, 2003; Lou et al., 2007; Xu, Gandour, & Francis, 2006). These differences have been attributed to language experience effects (i.e., repeated exposure in tonal language to pitch contour variations for lexical distinctions). The gating of the interrupted noise was random thereby eliminating any pitch percept that may possibly arise from periodic modulation of the noise that may be used as a cue to segregate signal and noise by the listener (Stuart, 2004; Stuart & Phillips, 1998). Eliminating any possible pitch percept would negate an advantage for the Mandarin speaking listeners.

CONCLUSIONS

Word recognition was examined in quiet and in two energetic noise maskers with identical power spectrums and different temporal continuity, as a function of S/N with Mandarin-English BLs and American English MLs. The first line on inquiry involved examining the effect of the different stationary (i.e., continuous noise) and non-stationary (i.e., interrupted noise) speech competitors on ML and BL listeners. The second line of inquiry involved examining the effect of linguistic exposure and speech stimuli on listeners' temporal resolution ability. This was the first study to evaluate BL listeners' L2 speech perception against a non-stationary speech competitor. As expected, performance for both groups was poorer in the continuous noise and deteriorated with decreasing S/N. At the poorest S/N, participants demonstrated superior performance in the interrupted noise compared to continuous noise (i.e., a RFM). BLs perceived L2 speech stimuli poorer than MLs with both stationary and non-stationary energetic maskers. The differences between the two groups, however, did not increase as the S/N became less favorable. Poorer processing efficiency for L2 stimuli was attributed for the inferior performance of the BL versus ML participants. Most important was the fact that there were no differences in the RFM between the ML and BL groups. It was inferred that the temporal resolution ability, as indexed with a measure of RFM, is independent of linguistic exposure of listeners. This is consistent with the view that this word recognition in noise paradigm exposes basic temporal resolution ability and is not language or experience-dependent.

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ENDNOTE

[1]A standardized test of English proficiency was not administered to the BL participants. We assumed a minimal level of English proficiency among these participants, as they were all graduate students at East Carolina University. For admission, the university requires students to meet a language exam requirement of a TOEFL® score of 20 on each section for a total minimum score of 80, 550 (paper based), or 213 (computer based), or IELTS™ score of 6.5.

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Developing Phonological Awareness Skills in Children with Down Syndrome

Développement des habiletés de conscience phonologique chez des enfants avec le syndrome de Down

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KEY WORDS
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Abstract

The response of children with Down syndrome (DS) to a program focusing on phonological awareness (PA) skills is reported. Seventeen children with DS were randomly assigned to the PA program or to an alternate program. The program involved individual twice weekly 30-minute sessions for 22 weeks. Rhyming and initial and final phoneme identification were targeted. A significant treatment effect for phoneme identification in final position was found with a large effect size. Phonological awareness skills are particularly challenging for children with DS. The results suggest that it is possible to teach phonological awareness skills to children with DS with a focused intervention program.

Abrégé

Cette étude porte sur la réaction d'enfants avec le syndrome de Down à un programme portant sur les habiletés de conscience phonologique. Dix-sept enfants avec le syndrome de Down ont été répartis aléatoirement en deux groupes, soit un qui a reçu le programme de conscience phonologique, et l'autre, un programme alterne. Le programme ciblé consistait en des sessions individuelles de 30 minutes deux fois par semaine pour une durée de 22 semaines. Les buts ciblés étaient les rimes et l'identification du phonème initial et final. Nous avons trouvé un effet de traitement significatif et une grande ampleur d'effet pour l'identification des phonèmes en fin de mot. Les habiletés de conscience phonologique sont particulièrement difficiles pour les enfants avec le syndrome de Down. Les résultats suggèrent qu'il est possible d'enseigner ces habiletés aux enfants avec le syndrome de Down grâce à un programme d'intervention ciblé.

Much is known about the oral language development of individuals with Down Syndrome (DS; see Roberts, Chapman & Warren, 2008 for a comprehensive review). Less is known about their written language development although, recently, this has become a focus of research (Buckley & Johnson-Glenberg, 2008; Kay-Raining Bird & Chapman, 2011). It was once thought that children with DS could not learn to read but it is now known that a substantial proportion of individuals with DS can develop some literacy when explicit instruction is provided (Fowler, Dohery, & Boynton, 1995; Kay-Raining Bird, Cleave, & McConnell, 2000). In fact, some children learn to read earlier than would be expected based on language and cognitive development when assessed using real words (Buckley, 2003).

There have been a number of studies examining reading development in children with DS. Typically these have involved testing a group of children with DS at various levels of reading with a battery of tests and examining the relationship among language and literacy skills, sometimes in comparison to a mental-age match. Both cross-sectional (Boudreau, 2002; Fletcher & Buckley, 2002; Fowler et al., 1995; Gombert, 2002; Kennedy & Flynn, 2003; Snowling, Hulme, & Mercer, 2002; Verucci, Menghini, & Vicari, 2006) and longitudinal designs (Byrne, MacDonald, & Buckley, 2002; Cupples & Iaconao, 2000; Kay-Raining Bird, et al., 2000; Laws & Gunn, 2002) have been used. Across these studies, a generally consistent pattern of reading development in children with DS emerges. Real word and non-word reading have been found to be related to language skills (e.g., Boudreau, 2002) and auditory memory (e.g., Fowler et al., 1995; Kay-Raining Bird et al., 2000; but note contrary findings in Boudreau, 2002). In addition, the real word reading of children with DS has been shown to be in advance of their non-verbal mental age (e.g., Boudreau, 2002; Laws & Gunn, 2002; Verucci et al., 2006) and their oral language skills (e.g., Laws & Gunn, 2002, Cupples & Iaconno, 2000). In comparisons of components of literacy, reading comprehension has been found to lag behind real word reading (e.g., Boudreau, 2002; Byrne et al., 2002; Fletcher & Buckley, 2002; Laws & Gunn, 2002; Roch & Levorato, 2009; Verucci et al., 2006) and real word reading has consistently been found to be better than non-word reading (e.g., Boudreau, 2002; Kay-Raining Bird et al., 2000; Verucci et al., 2006), which means that the reading age achieved on tests of real word reading surpass those achieved on tests of non-word reading.

As noted, children with DS show a strength in real word reading. However, an understanding of the alphabetic principle is important in the development of reading in that it allows children to read words they have not encountered in print (Kamhi & Catts, 2005). In fact, Ehri (2005) argues that learning to read real words involves establishing connections between phonemes and graphemes, a process that is dependent on phonemic awareness. These connections link the spelling of a word to its meaning and pronunciation. Phonemic awareness skills (i.e., phonological awareness skills at the phoneme level) have been shown to be important for the development of real word and non-word reading in typically developing children, children at risk for reading impairments, and children with reading impairments (Blachman, 2000). In fact, the National Reading Panel report (NRP, 2000) identified phonemic awareness as one of the five critical components of learning to read. Therefore, it is not surprising that phonemic awareness skills have also been examined in studies of reading development in children with DS.

Studies have shown that the phonological awareness skills of children with DS, both at the syllable and phoneme levels, are lower than real word reading level would predict (Boudreau, 2002; Gombert, 2002; Kay-Raining Bird et al., 2000; Verucci et al., 2006). However, research has demonstrated that individuals with DS do develop phonological awareness skills and that there is a positive relationship between phonemic awareness and real word and non-word reading in children with DS (Cupples & Iacono, 2000; Fowler et al, 1995; Kay-Raining Bird et al., 2000; Roch & Jarrold, 2008). Furthermore, phonemic awareness skills have been found to predict later real word (Laws & Gunn, 2002) and non-word (Cupples & Iacono, 2000) reading skills in children with DS. Thus, phonological awareness is an area of particular difficulty for children with DS. However, children with DS can develop phonological awareness skills, and similar relationships between phonemic awareness and reading have been found in children with DS as have been found in typically developing readers.

Research has investigated the training of phonological awareness skills in typically developing children and in children at risk for, or with documented, language and reading impairments. In a meta-analysis of this work, Ehri and colleagues reported that the training of phoneme awareness had positive effects on phoneme awareness, decoding, and reading comprehension (Ehri, Nunes, Willows, Schuster, Yaghoub, & Shanahan, 2001). This was true for typically developing children, those at risk for language and reading impairments, and those with documented reading impairments. However, the effect sizes were generally smaller for children with reading impairments.

In contrast, there has been limited research on training

phonological awareness skills in children with DS. A recent review identified only three intervention studies in which phonological awareness skills were directly targeted (Lemons and Fuchs, 2010). Furthermore, the authors noted significant weaknesses in the designs of each of these studies. These three studies plus a fourth are described below.

Kennedy & Flynn (2003) reported on a multiple baseline, single subject design study involving three children with DS. The children participated in eight 1-hour sessions which were held twice weekly for 4 weeks. Rhyme and alliteration detection, phoneme isolation, and spelling of orthographically regular words were trained. These skills, and also a generalization task involving phoneme segmentation and control tasks involving comprehension of passive structures and spatial terms, were assessed. All three children showed some growth in phoneme isolation and spelling skills. Two of the three children showed gains in rhyming. However, none of the participants showed evidence of generalization to the non-trained phoneme segmentation task. The control goals (i.e., passive sentences and spatial terms) showed no growth.

In 2006, a second study about a phonological awareness intervention with children with DS was reported (van Bysterveldt, Gillon, & Moran, 2006). Seven 4-year old children with DS enrolled in a specialized early intervention program participated. The intervention was administered by the parents. During one training session, the parents were taught to use print referencing techniques and to bring the child's attention to four target phonemes and their corresponding letters while reading a book with their child. The parents then conducted four 10-minute sessions weekly in their home for 6 weeks. The authors report that pre-post comparisons using a number of t-tests showed a significant change in initial phoneme identification, letter sound knowledge, and print concepts. The change in letter name knowledge approached statistical significance. Five of the seven children with DS followed this pattern while two children showed no change. Although the study design did not involve experimental control sufficient to establish treatment effects, the researchers did administer the same assessments to a group of age-matched typically developing children who received no intervention beyond their regular preschool programs. Over the same time period, the TD group demonstrated significant changes in only letter name knowledge. The authors interpret this as evidence that their intervention program impacted phonological awareness skills in the children with DS.

Van Bysterveldt and her colleagues recently conducted another study in which phonological awareness activities were integrated into a phonologically based intervention for speech production (van Bysterveldt, Gillon & Foster-Cohen, 2010). This study was not included in the review by Lemons and Fuch (2010). Ten preschool children were involved in this replicated single subject design study. The intervention included a parent-based program similar to the program in the study described above, therapy sessions with a speech language pathologist and computer work. The speech therapy sessions took place once a week for 20 minutes. They were organized around goals selected to target speech production errors, which included initial and final consonants as well as initial consonant clusters. In the sessions, some of the activities involved matching words with the target speech sound and instruction on the letter associated with the target speech sound. In the computer sessions, phonological awareness and letter knowledge tasks were presented. These also took place once a week for 20 minutes. There were two 6-week blocks of therapy for a total of four hours of speech therapy and four hours of computer work. The authors report that all 10 participants made improvements on speech production measures, six showed improvement on letter knowledge and seven showed increases in initial phoneme matching, although their responses did not get above a chance level.

Finally, Goetz and her colleagues reported on a study (Goetz et al., 2008) involving 15 children with DS between the ages of 8 and 14 who attended mainstream schools. To be included in the intervention study, the children had to demonstrate emerging literacy skills, defined by reading at least five words on a test of early word reading and scoring less than 50% correct on a nonword reading test. Eight children received the intervention program immediately and seven served as a delayed treatment control group. The intervention was administered by the children's learning support assistants and involved one-on-one sessions, 40 minutes per day for 8 weeks. The program targeted literacy on a number of levels. It included work on letter sound knowledge, phoneme segmenting and blending, sight word reading, and book reading. It also included oral-motor exercises focusing on the production of target phonemes. The immediate treatment group showed statistically greater gains in letter-sound knowledge and early word recognition after 8 weeks of intervention. They also showed more progress on initial phoneme matching. On this measure, there was a large effect size although it did not quite reach statistical significance. However, as noted by the authors, the reading and phonological awareness gains were modest.

Purpose

The four studies reviewed above provide some indication that phonological awareness skills can be taught

to children with DS. However, all of the studies were small scale, two of the four were single subject designs (van Bysterveldt et al., 2010; Kennedy & Flynn, 2003) and one did not include a control group (van Bysterveldt et al., 2006). Therefore, additional information is necessary to establish whether targeted intervention can improve the phonological awareness skills of children with DS. In studies involving children with DS, it is difficult to achieve a large sample size. Therefore, well-designed smaller N studies must be conducted. When a consistent pattern of results is found across such studies, the reliability of the findings is enhanced. The current exploratory study was designed to determine how children with DS responded to a focused phonological awareness-training program. A group design was used, with the comparison group receiving an equivalent amount of training focused on narrative development. We predicted that the children receiving the phonological awareness program would make greater gains in phonological awareness skills and in word decoding skills.

METHOD

Participants

Seventeen school-aged children and adolescents with DS between the ages of 5;10 and 16;8 participated. There were 10 girls and 7 boys. They were recruited from public schools across Nova Scotia, Canada where they were integrated into regular classrooms in their neighbourhood schools. To be included in the study, the children had to be native English speakers and show limited word level reading abilities (i.e., read fewer than 8 items on a real word reading test). The children were randomly assigned to one of two treatment groups (see below). Table 1 presents cognitive, language, literacy and phonological awareness skills at the outset of the study for each group.

Table 1

Participant Characteristics at Beginning of Study [mean (standard deviation)]

Characteristic	*PA Group[a] (n = 8)*	*NI Group[b] (n = 9)*
Chronological Age in months	140.4 (43.7)	120.6 (29.0)
Mental Age in months	48.4 (9.4)	53.4 (13.9)
OWLS Expressive	32.1 (9.0)	34.6 (9.8)
OWLS Receptive[c]	37.8 (13.4)	33.0 (8.7)
WRMT – Letter Identification	15.0 (10.9)	19.3 (5.9)
WRMT – Word Identification	5.6 (10.7)	4.3 (4.5)
WRMT – Work Attack	0.00 (0.0)	.13 (.35)
Rhyme task	0.6 (1.2)	0.3 (0.5)
TOPA Initial	2.9 (2.3)	3.3 (2.3)
TOPA Final	1.5 (1.2)	2.6 (1.5)

Notes. Oral Written Language Scales (OWLS) Expressive & Receptive Scales in age equivalent scores in months; Woodcock Reading Mastery Test (WRMT), Rhyme task, and Test of Phonological Awareness (TOPA) in raw scores.
[a]PA Group = Phonological Awareness Group
[b]NI Group = Narrative Intervention Group
[c]OWLS Receptive Scale scores were unavailable for 1 child in the PA group and 2 children in the NI group.

Procedures

The phonological intervention program (PA) was part of a larger study involving two interventions designed to impact language and literacy skills in children with DS. The two programs targeted language skills that are known to impact literacy development: phonological awareness and narrative skills. Only the results of the phonological awareness testing will be reported in this article.

The children were all assessed with a common test battery (see below) pre-intervention (T1), post-intervention (T2) and six months later as a maintenance test (T3). Eight children were randomly assigned to the phonological awareness intervention (PA) and 9 to the narrative intervention (NI). One child in the NI group moved and was unavailable for testing at T3. The children in the NI program (Kay-Raining Bird, Cleave, Bourassa, MacIsaac, & Armstrong, 2005) served as a control group for the PA group. The two intervention programs involved the same amount of intervention time, delivered by the same interventionists over the same time period. The interventionists all had postsecondary education (undergraduate university degree or college diploma) and experience working with young children with special needs. They received two full days of training, which included how to administer the programs and background information about children with DS. The interventionists were not told of the study's hypothesis but they were aware of the goals of the intervention programs they were administering. However, they had no involvement in the testing and did not know the measures that were used to assess phonological awareness skills.

Phonological Awareness Program. The intervention program was conducted in each child's school. Individual 30-minute sessions were conducted twice weekly for 22 weeks (44 sessions). The first four weeks focused on rhyme training. A total of nine word-final rhyme families, organized into groups of three, were targeted (i.e., -ate, -oe, -uck; -at, -og, -in; -ice, -ee, -all). These rhyme families were chosen because they were easily discriminated based on their differences in vowel and final consonant. Furthermore, each rhyme family contained a number of common words, which could be used in therapy activities. For the first 3 weeks, one group of three rhyme families was targeted each week (6 sessions). All nine rhyme families were targeted in the fourth week (2 sessions).

The final 18 weeks focused at the phoneme level. A total of nine phonemes were targeted and, as with the rhyme families, they were organized into groups of three (i.e., /f/, /n/, /p/; /m/, /d/, /k/; /s/, /t/, /tʃ/). The phonemes were grouped such that they were easily discriminated. Phonemes in each triad varied on at least two of the three commonly identified features voicing, manner, and place. Each group was the target for three weeks (6 sessions). In the first three sessions, two of the three phonemes were targeted (i.e., 1&2, 2&3, 1&3). In the final three sessions, all three phonemes were included. The first nine weeks targeted the three phoneme triads in initial position (18 sessions) and final nine weeks targeted the same phonemes in final position (18 sessions). Initial and final positions were targeted to draw the children's attention to both the beginning and ending of words.

In both rhyme and phoneme sessions, alliteration, identification and matching activities were used. Games such as bingo, fishing, and hide and go seek were used to keep the children's interest. Letters were paired with the rhyme and phoneme targets whenever possible. However, care was taken to ensure that the children were required to make their decision using auditory information. For instance, in the fishing game, there were two target phonemes that were contrasted. There were two buckets, each with a picture of a word starting with one of the target phonemes and the corresponding letter pasted on the front. The child caught a fish with a picture on it. He then decided which of two buckets to put the fish in based on the initial phoneme. The words were not printed on the pictures. Thus, the child could not make their decision based on visual matching of the letter. For phoneme sessions, word position was visually supported using a train with the targets placed on the engine or caboose. This was introduced at the beginning of the each session. In introducing the session's targets, both letter name and sound were provided (e.g., this is the letter 't'. It says /t/).

Testing. All testing was completed by speech-language pathologists who were blind to the child's group assignment. The testing took place over one or two 90 minute sessions, with breaks as necessary. At T1 only, the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972) or the Pattern Recognition and Bead Memory subtests of the Stanford-Binet Intelligence Scale, 4th edition (Thorndike, Hagan, & Sattler, 1986) were administered to assess non-verbal cognition, depending on test availability. In addition, the Listening Comprehension and Oral Expression Scales of the Oral and Written Language Scales (OWLS; Carrow-Woolfolk, 1995) were used to determine general oral language abilities. At all three testing periods, phonological awareness and reading skills were assessed. Rhyming skills were assessed using a rhyme production task in which the child produced as many rhymes for the word 'pat' as possible in 2 minutes. The Test of Phonological Awareness (TOPA; Torgeson & Bryant, 1994) was used to assess initial and final phoneme identification skills. In the TOPA, the child is asked to identify which picture out of three starts or ends with the same phoneme as the stimulus picture. There are 10 items for initial position and 10 items for final position. The Letter Identification, Word Identification, and Word Attack subtests of the Woodcock Reading Mastery Test (WRMT; Woodcock, 1987) were administered to assess the children's early letter and word reading skills. In the Letter Identification subtest, children are asked to name letters. Initially, the letters are presented in a common font but later items involve less common fonts. The Word Identification subtest involves real word reading and the Word Attack subtest involves nonword reading.

In addition, two questionnaires were distributed to gather information about the children's experiences with reading. One was completed by the child's educational team and the other by the child's parents. The educator's questionnaire asked whether rhyming, initial and final sounds and reading were targeted in the children's educational program. It also inquired about the amount of time spent per week on the skill and asked for examples of activities used. Questions were also asked about the amount of time the child spent in the regular classroom and what supports the child received (e.g., speech-language pathology, program assistant, resource room, etc.). The parent's questionnaire asked about the child's reading and writing experiences at home, whether the parents focused on teaching letters and sounds and how they did this, and supports received outside of school (e.g., speech-language pathology, tutoring, etc.). These were distributed at the end of the study so that completing the questionnaire would not alter the schools' or parents' practices.

Analyses

Given the small number of participants and the fact that the data were not normally distributed, nonparametric analyses were used. Group gains on the phonological awareness and reading measures were compared using Mann-Whitney *U* tests. In this analysis, the rank order of participants in the two groups is compared thus the groups mean rank orders are presented rather than group means when discussing statistical results. Because there were a priori predictions that children in the PA group would make greater gains on phonological awareness and decoding skills than those in the NI group, 1-tailed tests were used. The probability index (Acion, Peterson, Temple, & Arndt, 2006) was used to calculate effect sizes. The probability index represents the probability that a participant in the treatment group performed better than a randomly chosen participant in the control group.

Where no group differences were found, the Sign test was used to see if there was evidence of growth across both groups as the difference scores were not symmetrically distributed. As this was an exploratory study, a *p* level of .05 was set for all analyses.

Treatment Fidelity

Treatment fidelity was measured using a rubric modeled after one developed by Brand Robertson & Ellis Weismer (1999) and was completed by the first author. The dimensions included were session structure, number of response opportunities, strategies used to highlight target in the input to the child and strategies used to highlight target in the feedback to the child. There were a total of twelve possible points. Eighteen sessions (5%) of the phonological awareness intervention program were randomly selected for evaluation, with the proviso that at least two sessions from each child were scored. The average treatment fidelity score was 11. The range was 10-12. This is evidence that the PA intervention adequately adhered to the program design.

RESULTS

Group Comparisons

Mann-Whitney U tests were conducted on T1 measures to determine if the groups differed significantly in terms of age or on any cognitive, language, phonological awareness, or reading measure. The tests revealed that the PA and NI groups did not differ significantly (*ps* > .20) on any measure pre-intervention. Furthermore, no child was at ceiling on the TOPA (max. 10; range 0-7 initial position, 0-5 final position). See Table 1 for the groups' scores at T1. Results for the cognitive and language testing are given in age-equivalent scores in months to provide a developmental picture of the children. The results for phonological awareness and reading testing are given in raw scores as these were used in the analysis of the response to treatment.

To assess the impact of the program on the children's phonological awareness skills, Mann-Whitney *U* tests were used to compare the PA and NI groups on gains between T1 and T2 and between T1 and T3 for the number of unique rhymes produced in two minutes, and the number correct on the TOPA for initial and final positions. There were no significant group differences on the T1 to T2 comparisons. For rhyme (U = 27.0, n_1 = 9, n_2 = 8, p = .17, 1-tailed) and final position (U = 24.5.0, n_1 = 8, n_2 = 8, p = .13, 1-tailed), the differences were in the predicted direction (i.e., PA higher than NI) and the effect sizes were P(PA > NA) = .63 and .66, respectively. The cut-off for a medium effect size is .64 (Acion et al., 2006), so these represented a medium effect size for final position and a small effect size that approached the medium cut-off for rhyme. For initial position, the difference was not in the predicted direction as the NI group's rank was higher than the PA group, though the ranks were almost identical (9.22 for the NI group and 8.75 for the PA group) and the effect size was P(PA > NA) = .53 which is below the cut-off of .56 for a small effect size (Acion et al., 2006). The groups' mean rank and gain scores from T1 to T2 can be found in Table 2. It should be noted that the rhyme family used in the testing (i.e., 'pat') was also used in treatment. This may have affected our results because the PA group was trained on the testing item. However, the tasks differed. In treatment, the children identified rhymes while in testing the children were required to generate rhymes.

There was a significant group difference between T1 and T3 for gains on the TOPA final position with the results in the expected direction (U = 15.0, n_1 = 8, n_2 = 8, p = .035, 1-tailed). According to Acion et al.'s (2006) criteria, the effect size was large (P(PA > NA) = .77). There were no significant group differences seen for rhyming (U = 23.5, n_1 = 8, n_2 = 8, p = .151, 1-tailed) or TOPA initial position (U = 24.5, n_1 = 8, n_2 = 8, p = .211, 1-tailed), although the PA group's rank was higher in both cases and the effect sizes were small, approaching the medium cut-off (P(PA > NA) = .63 and .62, respectively). See Table 2 for the groups' mean rank and gain scores from T1 to T3.

Given the nature of the DS population, there was a wide range in age and developmental level of the participants. Therefore, Spearman rank order correlations between gains in final position on the PA group and chronological age, mental age, and language scores were calculated. None of the correlations reached statistical

Table 2

Rhyme task and TOPA gain scores

	Time 1 to Time 2			*Time 1 to Time 3*		
Group	**Mean (sd)**	**Median**	**Mean Rank**	**Mean (sd)**	**Median**	**Mean Rank**
PA Group						
Rhyme	0.88 (1.4)	0.50	10.13	0.63 (1.2)	0.00	9.56
TOPA Initial	0.88 (2.3)	0.00	8.75	2.25 (2.4)	3.00	9.44
TOPA Final	1.75 (1.6)	2.00	10.44	2.13 (1.6)	2.00	10.63
NI Group	12,6 (3,3)	15,1 (1,6)	14,1 (1,5)	15,6 (0,6)	13,5 (1,6)	15,2 (1,3)
Rhyme	0.22 (1.0)	0.00	8.00	0.00 (0.5)	0.00	7.44
TOPA Initial	1.22 (2.6)	2.00	9.22	0.75 (3.3)	2.00	7.56
TOPA Final	0.44 (2.5)	1.00	7.72	0.25 (2.2)	-0.50	6.38

Notes. Rhyme task (number produced in 2 minutes) and Test of Phonological Awareness (TOPA) in raw scores.

significance although all were negative and moderate to strong (Cohen, 1988). The values were mental age r_s = -.405 (p = .32), oral language r_s = -.618 (p = 14), and receptive language r_s = -.685 (p = .06).

The impact of the intervention on the standardized measures of reading was also explored. On the WRMT word attack subtest, floor effects were noted in the performance of the children in both programs at all three testing periods. Therefore, statistical analyses were not conducted. On an individual level, at T1, one child in the NI group decoded one item correctly. At T2, that child decoded two items and two additional children, one in the NI group and one in the PA group, were able to decode one non-word. At T3, none of these children decoded any items though one additional child in the NA group decoded one item. Group gains from T1 to T3 on the Letter Identification and Word Identification subtests of the WRMT were examined using Mann Whitney U tests. No significant differences were found for the Letter Identification (U = 24.5, n_1 = 8, n_2 = 8, p = .215, 1-tailed) or the Word Identification (U = 28.5, n_1 = 8, n_2 = 8, p = .365, 1-tailed). Table 3 includes the groups' gain scores for the two subtests.

Individual response patterns

Given the heterogeneity of performance within groups (e.g., as evidenced by large SD_s), gain scores from T1 to T3 for the individual participants were examined.

Table 3

Woodcock Reading Mastery Test gain scores

	Time 1 to Time 3		
Group	**Mean (sd)**	**Median**	**Mean Rank**
PA Group			
Letter Identification	6.13 (5.7)	5.50	9.44
Word Identification	5.88 (11.6)	2.00	8.06
NI Group			
Letter Identification	2.63 (8.7)	3.00	7.56
Word Identification	4.50 (5.9)	2.50	8.94

Only one child in the NI group made gains of 3 or greater on the TOPA initial phoneme measure while four children in the PA group did so. In final position, only one child in the NI group made gains of 3 or greater while three children in the PA group made gains of this magnitude.

Growth over time

The lack of a group effect for initial position on the TOPA and the reading measures was unexpected. Thus,

additional analyses were conducted to see if both groups were making gains between T1 and T3. As the children were in school and we did not alter their educational plans, it was likely that all children were receiving some literacy training. Sign tests were used collapsing across groups resulting in one group of 16 children. Significant differences were seen for the TOPA initial position (p = .017, 1-tailed). Ten of the children demonstrated positive differences, two demonstrated negative differences and for four children their scores were unchanged. For the two reading measures from the WRMT, the alpha level was set at .025. The difference was significant for the Word Identification subtest (p = .019, 1-tailed) and it approached significance for the Letter Identification subtest (p = .026, 1-tailed). On the Word Identification subtest, 10 children showed positive change, two showed negative change and 4 showed no change. On the Letter Identification subtest, 11 children demonstrated positive differences while three showed negative differences and two showed no difference. There was no significant difference on the rhyming measure (p = .344, 1-tailed). On this task, ten children showed no change while four demonstrated positive changes and two demonstrated negative changes.

Questionnaire Data

Questionnaires were returned by the educators for 15 of the children. The educators for one child in the PA group did not return the questionnaire. All children had reading as part of their academic curriculum and had received training on initial sounds. For five children in the PA group and seven children in the NI group, initial sound training took place at least 15 minutes per day, on average. Only three children in the PA group were reported to have final sound training in school while seven children in the NI group had final sound training. Therefore, based on teacher report, the children in the NI group received more instruction on phonological awareness outside our intervention than those in the PA group.

Questionnaires were returned by 13 of the parents. The parents of one child in the PA group and two children in the NI group did not return the questionnaires. Thus, there were seven parental questionnaires from the PA group and six from the NI group. Five of the parents of the PA group and all of parents of the NI group reported reading at least 3 – 6 times per week to their children. In both groups, five parents reported that they began reading to their child before age one. All parents in both groups reported that they tried to help their children learn to read and write and "learn their letters and sounds."

DISCUSSION

With changes in expectations, early intervention, and teaching practices, many individuals with DS develop literacy skills today. It is important that we better understand their literacy development so we can design intervention programs that will enable individuals with DS to maximize their literacy potential. Whole word approaches are recommended in early reading instruction with children with DS (Buckley, 2003, Buckley & Johnson-Glenberg, 2008, Verucci et al., 2006). However, there are limitations to this approach. Phonological awareness, an important skill for literacy development, is not directly targeted in whole word approaches. Therefore, teaching phonological awareness skills may be an important adjunct to word-based reading approaches. This study explored the response of children with DS to a program which provided focused input on phonological awareness skills. The program was delivered on an individual basis in the child's school twice a week for 30 minutes and focused on teaching rhyming and initial and final phoneme segmentation skills.

There was some evidence that the focused input provided by the program did impact the children's phonological awareness skills. This was seen in group comparisons for phoneme identification in final position. The group receiving the phonological awareness program made significantly more gains at T3 testing and the effect size was large. Furthermore, the effect size for the group comparison of gains for the final phoneme measure between T1 and T2 was medium, although it must be recognized that the difference did not reach statistical significance so the reliability of this finding is uncertain. The same is true for the differences seen on rhyme measures between T1 and T2 and T1 and T3 and the initial phoneme measure between T1 and T3 where effect sizes approached medium size but the differences were not statistically significant. The individual data were also suggestive of an effect of the program in that more children in the PA group demonstrated improved performance. Given the relatively small number of children involved in the study, the statistical power was limited. This may explain the lack of statistical significance for comparisons where medium effect sizes were seen. Thus, replication of the findings of this exploratory study is important. In future studies, it would be important to exclude all testing stimuli from training, as was done with the rhyming in this study.

The literacy component of the children's educational program may be another factor affecting the number of significant findings. The children were all integrated into their neighborhood schools and, for ethical reasons, no attempt was made to influence their individual

educational plans. On a questionnaire completed at the end of the program, it was reported by the children's teachers that all of the children had training on initial sounds as part of their educational program. Fewer had training on final sounds. Thus, it is possible that our program only offered more intervention on final position. Also, it is important to note that more children in the NI program received training on initial and final sounds. More received this training at least 15 minutes per day. This may have worked against us finding a treatment effect in group comparisons. As the questionnaire was completed at the end of the program (T2), it is possible that the educational programs for the children in the PA group provided training on final sounds between the end of treatment (T2) and the maintenance testing (T3) beyond that provided to the NI group. However, T2 testing occurred in May and T3 testing occurred in October. Thus, a significant amount of the maintenance period covered the summer holiday months when the children were not involved in educational programs.

The significant group difference in final position was seen between the beginning of treatment (T1) and the maintenance tests (T3). The difference between the beginning of treatment (T1) and the end of treatment (T2) failed to reach a significant level, although the effect size was medium. Thus, the greatest differential growth occurred after the intervention program was finished. The continued growth after the program suggests that the children in the PA group were developing skills which they could apply outside the PA program. An examination of the average gain scores for the groups shows that the PA group gained on initial and final phoneme identification between the end of treatment (T2) and the maintenance testing (T3) while the NI group's scores decreased. As noted above, a considerable amount of the maintenance period covered the summer holiday months when the children were not in school.

A comparison of our results to the effect sizes for phonological awareness interventions reported in the meta-analysis conducted by Ehri and colleagues (2001) reveals similar effect sizes. In the meta-analysis, effect sizes for phoneme intervention were found to be large at post-test and medium at maintenance. When subanalyses for specific groups were done, studies involving typically developing children and studies involving children at-risk had large effect sizes. Studies with children with reading impairments had a medium effect size. In the current study, we found a large effect size for final position T1 to T3 and a medium effect size for T1 to T2. For rhyme T1 to T2 and T1 to T3 and initial position T1 to T3the effect sizes just failed to reach the medium range. In the meta-analysis (Ehri et al, 2001), the amount of intervention provided in the phoneme awareness programs ranged from 1 to 75 hours. The largest effect sizes were seen for programs between 5 and 18 hours. Our program involved 22 hours of treatment and thus fell within the range of programs from the meta-analysis. The effect sizes in the current study compare favorably to that found for children with reading impairments in the meta-analysis. This was despite the fact that our participants with DS had intellectual disabilities. However, it is important to recall that, given the small sample size, it was only the large effect size that was statistically robust.

It is also important to recall that effect sizes represent the difference in gains made by the two groups. They are not a metric of absolute amount of growth. Although the PA program did improve the children's skills, the gains made by the children in the PA group were modest. Furthermore, the children did not achieve mastery of phonological awareness skills. This suggests that a longer program may have resulted in more positive results. Although the children in the PA group showed continued phonological awareness development after the program, the modest gains indicate that additional training in phonological awareness skills was needed in order for the children to fully develop these skills. This is not surprising given the intellectual and linguistic disabilities that children with DS have. The relatively modest gains reflect the fact that phonological awareness skills are challenging for children with DS.

Despite the effect on growth in phonological awareness skills, there was no evidence that the program affected reading skills. Given the intellectual and cognitive impairments associated with DS, it is not surprising that effects were not seen in reading after 22 hours of intervention on phonological awareness. However, on real word reading as measured by the Word Identification subtest of the WRMT, both groups made gains. This is consistent with developmental studies showing that phonological awareness skills lag behind cognitive and whole word reading skills in children with DS (Boudreau, 2002; Kay-Raining Bird et al., 2000; Laws & Gunn, 2002; Verucci et al., 2006). For ethical reasons, we could not limit the children's literacy program to the experimental paradigm. However, we did not inform the school about the children's group assignment nor the nature of the programs until the intervention was completed. This was done to avoid influencing the children's educational program. All children would have continued to receive language and literacy instruction consistent with their individual education plans. Therefore, it is not surprising that gains were seen in real word reading in both groups.

Gains were also seen in both groups on the Letter Identification subtest of the WRMT. While the PA

program did not involve any reading, letters representing the nine target phonemes were used periodically. This might have lead to the prediction that the program would have had an effect on Letter Identification. However, at pre-test, the majority of the children knew the name of a number of the letters as evidenced by their raw scores. On the Letter Identification subtest, the higher items are comprised of letters in less common fonts. Thus, the growth seen in both groups primarily reflected an ability to recognize a variety of fonts. Our program used a consistent, common font for the letters so the lack of a group difference is not surprising.

Although the children made gains in whole word reading over the year, there was no growth seen in non-word reading as measured by the Word Attack subtest of the WRMTAt the beginning of the program, one child in the NI group decoded one item correctly. After the interventions, that child decoded two items and two additional children, one in the NI group and one in the PA group, were able to decode one non-word. Given the relationship between phonological awareness skills and decoding skills in children with DS reviewed above (e.g., Cupples & Iacono, 2000; Kay-Raining Bird et al., 2000; Roch & Jarrold, 2008), this was surprising. Perhaps a higher level of phoneme awareness skill is needed before a child with DS can apply these skills to decoding non-words. It is also possible that a more explicit pairing of reading with phonological awareness activities and practice in decoding novel or non-words would lead to better gains in decoding skills. Finally, the program may have been too short for advances in phonological awareness skills to be extended to decoding abilities given the intellectual difficulties displayed by children with DS.

There have been a number of articles reporting on the development of phonological awareness skills in children with DS and its relationship to reading. However, there have been few reports on interventions to improve these skills. As noted in the introduction, there have been four recent reports of training programs for teaching phonological awareness skills to children with DS. The results of two studies are similar to those of the current study. Both the studies by Goetz and van Bysterveldt reported improvements in the children's phonological awareness skills but the results were modest and did not reach statistical significance (Goetz et al., 2008) or rise above chance (van Bysterveldt et al., 2010). However, the current study did find a statistically reliable effect for phoneme identification in final position. The other two studies reported more positive results. The study by Kennedy and Flynn (2003) used a single subject design replicated across three participants. In contrast to the current study, all three children achieved mastery in initial phoneme identification. Perhaps teaching multiple phonological awareness skills and spelling concurrently is more effective. However, one child was at mastery for initial phoneme identification across baseline and the other two children were at approximately 45% and 65% accuracy. Therefore, an equally plausible explanation for the difference is the fact that the children started at a higher degree of accuracy.

The second study (van Bysterveldt et al., 2006) involved a parent-training program teaching initial phoneme identification, letter names and sounds, and print concepts to preschoolers with DS. The authors showed pre-test to post-test changes. This was despite the relatively low cost both in terms of professional and parental time. There was no control group. Therefore, the group findings of this study need to be interpreted with caution. On an individual level, five of the seven children showed gains in initial phoneme identification skills. Although the programs conducted by ourselves and van Bysterveldt et al. involved a similar amount of intervention time per week, our program was conducted for a much longer time. Yet, the two programs showed a similar proportion of children with gains. The characteristics of the children were quite different, however. The children in the study by van Bysterveldt and colleagues were younger (mean age 4;7 compared to 11:8 in the present study). In addition, the children in the van Bysterveldt study were attending a specialized early intervention preschool program. Thus, the results of the study may point to the value of early intervention programs. In the current study, the negative correlations found between gains in treatment and non-verbal and language developmental scores also support the importance of early intervention. However, the results from the current study show that it is possible to develop phonological awareness skills in older children with DS who have more significant developmental delays.

Limitations of the Study

This study included children with DS who displayed a mental age above 3;0 and showed limited whole word reading who were referred from four school districts. Treatment efficacy research standards such as random assignment to experimental and comparison treatment groups, treatment fidelity measures, and blinding of testers were incorporated. The gains achieved were modest although the effect sizes were medium to large. However, there were a number of limitations. The greatest of these was the small sample size and heterogeneity of participants, which led to limited power. A study with a more homogeneous group in terms of age, mental age and literacy skills may have had different results but the heterogeneity of participants represented the variability in the DS population. One consequence of the

heterogeneity of the sample was that the groups were not as well matched as one would like, which is a common problem in research with children with DS. Although the groups did not differ significantly at T1 on any measures, the PA group did display a lower mean score on the PA measures at T1, which may have positively affected our results. At the same time, the NI group displayed higher mental age scores, which may have negatively affected our results. The limited power meant that only the large effect size (i.e., the analysis involving final position) was statistically significant. With a larger sample, the moderate effect sizes might have reached statistical significance.

In order to maintain treatment fidelity, individuals trained on the intervention programs went to the children's schools to administer the programs. This also allowed us to control for trainer effect because the same trainers administered both intervention programs. Also, to limit outside confounds, the schools were not informed which program a particular child was receiving. These decisions strengthened the experimental design. However, they meant that the programs were not integrated with the children's educational programs. An intervention which was better integrated with the children's educational program may have resulted in greater gains and better generalization of skills. Finally, the group design resulted in all children receiving the same type and amount of intervention for each skill. An intervention program that is able to be more responsive to a particular child's learning style and speed may have resulted in greater effects.

CONCLUSIONS

Literacy is an important goal for individuals with DS. However, how to best achieve this goal is largely unknown. Phonological awareness has been shown to be important in the development of decoding skills. Phonological awareness is a difficult area for children with Down syndrome but gains can be made when focused intervention is provided. The current study adds to the available evidence. The convergence of results across studies provides a more reliable evidence base for the impact of phonological awareness training. Future research is needed to determine how to facilitate the application of phonological awareness skills to decoding by children with DS. Furthermore, we need research on how best to teach not only phonological awareness skills and decoding but all aspects of written language development so that individuals with Down syndrome can achieve their full literacy potential.

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The Classroom Listening Environment in the Early Grades

Le milieu d'écoute en salle de classe au premier cycle du primaire

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Abstract

Classroom acoustics contribute to a student's ability to hear, understand and learn in the classroom. The purpose of this study was to investigate selected components of the classroom listening environment in the early grades and to make recommendations for improving classroom listening. This study of 60 kindergarten to grade 3 classrooms investigated: 1) hearing status of students; 2) the noise level in classrooms; 3) classroom communication with and without sound field amplification; and 4) perceptions of teachers and students who used sound field amplification. Of those who participated in the hearing screenings (n=947), 71% to 88% met the criteria established in this study for adequate hearing levels. Acoustical quality of 26 classrooms indicated that only 31% of the classrooms met the recommended standard. Observation of communicative interactions in 31 amplified and 29 unamplified classrooms and interviews with teachers and students found that students focused better and exhibited fewer distracting communicative behaviours when they could hear the teacher clearly. School personnel need to be aware of the many components involved in creating optimal classroom listening environments including characteristics of the students, room acoustics, and benefits of using sound field amplification.

Abrégé

L'acoustique en salle de classe contribue à la capacité d'un élève à entendre la parole, à la comprendre et à apprendre. Cette étude visait à examiner certaines composantes du milieu d'écoute dans des salles de classe du premier cycle du primaire, ainsi qu'à présenter des recommandations pour améliorer l'écoute en salle de classe. Nous avons recruté 60 salles de classe de la maternelle à la troisième année pour examiner : 1) le niveau d'acuité auditive des élèves; 2) le niveau de bruit dans les salles de classe; 3) la communication dans les salles de classe avec et sans amplification du champ acoustique; 4) la perception des enseignants et des élèves dans les classes où l'amplification était utilisée. Parmi les élèves qui ont participé au dépistage de l'audition (n=947), 71 % à 88 % remplissaient les critères établis d'un niveau d'audition adéquat aux fins de cette étude. La mesure de la qualité acoustique de 26 salles de classe a démontré que seulement 31 % d'entre elles répondaient aux normes recommandées. Grâce à l'observation des interactions de communication dans 31 salles de classe avec amplification et 29 salles de classe sans amplification, de même qu'à des entrevues auprès des enseignants et des élèves, nous avons déterminé que les élèves avaient une meilleure attention et concentration et avaient moins de comportements de communication distrayants quand ils entendaient plus clairement l'enseignante. Le personnel travaillant dans les écoles doit connaître les nombreuses composantes qui favorisent un environnement d'écoute optimal en salle de classe, y compris les caractéristiques des élèves, l'acoustique de la salle et les avantages liés à l'utilisation de l'amplification du champ acoustique.

INTRODUCTION

Classroom listening conditions have a significant effect on students' academic success because learning is highly dependent on clearly hearing the messages being communicated (Edwards, 2005; Flexer, 2005). In an ideal classroom, words can be heard and understood by the students with little or no effort. Being able to focus on speech sounds is fundamental for learning the phonology of language, which underlies learning to read and write (Nelson, Kohnert, Sabur, & Shaw, 2005). Teachers who must raise their voices in order to be heard are unable to provide clear signals across the full range of speech sounds. As Boothroyd (2005) explains, a raised voice increases audibility, but not intelligibility of speech. A loud voice enhances the vowels, but may obscure the consonants where most of the meaning is carried (Flexer, 2005). Sound field amplification has been used to help improve the classroom listening environment by enhancing the voice of the person speaking and evenly distributing the speech signal throughout the room. Classroom acoustics, student characteristics, and sound field amplification all contribute to the listening environment and are discussed in more depth below.

Classroom acoustics

A number of features within classrooms, as well as external noise sources, influence classroom acoustics. Noise sources may include background noise from heating, ventilation and air conditioning (HVAC) systems or electronic equipment in the room, collaborative groups in the classroom, and noise in the hallways or outside the windows (Crandell, Smaldino, & Kreisman, 2004; Nelson & Soli, 2000). In addition to noise, the degree to which surfaces absorb, reflect, or reverberate sound (Smaldino & Crandell, 2000; Smaldino, Doggett, & Thunder, 2004) and the natural loss of the teacher's speech signal as it travels over distance (Crandell, et al., 2004; Nelson & Soli, 2000) affect classroom acoustics.

Effective communication in the classroom largely depends on having a speech signal that is intelligible over the background noise. Sato & Bradley (2008) noted that a desirable listening environment for young students is created with a +15 dB signal-to-noise ratio (S/N). While there are no national building code standards in Canada for classroom acoustics, national standards have been developed in a number of other countries (Shield & Dockrell, 2003). The American National Standards Institute (ANSI) recommends 35 dB for an acceptable classroom noise level (Acoustical Society of America, 2002). When this standard is met, a S/N of at least +15 dB can be achieved provided that the speech signal is a minimum of 50 dB (Acoustical Society of America, 2002). In most classrooms, background noise levels can be a significant problem. It has long been recognized in the United States that the acoustic environment in occupied classrooms is greater than 35 dBA (American Speech-Language-Hearing Association, 2005). In fact, Nelson et al. (2005) estimated that many occupied classrooms have noise levels of 70 dBA or higher, which would result in a S/N of 0 or -5 dB for an average speaker.

ANSI in the S12.60 standard also recommends a maximum of 0.6 seconds as a standard reverberation time (RT) for classrooms (Acoustical Society of America, 2002). RT refers to the amount of time required for a signal to decrease 60 dB below its initial level (Crandell et al, 2004). Picard and Bradley (2001) reported results from seven studies that measured RTs in classrooms and found values that ranged mainly from 0.4 to 1.2 seconds. In addition, Seep, Glosemeyer, Hulce, Linn, & Aytar (2000) noted that many American classrooms have RTs of 1 second or more. Although Picard and Bradley recognized that both RTs and noise levels were often too high in classrooms, noise levels exceed recommendations to a greater degree than do RTs and, therefore, interfere more with speech recognition.

Student characteristics

It has been shown that speech perception may be adversely affected in classrooms with poor acoustics (Boothroyd, 2004; Crandell, Kreisman, Smaldino, & Kreisman, 2004). Being able to clearly understand speech in the classroom environment is important for early literacy learning, which potentially impacts later academic performance (Nelson, et al., 2005). Palmer (1998) explained that students who are able to hear the signal clearly are less fatigued, leading to better educational outcomes.

While it is commonly recognized that students with sensorineural hearing loss have difficulty with speech recognition in noisy or reverberant environments, it is less well known that other student characteristics also affect the ability to understand speech in the classroom (Crandell, Smaldino, & Flexer, 2005; Nelson & Soli, 2000). These characteristics include conductive hearing loss, temporary hearing loss due to otitis media, articulation disorder, language disorder, auditory processing deficit, learning disabilities, attentional deficits, developmental delays, the age of the student, and the student's level of familiarity with the language of the classroom (Bennetts & Flynn, 2002; Cornwell & Evans, 2001; Crandell, Smaldino, & Flexer, 2005; DiSarno, Schowalter, & Grassa, 2002; Flexer & Long, 2003; Flexer, Millin, & Brown, 1990).

Crandell et al. (2005) stated that recurrent bouts of otitis media with effusion (OME) have been associated

with speech, language, intellectual, and attentional problems. Hearing screenings are needed to identify students who have sensorineural hearing loss as well as those who have middle ear problems (Yockel, 2002). Flexer, Richards, Buie, and Brandy (1994) found a high incidence of minimal hearing loss in their study of young children who were tested at four different times of the year. One fourth to one third of their 282 kindergarten and grade 1 students had reduced hearing with the results varying by season. Otitis media and associated minimal hearing loss have been reported to be increasing among school aged children and even slight hearing loss has been related to deficits in vocabulary, reading, and other academics as well as reduced incidental learning (Nelson, 1999).

In a large study in the United States, air conduction thresholds at 500 to 8000 Hz were measured in over 6000 students aged 6 to 19 years (Niskar, Kieszak, Holmes, Esteban, Rubin, & Brody, 1998). The prevalence of hearing loss, defined in this study as threshold values of at least 16 dB, was 14.9%. These researchers concluded that screening of both the high and low frequencies is needed to detect hearing loss in school-aged students. Yockel (2002) performed pure-tone audiometric screenings with 141 students aged 5 to 8 years from special and regular educational programs. For those who did not hear every tone at their criteria of 25 dB, a hearing threshold test was done and for those who did not pass, middle ear testing was conducted. A total of 21% of the students failed either the pure-tone or middle ear testing. With the middle ear testing, 10 students with OME were identified who otherwise would have been overlooked on the pure-tone testing alone. In another study by Serpanos and Jarmel (2007), 5% of a sample of 3 to 5 year old children did not pass a pure-tone screening at their criteria of 20 dB using levels of 1000, 2000, 3000, and 4000 Hz. Given the importance of good hearing for learning in the classroom, early identification of hearing problems is vital.

Adults have more developed auditory systems than children and, therefore, may not appreciate the negative effects of poor classroom acoustics on young students (Bradley & Sato, 2004). Children younger than 13 to15 years do not have mature hearing systems and their ability to focus in noisy surroundings is less well developed than that of adults (Anderson, 2004; Boothroyd, 2004; Crandell & Smaldino, 2000; Flexer, 2005). Furthermore, due to fewer life experiences, young children have less extensive vocabularies to help them fill in the gaps of missed information (Flexer, 2005; Seep et al., 2000). Bradley and Sato (2004) demonstrated that young students require a higher signal-to-noise ratio (S/N) for speech recognition than young adults. Speech recognition was tested using the Word Intelligibility by Picture Identification (WIPI) at two different S/N values for grade 1 and three values for grades 3 and 6. In this test, each word is presented aurally and students are asked to identify the correct picture. The results included intelligibility scores over a range of S/N from -15 to +30 dB. Students in grade 1 required +15.5 dB S/N to achieve a mean score of 95% correct in the WIPI speech recognition task, while students in grade 3 required +12.5 dB S/N, and those in grade 6 required +8.5 dB S/N for these same results. With a higher S/N of +25 dB to +30 dB, the students in grade 1 and grade 3 had a mean score of 98%, while those in grade 6 scored on average almost 100% on this speech recognition task.

The need for good acoustics is especially important for students who are learning in a second language because they cannot rely on previous linguistic experience and must depend more heavily on hearing the spoken messages accurately (Nelson & Soli, 2000). Nelson et al. (2005) tested grade 2 students, who were either non-native English speakers or native English speakers, using a picture-word identification task in quiet and noise conditions. They found that noise had a stronger negative impact on word recognition performance for the non-native English speakers. In another study with 8 to 10 year olds who were either English second language learners or native English speakers, sentence perception was tested across varying noise conditions (Crandell & Smaldino, 1996). The results indicated that students learning in a second language had more difficulty perceiving speech in noise than did native speakers and this effect increased with higher noise levels. Recognition of speech in noisy or reverberant environments has also been found to be more difficult for non-native adults than for adults listening in their native language (Bradlow & Alexander, 2007). Further, Mayo, Florentine, and Buus (1997) found that adults who learn a second language earlier in life are better able to perceive speech in noise than those who learn later.

Sound field amplification

Reducing barriers to classroom listening is essential for improving the learning environment. The room acoustics and student characteristics contribute to the ability to hear and understand in the classroom. In addition, researchers have found that enhancing the classroom listening environment through sound field amplification has positive effects on students' learning (Crandell et al., 2005; DiSarno et al, 2002; Eriks-Brophy & Ayukawa, 2000; Massie, Theodoros, Bryne, McPherson, & Smaldino, 1999). Sound field amplification technology is a method for enhancing the vocal signal above the background noise found in typical classrooms. Amplification allows teachers to speak in conversational

tones and can reduce their voice strain (Jónsdottir, Laukkanen, & Siikki, 2003; Sapienza, Crandell, & Curtis, 1999).

Sound field technology includes a wireless microphone with one or more loudspeakers which allow the voice of the person speaking to be enhanced. The speech signal is evenly distributed around the room and the message is more clearly heard over the background noise. The use of a pass-around handheld microphone for individual students can also help them to hear their peers more clearly when discussion is part of the learning activity.

PURPOSE

The purpose of this study was to investigate selected components of classroom listening environments in the early grades with a Canadian sample and to make recommendations for improving listening and, ultimately, learning in the classroom. Specifically, this study measured: 1) the hearing status of kindergarten to grade 3 students; 2) the noise level in some of their classrooms; 3) classroom communication with and without sound field amplification; and 4) perceptions of teachers and students who used sound field amplification.

Addressing students' hearing status and deficits in room acoustics are the first steps towards removing the barriers to optimal classroom listening. Sound field amplification can also help to improve the listening environment by enhancing the voice of the person speaking. The present study measured the effects of introducing this technology into the classroom environment by focusing on students' responses to teachers' communication with and without sound field amplification and the perceptions of teachers and students about this technology.

METHOD

Participants

This study involved eight schools across three school districts in an eastern Canadian province. The location of the three districts was selected by the Department of Education. The districts represented geographically separate regions of the province and included an urban and rural mix. The Directors of Student Services within each district provided the researchers with information to enable matching of schools on the number of students registered and the type of program(s) offered (English and French Immersion). The Directors of Student Services identified which schools were to be provided with sound field amplification systems.

The number of students in the participating classes by school district and type of program is outlined in Table 1. A total of 947 students participated in the hearing screenings. Sound field systems were installed in 31 classes (n=610 students), which comprised the amplified group, and not in 29 classes (n=552 students), which comprised the unamplified group.

Table 1

Number of Students and Classes by Grade and Program

Grade	Program	Amplified		Unamplified	
		Classes	Students	Classes	Students
Kindergarten	English	7	148	7	143
Grade 1	English	5	83	4	60
Grade 1	French Immersion	3	59	3	59
Grade 2	English	5	90	5	82
Grade 2	French Immersion	3	60	3	50
Grade 3	English	5	109	4	100
Grade 3	French Immersion	3	61	3	58
Kindergarten to Grade 3	English and French Immersion	31	610	29	552
Kindergarten to Grade 3	English	22	430	20	385
Grade 1 to Grade 3	French Immersion	9	180	9	167

Note: French Immersion program is not available in Kindergarten.

Procedure

The study took place in the winter and spring months of the same school year and involved four components: (a) hearing screenings, (b) classroom noise measurements, (c) classroom observations, and (d) participant interviews. Each classroom in the amplified group was provided with a Phonic Ear frontrow™ pro infrared sound field system, four mounted speakers, a wireless pendant microphone, and one handheld wireless microphone. There were variations in the way the sound systems were installed and the length of time required to install them since each school district made its own arrangements. Teachers received basic instruction on the technology from either an audiologist or the sound system vendor. Since a standard in-service training package was not available, the content of the training may have varied.

Parents or guardians of students submitted a written permission form for their child's participation in the classroom observations and interviews. A second written permission form was required for the hearing screening. Teachers also submitted a written permission form for their participation. Of the 1162 students in the participating classes, parents of 87% of the students (n=1011) gave permission for their child to be observed and parents of 88% of the students (n=1023) gave permission to have their child's hearing screened. Of the 139 parents who did not consent to a hearing screening, four identified that their child had a hearing loss, two identified that their child had special needs, and the remaining 133 did not give a reason for their decision.

Hearing screenings

Hearing screenings were conducted by the first author, a speech-language pathologist (SLP), using a GSI 17 Grason-Stadler 17 portable screening audiometer. An audiologist provided assistance with screening students in three of the schools using a Model MD-IP M.D. audiometer. The SLP and audiologist were certified by the Canadian Association of Speech-Language Pathologists and Audiologists. Both audiometers were calibrated in a hospital audiology department prior to the study. Operational checks were made to ensure their proper functioning prior to each school visit. Screenings took place in quiet rooms that were made available by the school administrators such as conference or library spaces. The SLP or audiologist monitored the acoustical conditions to ensure that they were appropriate for conducting the screenings. On occasion, the ambient noise level was subjectively judged to be high enough to interfere with testing and an alternate location was used.

Instruction was provided by the SLP or the audiologist to an individual or small group of up to six students as the room size and attention span of the children permitted. Instruction included placement of the headphones and practice responding by raising a hand to tones presented by the examiner without using the headphones. For a small number of students, who could not reliably raise their hands when hearing the tone, an alternate procedure was utilized. This involved teaching the students to respond to the sound by releasing an item into a container each time they heard a sound.

Students were screened using the guidelines established by the New Brunswick Association of Speech-Language Pathologists and Audiologists (1988). According to Niskar et al. (1998), the low frequency screening level of 500 Hz, while often not included in standard school screenings, should be performed. Screening levels were 500 Hz (25 dB), 1000 Hz (20 dB), 2000 Hz (20 dB), and 4000 Hz (20 dB). Students who responded to all of these frequencies were considered to have passed or met the criteria for adequate hearing. If the child failed to respond to one or more of the frequencies tested, the child was identified as needing to be rechecked or referred for follow-up. Of the total 1023 participants with parental consent for hearing screening, 93% (n=947) were screened. The percent of potential students screened at each grade level was as follows: kindergarten, 82% (n=241); grade 1, 82% (n=215); grade 2, 89% (n=251); grade 3, 73% (n=240). Time factors restricted rescheduling of screenings for the 7% of students (n=76) who were absent.

Classroom noise measurements

Another audiologist, the fourth author, measured the noise levels in 26 unoccupied classrooms in two participating schools in one school district. The classrooms in one of these schools (School X) were amplified and the classrooms in the other school (School Y) were unamplified. The average ambient noise level was measured with an A-weighted scale using the ANSI S12.60 standard of 35 dB with a 2 dB tolerance (Acoustical Society of America, 2002). The A-weighted scale is the measurement standard that most closely approximates the human ear.

Noise level measures were recorded at the key location in each room as per the ANSI guidelines. A Quest 2900 Integrating Average/ Data Logging sound level meter (SLM) was mounted on a tripod set at .8 meters, consistent with a typical seated position of a child. The SLM was held while walking around the classroom seating and standing area. Real time measurements were taken to find the area with greatest noise level. This was considered to be the key location. The SLM was placed on the tripod at the key location. Five 1-minute measurements were taken at the key location in each room. The five readings were

averaged to determine the overall background noise level. The lowest reading at the key location was subtracted from the highest reading to find out if the background noise level was within the ANSI conformance tolerance. A difference of 2 dB or less was consistent with steady background noise levels. Unsteady background noise levels were suggested when the difference was greater than 2 dB. However, unsteady noise was not verified since a more comprehensive assessment over a longer period of time would have been necessary to confirm this suggestion.

Classroom observations

Four research assistants (RAs) were trained by the first three authors in the use of Massie's (2000) observation protocol, *Revised Environmental Communication Profile* (RECP). This structured coding system measures the dynamics of classroom communication. The data that was collected pertained to communication made by teachers and students during the normal course of events in Language Arts classes. All of the sixty classes were observed by the RAs. Each RA observed the same classes pretest and posttest (after sound field systems had been in use for 10-14 weeks). Inter-rater reliability checks were conducted both pretest and posttest with each RA by the first two authors. Inter-rater reliability results ranged from 80% to 95%.

A time sampling procedure, in which each child was observed for 30 seconds followed by a 10-second recording period, occurred four times in each class. There was a potential data set of 4032 pretest and 4032 posttest observations. Due to student absenteeism, the number of actual observations was 3543 pretest and 3519 posttest. Neither teachers nor students were aware of who was being observed.

The use of the RECP facilitated quantification of the child's verbal and nonverbal communicative interactions and the direction of communication. As shown in Appendix A, the coding scheme included two types of verbal and four types of nonverbal ways students could communicate. These communicative interactions could occur in four possible directions. If a student communicated while being observed, the environmental event was recorded which could include either a teacher's or a peer's communication.

The sources of the stimuli to the child were also recorded. It was thought that students who could hear the teacher better (when amplification was used) would respond more often to the teacher when they were addressed directly as compared to those in the non-amplified group. This would be seen on the RECP as more items recorded in the section of Child's Communicative Interactions, and the Direction of Communication would be towards the teacher. An increase in response rate from the pretest to the posttest would show that students were engaging in more communicative interactions after sound field systems were in place. Such an increase would be considered a positive result when the teacher was addressing the class. Conversely, it was thought that when an amplified teacher was addressing either the whole class or a peer, the observed student would engage in fewer communicative interactions than students in the non-amplified group. It was thought that this would occur because the student was focusing more on the teacher rather than engaging in other communications which could be off-task. In this case, a decrease in the number of communicative interactions would be a positive result.

One or more communicative interactions could occur within each observation depending on what was happening in the classroom. Since this resulted in the amplified group and the unamplified group having different numbers of communicative interactions, the data were expressed as proportions of student responses out of the total number of cues given by the teacher for each of the three types of communication. The data were then tested for significance of the difference between two independent proportions. The z-ratio and associated one-tail and two-tail probabilities for the difference between two independent proportions were calculated. Pretest and posttest results were compared within both the amplified and unamplified groups.

Participant interviews

At the posttest stage of the study, the third author conducted 62 semistructured interviews in each of the 31 amplified classes. Interviews were conducted individually with the 31 teachers using the following open-ended questions: What has having this system in your classroom meant for you? What differences has the system made for you and your teaching? What have you noticed about the children's responses when you used the system? Elaborating probes were used to elicit further information (Creswell, 2005).

The students in each of the 31 classes were interviewed as groups using general questions pertaining to what they liked or disliked about the sound field systems in their classrooms and whether they noticed any differences when the systems were used. Probes were used in these discussions to help the students elaborate their responses more fully. The student data was analyzed by interview, rather than by participant, since the interviews were conducted in groups.

Teachers' and students' perceptions about their experiences using the sound field amplification systems were digitally recorded and transcribed verbatim. The transcripts were read repeatedly to become familiar with

the content and to listen for emerging themes. Using a word processing program, blocks of data were marked with the same colour when they pertained to a particular category. These categories were sorted and reduced into descriptive themes by combining overlapping concepts. An experienced educator, independent of the research, then reviewed the data and the proposed themes to determine their compatibility from an educational perspective (Sandelowski, 1986).

RESULTS

Hearing screenings

Figure 1 shows the results of the hearing screenings for kindergarten, grade 1, grade 2, and grade 3.

Out of the total 201 students who did not meet this study's criteria for adequate hearing, there were at least six possible audiology clinics in the region that may have provided follow-up. Results were provided by only one of these clinics where fourteen of the students were seen. Eight of these students had normal hearing and were discharged. Five students who had conductive hearing loss were referred for medical treatment. One student was diagnosed with permanent bilateral sensorineural hearing loss and was fitted with hearing aids.

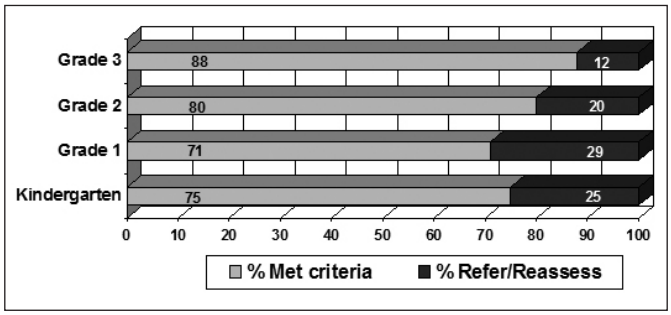

Figure 1.
Percentage of students by grade level who met the criteria for adequate hearing, and those who needed to be referred or reassessed.

Classroom noise measurements

The acoustic measures taken in the two schools referred to as School X and School Y are shown in Tables 2 and 3.

The mean ambient background noise level of the classrooms ranged from 33.6 dBA to 52.3 dBA. All 14 classrooms in School X failed to meet the ANSI standard for adequate listening conditions (Acoustical Society of America, 2002). The noise state was either steady according to ANSI standards or unverified. All but four classrooms in School X had steady noise. In those classrooms where the noise state was unverified, a

Table 2
A-Weighted Sound Level Readings in the Key Location, Mean Ambient Noise Level, and Noise State for Classrooms Tested in School X

Room	Key Location Measurements in dBA (1 min average)					Mean Ambient Noise Level	Noise State
X1	45.4	44.8	45.5	46.2	45.8	45.5	Steady
X2	53.0	53.1	52.8	48.2	42.6	49.9	Unverified
X3	49.9	49.0	48.9	48.9	48.9	49.1	Steady
X4	46.6	46.6	46.6	46.7	46.8	46.7	Steady
X5	45.3	45.2	44.8	45.1	45.4	45.2	Steady
X6	52.3	51.5	49.6	49.7	49.8	50.6	Steady
X7	40.8	41.7	41.4	41.2	41.1	41.2	Steady
X8	51.0	47.1	46.6	46.7	43.8	47.0	Unverified
X9	46.8	47.1	50.9	46.9	45.9	47.5	Unverified
X10	47.9	48.0	48.3	48.0	48.2	48.1	Steady
X11	55.5	51.6	51.6	51.3	51.3	52.3	Unverified
X12	50.7	49.2	49.1	49.0	49.0	49.4	Steady
X13	47.4	47.3	47.4	47.5	47.5	47.4	Steady
X14	43.5	43.4	44.2	43.1	43.4	43.5	Steady

Note: A level of 37 dB was accepted as the standard for the noise level of the classrooms in this study using the guidelines of the Acoustical Society of America (2002).

Table 3

A-weighted Sound Level Readings in the Key Location, Mean Ambient Noise Level, and Noise State for Classrooms Tested in School Y

Room	Key Location Measurements in dBA (1 min average)					Mean Ambient Noise Level	Noise State
Y1	34.7	34.0	34.3	33.9	34.2	34.2	Steady
Y2	36.0	36.3	35.1	35.5	35.6	35.7	Steady
Y3	36.6	35.4	35.1	35.0	35.0	35.4	Steady
Y4	39.2	37.1	38.3	36.8	36.7	37.6	Steady
Y5	38.5	38.7	38.7	38.5	38.9	38.7	Steady
Y6	36.4	36.5	36.6	36.2	36.7	36.5	Steady
Y7	38.8	39.2	39.2	38.7	39.2	39.0	Steady
Y8	36.4	35.8	35.4	35.2	35.4	35.6	Steady
Y9	34.8	33.2	33.7	33.0	33.3	33.6	Steady
Y10	38.7	36.4	37.4	37.0	36.3	37.0	Steady
Y11	41.3	44.3	45.3	46.1	46.1	44.6	Unverified
Y12	36.7	36.7	37.0	36.8	36.8	36.8	Steady

Note: A level of 37 dB was accepted as the standard for the noise level of the classrooms in this study using the guidelines of the Acoustical Society of America (2002).

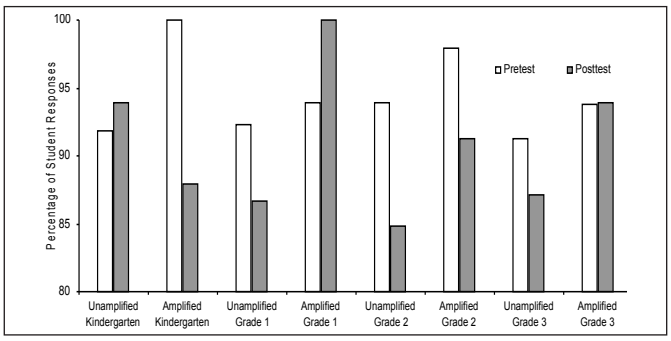

Figure 2.
Percentage of student responses to statements made by the teacher directly to the child in unamplified and amplified classes by grade level.

one-hour average background noise measure would be required to verify if the background noise was steady or unsteady. The HVAC system was a major contributor to the noise levels. Following the HVAC system noise reduction after regular school hours, two classrooms were retested and showed a significant background noise reduction of 12.5 and 14.2 dBA. In School Y, all but one of the 12 classrooms had steady noise. Four classrooms in School Y failed to meet the ANSI standard for noise level.

Classroom observations

The data gathered from the RECP included the individual student's verbal and nonverbal communicative interactions, the teachers' and peers' communicative interactions, and the source of the stimulus. Communications that the student initiated towards him- or herself were not included in the analysis. For this study, teachers' nonverbal communications and peers' communications were excluded since the focus was on voice amplification of the teacher. Regarding the sources of stimuli, cues between peers and environmental noise were excluded along with cues to the child or the class from the peer.

The following sections discuss the results of the classroom observations when the three sources of stimuli occurred: (a) cues to child from teacher (n=742); (b) cues to class from teacher (n=5042); and (c) cues to peer from teacher (n=920).

Cues to the child from the teacher. Figure 2 shows the response rate from students was high (over 85%) in all groups. It was hypothesized that students would respond more to amplified teachers when addressed directly. This pattern was shown in grades 1 and 3. In kindergarten, student responses decreased when amplification was used. In grade 2, they decreased but not as much as in unamplified classes. Significance levels in the individual grades could not be calculated due to small sample sizes.

As shown in Figure 3, when the data from grades 1 to 3 were combined, the decrease in responses in the unamplified condition was significant ($z=1.684$, $p<.05$).

No significant change in the amplified condition was seen. In kindergarten, the reverse response pattern was noted.

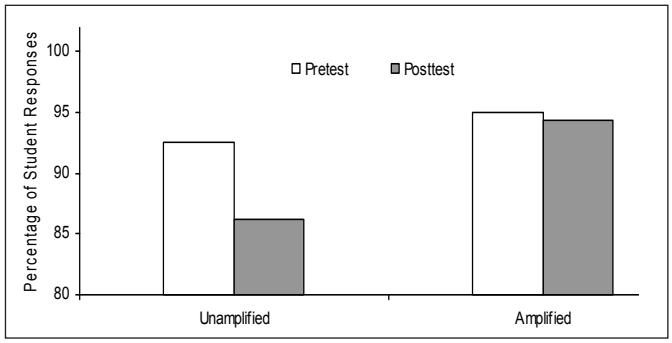

Figure 3.
Percentage of student responses to statements made by the teacher directly to the child in unamplified and amplified conditions in grades 1 to 3 combined.

Cues to the class from the teacher. Figure 4 shows decreases in the number of communicative interactions over time when the teacher addressed the class. In the unamplified classes, in kindergarten and grades 1 and 2, the decrease was not significant. There was a significant decrease in the unamplified grade 3 classes ($z=1.963$, $p<.05$). In the amplified groups, the decrease was significant in grade 1 ($z=2.298$, $p<.05$), grade 2 ($z=1.709$, $p<.05$) and grade 3 ($z=2.375$, $p<.01$). The decrease in kindergarten was greater in the amplified group, but was not significant.

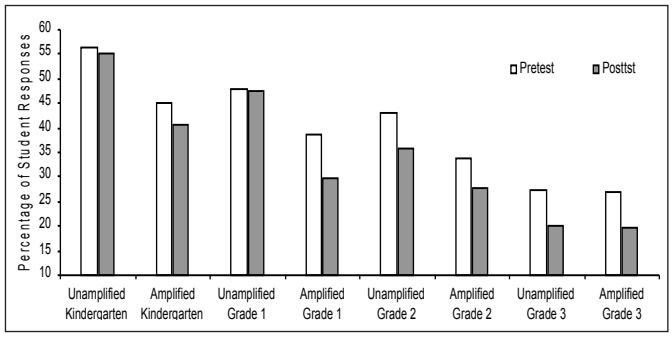

Figure 4.
Percentage of student responses to statements made by the teacher to the class in unamplified and amplified classes by grade level.

As shown in Figure 5, when the data from grades 1 to 3 were combined, the decrease in student response rate was significant in both groups, but not as strong in the unamplified condition ($z=2.101$, $p<.05$) as in the amplified condition ($z=3.55$, $p<.01$).

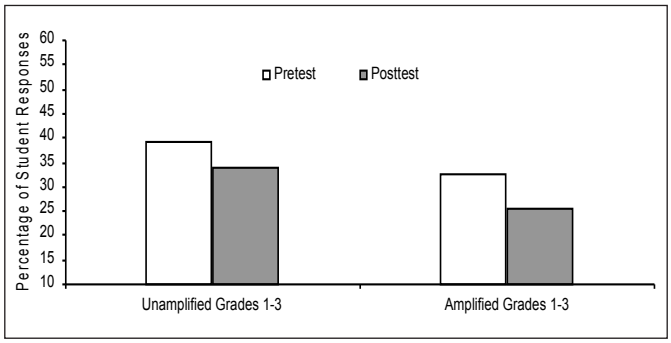

Figure 5.
Percentage of student responses to statements made by the teacher to the class in unamplified and amplified classes in grades 1 to 3 combined.

Cues to a peer from the teacher. Figure 6 shows the percentage of student responses when the teacher addressed a peer of the student being observed. In the unamplified classes, there was a significant decrease in student response in kindergarten ($z=1.84$, $p<.05$), no significant differences in grades 1 or 2, and a significant decrease in grade 3 ($z=3.143$, $p<.01$). In the amplified kindergarten classes, students did not respond during pretest observations. Posttest response rates were similar to those in the unamplified kindergarten classes. The sample size was too small to calculate significance levels in the amplified kindergarten group. Significant decreases in response rate were found in the grade 1 ($z=3.452$, $p<.01$) and grade 2 ($z=3.191$, $p<.01$) amplified classes. In grade 3, the student responses did not change significantly in the amplified classes.

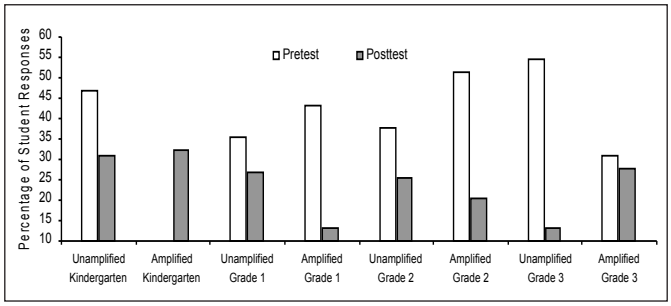

Figure 6.
Percentage of student responses to statements made by the teacher to a peer in unamplified and amplified classes by grade level.

When the data for grades 1 to 3 were combined (Figure 7), the percentage of student communicative interactions decreased significantly in both the unamplified ($z=2.792$, $p<01$) and the amplified classes ($z=3.697$, $p<.01$).

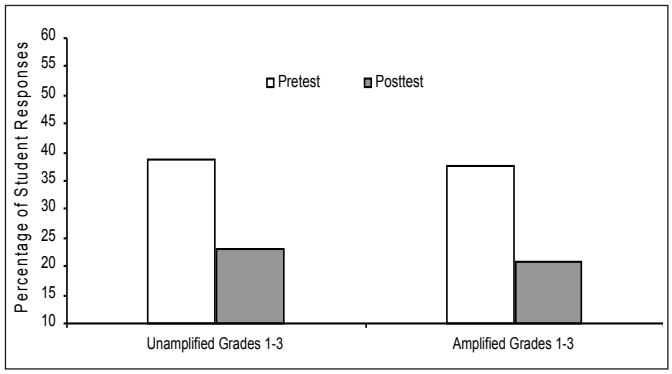

Figure 7.
Percentage of student responses to statements made by the teacher to a peer in unamplified and amplified classes in grades 1 to 3 combined.

Participant interviews

In the interviews, 11 broad coding categories were uncovered. The frequency differed for teachers and students as shown in Table 4. Through the qualitative analysis of the teacher interview data, six themes were generated. These themes occurred in the interviews with frequencies of 74% to 87%. The themes were: the need for increased education about the technology; calm, relaxed learning environment; increased student attentiveness; efficient use of class time; increased participation of all students; and improved teacher health. Each of these themes is discussed below and representative examples of teachers' comments are given to further illustrate each theme.

There was a need for more than the initial education on the use of the sound field systems. A majority of the teachers (27 out of 31, 87%) reported that they had to resolve some issues regarding operation and care of the systems, such as recharging the batteries, avoiding feedback, ensuring that the microphone was clear of objects like clothing and jewelry and avoiding amplification of vocal sounds such as coughing. A grade 1 teacher noted, "If you have a piece of paper in front of [the microphone] and it squeals it startles [the students]." Also, a grade 3 teacher stated, "I've structured my classroom so we're not getting [feedback] any more."

Some teachers (24 out of 31, 77%) described the classroom environment as being more relaxed when the students could hear the teacher clearly. They stated that other classroom noises seemed less prevalent and students could hear them wherever they were in the room. "The noise level in the class really goes down when I use [the sound system]" stated a grade 1 teacher. A grade 2 teacher said, "The kids do comment that they're hearing me in every corner of the room." A grade 3 teacher stated, "Now I'm just able to be on an even keel for the whole day. I find they're all a little more relaxed."

Many teachers (24 out of 31, 77%) found that students were more attentive when the sound field system was used. A kindergarten teacher remarked, "It's just so much clearer, even if their eyes aren't on me, they can tell me what I said. My voice doesn't blend in anymore." A grade

Table 4
Percentage of Occurrence of Coding Categories

Coding Category	Teachers	Students
Acceptance/positive attitude toward sound field systems	87	0
Improved student attending and learning	77	61
Voices heard over the background noise	74	100
Teachers' voices more rested/teachers less tired	74	23
Teachers develop strategies for using sound field systems	74	23
Basic understanding of the operation of the system	74	32
Feedback noted as a problem	48	65
Students with soft voices and shy students more willing to speak	42	20
Inclusion of students with special needs	39	0
Microphone needs to be clear of objects and non-speech sounds	39	32
Volume set too high	16	52

1 teacher stated, "Children are more attentive whenever I turn the system on. They tend to look at me more".

When using the amplification system, teachers (24 out of 31, 77%) stated that they were able to use class time more efficiently and could focus on presenting new information. They found that they could move around the room and be heard clearly by all students. A grade 1 teacher said, "I don't have to repeat as much," while a grade 3 teacher noted that prior to using the system, "sometimes I would have to take time to come way over to get to [the students], touch them because they wouldn't hear me. But at least with this system I can get their attention from where I am. It's quicker, it's faster, it's easier that way."

In Canada today, with the philosophy of inclusion, there is a greater variety of learning needs in every classroom. The teachers in this study (23 out of 31 teachers, 74%) felt they were creating more inclusive classrooms due to increased participation of students when sound field amplification was in use. A grade 1 teacher described using the pass-around handheld microphone by saying, "There are [quiet] children that would take part, but we would never hear what they have to say. I would always have to repeat for the other children to be able to hear. Now, they can actually say what they need to say and everyone else hears them saying it." A grade 2 teacher said "[the handheld microphone] seems to give kids a sense of empowerment." Inclusion of children with a variety of learning needs was also highlighted by about half of these 23 teachers. They noticed that students with special needs were able to attend for longer periods and take part more in classroom activities. One of the grade 1 teachers expressed this idea by saying, "…the one we thought might have a central auditory processing disorder…he's really started to speak and participate."

Many teachers (23 out of 31, 74%) commented that they had had vocal health issues, such as sore throats, vocal strain, and laryngitis from projecting their voices. They stated that the amplification system improved these problems and also helped them feel less tired. The teachers found that they could communicate at a comfortable volume without additional effort to make themselves heard. One kindergarten teacher noted, "I don't have to strain. I end up with a lot of sore throats. I haven't had a sore throat since [using amplification]." A grade 3 teacher remarked, "I wasn't straining [or] having to talk loud anymore. My throat finally got better and I'm not as tired at the end of the day."

Discussions were held with the students in each of the amplified classes. The number of students in each class who chose to respond to the researcher varied. Further, older students were generally more articulate than younger students. Often, the younger ones strayed from the topic and needed to be redirected with more questions. Analysis of the data revealed that the student focus was predominantly on categories related to what they could hear and how they connected that with their learning. The students' data is presented using the coding categories (Table 4) rather than the educational themes since the students concentrated mainly on sounds and not on teaching practices. The students' six highest categories are described below and representative examples of their statements are given.

In all of the classes, students mentioned that the sound systems helped them hear well because voices were louder. A grade 1 student said, "When we didn't have the [sound system and the handheld] microphone … we couldn't hear anybody so since we have it, we can hear them perfectly." In a kindergarten class, one young student noted, "We can hear our teacher much gooder." In 61% of the classes, students mentioned that the sound field system helped their learning. "I'm glad we got that [sound field system] because now it's a lot easier to learn and understand what our teacher is saying" was a statement made by a grade 3 student, while in a grade 2 class, a student acknowledged that "Now, when I hear, I know what to do." Also in grade 3, students remarked, "I listen better when she has the speaking thing on. I like it because it helps my learning … so I can hear better and get my work done" and "Now that we have the microphone we're learning a lot more and we're actually listening and not fooling around."

In some of the classes, the students spoke about problems they noticed in the use of the sound system, including occasional feedback (65%), volume set too high (52%), and interference from objects touching the microphone or vocal sounds, like coughing (32%). Also, in 32% of the classes, students mentioned that sometimes teachers forgot to charge the batteries or turn the microphone off when they left the room or turn it on when they were teaching the class. A grade 2 student noted the problem of feedback by saying, "the speakers squeak when our teacher gets too close to them" while a grade 1 student pointed out the problem of setting the volume too high by saying "When it's turned up too loud, I don't like it." A grade 2 student mentioned that "When [the teacher] blows her nose, it's really loud." A grade 3 student stated, "When the teacher … forgets to turn it on we can tell a big difference and we have to remind her to turn it on."

DISCUSSION

This study illustrates some of the elements involved in creating optimal classroom listening environments in the early school years. The practical implications which

emerged were related to students' hearing status, classroom acoustics, and the use of sound field amplification.

Hearing screenings

The results of the hearing screenings revealed that only 71 to 88 percent of the students tested met the criteria established in this study for adequate hearing levels. While the screening methods and criteria used by researchers vary, the findings and those of the present study highlight the need for hearing screening programs in the early school years (Niskar et al., 1998; Serpanos & Jarmel, 2007; Yockel, 2002). Identification of students with hearing problems could lead to earlier medical and educational interventions, which may reduce the impact of hearing loss. Niskar et al. (1998) point out that screenings should include testing high and low frequency ranges. In addition, there needs to be a plan for students who do not pass the initial screening, such as including an assessment of middle ear status to ascertain the nature of the hearing problem (Yockel, 2002). While the present study focused only on the early school years, Serpanos and Jarmel (2007) note that hearing screenings are also needed throughout childhood to help identify late onset or acquired hearing loss.

Classroom noise measurements

The results of this study were consistent with previous research, which revealed high levels of background noise in many classrooms (for a review see Picard & Bradley, 2001). Suggestions for improvement of the listening conditions in classrooms with poor acoustics have been well documented in the literature (Berg, Blair, & Benson, 1996; Choi & McPherson, 2005; DiSarno et al., 2002; Edwards, 2005; Siebein, 2004; Siebein et al., 2000). While this study did not evaluate the need for physical modifications to the classrooms, it has been noted in the literature that structural modifications should be considered before implementing sound field technology (Nelson & Soli, 2000). Also, as Palmer (1998) noted, the distance between the teacher and students may contribute to unfavourable listening conditions as teachers move around the room. Thus, structural modifications may still not provide a uniform S/N for all students in the room.

It was noted in the present study that the HVAC system in two classrooms created unfavourable listening conditions. When the systems were turned off, there was a reduction in noise level, but the systems could not be turned off during school hours due to the design of the building. There are currently no Canadian building code standards for classroom acoustics. Implementation of recognized standards would increase the likelihood of new or renovated school construction incorporating acoustical features that result in favourable listening conditions for students. Experts such as audiologists or sound engineers familiar with standards for room acoustics can have a distinct role in the planning stages for new school facilities as well as evaluating and addressing problems with existing classrooms (Seep et al., 2000; Siebein, 2004; Smaldino, Doggett & Thunder, 2004).

Classroom observations and participant interviews

Classes were observed in their naturalistic context with no attempt made to alter the teaching methods or content. The only constant was that observations occurred during Language Arts classes. Variation in teaching approaches may have contributed to the differences in student response rates that were found among the classes at pretest. While the classes were different at pretest, the classes in each condition were compared to themselves posttest and not to each other. A number of factors may have contributed to changes such as how teachers used the sound systems and which teaching approaches were used during the study. Other factors may also have had unknown effects on the results which could account for why there were changes in the unamplified classes. In addition, the changes in the amplified classes were not always in the expected direction and were not always significant. However, we would argue that, in general, some of the trends in the amplified classes were in the expected direction and showed that amplification had a positive effect. The interviews clarified the participants' perceptions of what occurred while the amplification systems were being used. The interviews helped to interpret the observational data. Some of the data gathered in the classroom observations showed that students in amplified classrooms responded more to the teacher when they were being directly addressed. Similar to other research findings, the teachers in this study found that students paid better attention and understood verbal instructions more efficiently when sound field amplification was used (Cornwell & Evans, 2001; DiSarno et al, 2002; Eriks-Brophy & Ayukawa, 2000). The interview data supported the idea that students' higher rates of response in amplified classes may have been due to improved attention. Conversely, the observational data showed students' decreased communication when the teacher was addressing the whole class or a peer. This was also supported by teachers' comments regarding students' increased focus on the learning tasks.

The findings from the participant interviews were consistent with DiSarno et al. (2002) and Flexer (2005). They showed that teachers, when amplified, felt they could move freely around the classroom without the concern of how well students heard their messages, allowing for more efficient use of class time. Students sitting in all parts of the

room continued to hear the teacher's voice at a constant volume even though the distance between the teacher and students changed. Similar to Eriks-Brophy & Ayukawa's (2000) findings, teachers in this study felt that when they used amplification, their classroom became a more inclusive environment. They noted greater involvement in class activities and that students with exceptionalities could more easily focus, take risks, be drawn into the learning environment, and engage with others.

The pass-around handheld microphones were also noted as beneficial to the learning environment. Flexer (2005) explained that pass-around microphones improve students' ability to hear each other, thus enabling them to capitalize on incidental learning opportunities and engage in auditory self-monitoring. In the participant interviews, teachers noted that the voices of quiet students could be heard and there was less need to ask them to speak up. In addition, shy students were more likely to participate when they could use a handheld microphone.

The teachers experienced improvements in their health with the use of amplification. As was found with teachers interviewed by Palmer (1998) and Eriks-Brophy & Ayukawa (2000), teachers in this study felt more relaxed, less stressed and less fatigued. Consistent with other findings in the literature, there was a reported reduction in sore throats and laryngitis and loss of work time associated with these conditions (Jónsdottir et al., 2003; Picard & Bradley, 2001; Sapienza et al., 1999). When teachers maintain voice health, fewer substitute teachers are needed which helps the continuity in students' education.

The interview data suggested that teachers needed more education on the sound field systems. Flexer (2005) recommended that individuals knowledgeable in classroom acoustics should provide information on the setup, operation, and rationale for the equipment and create opportunities to practice with it. In addition to initial education, follow-up sessions would help to ensure continued effective use of the technology. The preparation of a training package for substitute teachers would also be beneficial.

LIMITATIONS AND FURTHER RESEARCH

Hearing screenings

A number of factors may have affected the sample of students who were screened. It was not known how many parents of students with hearing problems withheld consent for screening if an audiologist was already following their children. Testing was spread across winter and spring months due to the limited availability of qualified hearing screeners. It is unknown whether this extension across seasons may have affected the sample due to the potential influence of seasonal health problems (Flexer et al., 1994). Another factor that may have affected the results was the ambient noise level in the rooms used for screenings. Although the rooms used were subjectively assessed, sound level measures were not taken.

Time limits did not allow follow-up school visits to screen students who were absent or rescreen those who did not pass the initial testing. While follow-up by an audiologist for fourteen students was reported to the authors, it is unknown how many other students who did not meet the criteria of the screening were assessed by other audiologists. Future research should allow time for repeat visits and for follow-up of all identified students to better understand the nature of their hearing problems. Such research would provide a more complete profile of the hearing status of the target population and could potentially lead to better educational outcomes for those students who have hearing loss.

Classroom noise measurements

The noise levels in only two of the schools were measured. One limitation was that the noise level in School X was higher than in School Y. It is unknown whether these schools are representative of the variability of the schools in this study. More schools could not be tested since time was not available to cover the geographic distance among all of the schools. Further research could be done with a larger sample of buildings that represent the variability in school designs.

Time and equipment restrictions limited the number of acoustic measures that were taken at the two selected schools. Other measures, such as reverberation, distance, and the influence of teachers and students on background noise could also be included to provide a more thorough evaluation of the classroom acoustics. As well, the present study used only an A-weighted scale to measure the classroom noise. Further research using a C-weighted scale would provide additional acoustic measures (Crandell et al., 2004).

Classroom observations

Four research assistants were needed in order to collect data within the same pretest and posttest periods since observations were made only within Language Arts subject area classes. For the same reasons, two researchers were needed to conduct reliability checks concurrently. Since the RECP was a complex data collection instrument, inconsistency among observers and researchers was a possible limitation.

Sample size in each classroom was too small to allow for exclusion of students who were not present in both the pretest and posttest observation periods. Follow-up for

students who were absent was not part of the procedure because classroom environments, types of lessons, student groupings, or teaching styles could change from day to day.

The content and purpose of students' responses was not recorded, nor were teachers' methods for delivering instruction. Since this information was not included in the classroom observations, the relationship between instructional method and classroom observations could not be analyzed. Future research could include more descriptive measures of the teaching-learning environment. Another study might involve observing students only during times of pre-selected instructional methods. Additionally, in the present study, English and French Immersion class data was not separated in the analyses. A further investigation could focus on French Immersion classes where teaching methodology incorporates both second language and content learning.

The results from the observations in kindergarten classrooms often differed from those of the other grades. It is not known if the communicative interactions and pedagogical methods associated with verbal instruction used in kindergarten may vary from those used in other grades. Further study at the kindergarten level could be designed to consider these variables.

The use of the RECP as a recording protocol was limited in terms of the type and amount of observational data that could be recorded. The time sampling procedure allowed for only brief observations. Since the content of the communicative interactions were not videotaped, the context was not known and could not be part of the analyses. Only the frequency of responses by students could be analyzed. Further study of classroom interactions might include data on the content of the teachers' and students' communication and the context.

Participant interviews

Time factors limited the ability to probe more deeply into participants' comments during the interviews. Additional time would have allowed for follow-up visits to verify the themes and elaborate on what was said. Three areas for future research emerged from the interviews.

First, the benefits of sound field amplification on teachers' vocal health could be measured by investigating absenteeism related to vocal hygiene problems. Such a study could also measure the cost of replacing teachers with substitutes including the potential impact on students of reduced continuity in teaching.

Second, some teachers commented that they had questions regarding the use of the technology. The schools had variations in the length of time sound field systems were used, how they were installed, and the technical support provided. Future research could ensure that all teachers receive the same instruction, including information on the setup, operation, and rationale for the use of the equipment as well as periodic follow-up sessions by individuals knowledgeable in acoustics and the use of sound field technology.

Third, the use of handheld microphones in the classroom is another area for further research. While this study focused mainly on the amplification of the teachers' voices, increasing the volume of students' voices may have additional benefits on student engagement in the learning process.

CONCLUSION

This research contributes to the understanding of the classroom listening environment in a Canadian context. The data in this study, along with current literature, suggests that rooms with poor acoustics require students to use more effort to attend and concentrate. This study also highlights the importance of addressing hearing problems among students in the early grades. School personnel need to be aware of the many components involved in creating optimal classroom listening environments including characteristics of the students, room acoustics, and benefits of using sound field amplification. Enhancing the listening environment and enabling students to hear in the classroom is critical because so much learning is based on accurately perceiving the message.

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APPENDIX A

Revised Environmental Communication Profile*
(Massie, Theodoros, Byrne, McPherson, & Smaldino, 1999)

Class: _____ School: _____ Date: _____ Start: _____ Finish: _____ Page ____ of ____

CHILD'S COMMUNICATIVE INTERACTIONS										ENVIRONMENTAL EVENTS															
Verbal		Nonverbal				Direction of Communication				Verbal			Nonverbal			Verbal			Nonverbal			SOURCE OF STIMULI TO CHILD				
										TEACHER						PEER										
Statements	Other Vocal Behavior	Eye Contact	Tactile	Gesture	No Response	Initiations to Teacher	Initiations to Peer	Initiations to Class	Initiations to Self	Statement	Other Vocal Behavior	Eye Contact	Tactile	Gesture	No Response	Statement	Other Vocal Behavior	Eye Contact	Tactile	Gesture	No Response	Cues to child from teacher or peer	Cues to class from teacher or peer	Cues to peer from teacher	Cues Between Peers	Noise/Environment

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Book Reviews
Évaluation des livres

Title: Building a Research Career

Authors: Christy L. Ludlow Ph.D., Raymond D. Kent Ph.D.

Date: 2011

Publisher: Plural Publishing Inc.

Cost: $89

Reviewer: Gillian de Boer
University of Toronto,
Department of Speech-Language Pathology

The goal of "Building a Research Career" is, in the words of the authors, to "introduce the new investigator to the explicit and not so explicit expectations of a research career." The authors, Christy L. Ludlow and Raymond D. Kent, are two of the most eminent and distinguished researchers in speech-language pathology, and the advice they dispense in this book is based on the authority of hundreds of research papers and millions of grant funding dollars. Although the book's publisher and its authors specialize in communication disorders, "Building a Research Career" does not. It is written for a broader audience, the scientists across all medical fields who may also be practicing health care professionals. Curiously, the authors avoid any explicit reference to their own profession.

The first chapter describes the stages of a research career and the characteristics of a successful scientist. It also includes important considerations when selecting a PhD program and a postdoctoral mentor. The second chapter provides an overview of research methodologies and study designs in the health sciences. The third chapter provides sound advice on how to keep up-to-date with information pertaining to one's field of research and how to organize that information.

The fourth and seventh chapters are devoted to writing. The fourth chapter focuses on journal articles, hones in on the etiquette of shared authorship and covers various ethical matters that can arise. The seventh chapter is dedicated to proposal writing for research grant funding. The content in the section on grant funding is geared towards an American audience and details the specific requirements of American granting agencies. However, Canadian readers would probably still find the chapter quite useful as any novice researcher could benefit from the proposal writing tips and schedule the authors provide.

"Membership in the Scientific Community" is the title of the fifth chapter. It discusses ways in which a researcher can participate in scientific life including networking, reviewing for journals, and participating in study review panels. While encouraged to branch out, the reader is advised to be selective with extracurricular scientific activities, so as not to overextend him- or herself. The authors also provide guidance on varied topics such as how to conduct oneself at meetings and how to write letters of recommendation. While some of this advice is fairly generic, it is nice to see it written down nonetheless: Academics usually receive very little training in many of these core skills, so even basic information about a topic like meeting etiquette may be quite eye-opening for graduate students and junior faculty.

Research practices are the focus of the sixth chapter. The importance of tracking research progress in a laboratory notebook is highlighted. The authors give a review of the capabilities and costs of various electronic laboratory notebook software products. Research Ethics Boards (Institutional Review Boards in the US) and a principal investigator's duty to them are covered. The authors also provide strategies to avoid the pitfalls of clinical research and how to handle adverse events, should they occur.

The next chapters delve into the planning of a research career. In the eighth chapter, the authors discuss the career prospects one may take away from academia, such as in a research lab within a hospital, with the American government, or in the private industry. There is also a brief overview of some alternative careers to consider. The ninth chapter focuses on long-term career strategies. The authors advocate the creation of a research plan including a mission statement to guide a budding researcher's career. They give advice on how to select the best technology, students and staff. Other important factors involved in running a laboratory are covered, as well as considerations for moving on to another organization.

The tenth chapter is specifically devoted to building a career in an academic setting. Junior faculty members may be relieved to learn that a sense of poor time management and a general feeling of ineffectiveness affect most new faculty members. The authors note that the number of women in biomedical research declines with higher academic rank. They summarize the National Health Institute's recommendations to organizations to remedy this situation but the authors themselves have no additional advice for female scientists.

For those who create a marketable invention in the course of their research, the eleventh chapter delves into an American perspective of intellectual property, patents, licensing and medical trials. In the final chapter, the authors provide advice on successful interviews and where to apply. They then review the core elements from previous chapters to underline their importance for the reader.

"Building a Research Career" provides much needed advice and guidance for anybody embarking on such a career track. However, qualifying for a faculty position is a long and complicated career path, and success cannot always be guaranteed. The book has precious little advice for those left along the wayside; the one page devoted to alternative careers may not provide enough reassurance for newly minted PhD level researchers who feel that they are not cut out for the demands of a university faculty career. Overall, the authors accomplish their mission to introduce the reader to the expectations of a research career. For graduate students, currently on their way to research degrees, the book offers a fascinating look behind the scenes of academic life. It is as much about what being a researcher entails as how to build a career in research.

Book Reviews
Évaluation des livres

Title: Aphasia and Related Neurogenic Language Disorders: Fourth Edition

Author: Leonard L. LaPointe

Date: 2011

Publisher: Thieme Medical Publishers, Inc.

Cost: $64.95

Reviewer: Susan Harper
University of Toronto, Department of Speech-Language Pathology

This the fourth edition of the book "Aphasia and Related Neurogenic Language Disorders." The editor Leonard LaPointe explains the need for this new edition as follows:

> The human brain should no longer be considered immutable. Changes in neuroarchitecture and neuroconnectivity that are directly connected to behavioural treatments are being reported and carefully studied every day, and the idea that carefully selected and programmed therapeutic experiences in the proper dosages can actually change the brain is one of the most exciting developments in brain and rehabilitative science in many a moon. Or maybe ever.

The book is organized into three sections. 'Section I: Foundations and Practicalities' is composed of seven chapters. Chapter 1 includes a brief overview of the anatomy and physiology of the central nervous system and a discussion of the structures in the brain and their functions. In Chapter 2, 'Humanistic Basics: Adaptation, Accommodation, and Aristos', LaPointe discusses the "wreck", stages in the illness experience and the "raft". Malcolm R. McNeil and David A. Copland write about aphasia theories, models of aphasia rehabilitation and classification systems in Chapter 3. Also in this section, Joseph R. Duffy, Tepanta R.D. Fossett and Jack E. Thomas discuss the acute care hospital setting and its focus on management versus rehabilitation. Julius Fridriksson writes about structural and functional neuroimaging, including Computerized Tomography (CT) scans and Magnetic Resonance Imaging (MRI) scans in Chapter 5. In Chapter 6, Joyce L. Harris discusses multicultural and multilinguistic issues and client-centred approaches associated with aphasia and other neurogenic language disorders, with a special focus on the aging culturally and linguistically diverse (CLD) population. The first section concludes with a chapter by Katherine B. Ross, on enhancing quality of life using a person-centred approach and evaluating it from the perspectives of an individual with aphasia.

'Section II: Assessment and Treatment' consists of nine chapters and covers specific impairments and their various treatment approaches. The topics are broken down into naming and word retrieval (by Anastasia M. Raymer), comprehension (by Mikyong Kim), and reading and writing (by Pélagie M. Beeson, Kindle Rising and Steven Z. Rapcsak). Gayle DeDe and Erin O'Bryan Richtsmeier discuss the assessment and treatment of disorders of sentence comprehension and production. Pragmatics and discourse are covered by Leanne Togher in chapter 12. In Chapter 13, Roberta J. Elman writes about "Social and Life Participation Approaches to Aphasia Intervention," including specific treatment approaches such as group treatment, couples and family training, internet training and book clubs. Joanne P. Lasker writes about assistive technology including hybrid computer-based approaches. In Chapter 15, Randall R. Robey covers treatment effectiveness and evidence-based practice. The last chapter in this section, written by Adrienne Hancock, is devoted to providing up-to-date resources for families and clinicians, including questions health professionals could ask caregivers to help direct them to the appropriate resources. Hancock also writes about insights that brain injury survivors and their caregivers may gain from the disorder. She includes some of their stories at the end of the chapter.

'Section III: Related Cognitive-Language Disorders' consists of three chapters. In Chapter 17, Margaret L. Blake writes about right hemisphere damage. Michelle S. Bourgeois discusses dementia in Chapter 18, including the pathophysiology, the features of the various types of dementia, and evaluation and treatment. In the last chapter of the book, 'Traumatic Brain Injury, Blast Injuries, and Multisystem Injuries', Carl A. Coelho writes about the pathophysiology of traumatic brain injury, the continuum of care, cognitive and communicative impairments, and types of intervention.

Throughout the book, figures, tables, case examples, chapter review questions and test questions help the reader consolidate his or her knowledge. The layout is clear and aids the presentation of the material with bolded subheadings within each chapter. Some of the chapters also

use sidebars, which alert the reader to important points in the corresponding section. While many chapters include useful glossaries, it might have been more practical for the reader to have a comprehensive glossary at the end of the book to put all the information in a central location.

Overall, this book is a well-organized resource providing the reader with up-to-date information about the advances in brain research, current theories and practice methods in aphasia and related neurogenic language disorders. The book is aimed at clinicians, researchers and student readers. It is definitely appropriate for all three groups, although student readers would need a solid background in aphasiology and neuroanatomy to fully benefit from the book.

Erratum: Exploration of the utility of a brief swallow screening protocol with comparison to concurrent videofluoroscopy

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Subsequent to the publication of this article in the fall, 2011 issue of CJSLPA, we have been made aware that some details are missing in our description of the Toronto Bedside Swallow Screening Test (TOR-BSST©) developed by Martino and colleagues (2009a; 2009b). Readers should note that the TOR-BSST© was erroneously omitted from the list of screening tests that include cup drinking in their protocol (Steele et al., 2011, page 230). Furthermore, the TOR-BSST© was validated in both the acute stroke and stroke rehab populations; this detail was missing from Table 2. To rectify this situation, a corrected version of Table 2 is reprinted on the next page. Finally, the reference to Martino et al. (2009) in the first paragraph of page 240 (Steele et al., 2011) refers to the manuscript by Martino, Silver, Teasell, Bayley, Nicholson & Streiner (2009) in the reference list and was missing an "a" following the citation to appropriately distinguish it from the paper by Martino, Streiner, Maki & Diamant (2009), which follows in the reference list.

REFERENCES

Martino, R., Silver, F., Teasell, R., Bayley, M., Nicholson, G., Streiner, D. L. et al. (2009). The Toronto Bedside Swallowing Screening Test (TOR-BSST): development and validation of a dysphagia screening tool for patients with stroke. *Stroke, 40*(2), 555-561.

Martino, R., Streiner, D. L., Maki. E., Diamant, N. (2009). A sensitivity analysis to determine whether ten teaspoons of water are really necessary. *Dysphagia, 24*(4),473.

CONTACT INFORMATION

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Table 2

Comparison of the methodology and results of previous swallow screening tool validation studies.

Test	Validation	Population	Sensitivity	Specificity	Negative Predictive Value	Positive Likelihood Ratio	Blinding?
Standardized Swallow Assessment (Perry, 2001)	Chart-documented evidence of dysphagia	Stroke	97%	90%	Not reported	9.70	Not reported
Massey Bedside Swallowing Screen (Massey & Jedlicka, 2002)	Chart-documented evidence of dysphagia	Stroke	100%	100%	Not reported	N/A	Not reported
VAMC Nursing Admission Dysphagia Screening Tool (Bravata et al., 2009)	S-LP evaluation of swallowing	Stroke	29%	84%	68%	1.81	Not reported
Royal Brisbane and Women's Hospital Dysphagia Screening Tool (Cichero, Heaton & Bassett, 2009)	S-LP Clinical Swallow Examination and Chart Review	Stroke	95%	97%	98%	31.6	No
TOR-BSST©* (Martino, Silver, et al., 2009)	VFSS confirmation of dysphagia using P-A Scale and MASA dysphagia subscore	Acute stroke‡	96%	64%	93%	2.60	Yes
Volume-Viscosity Screening Test (Clave et al., 2008)	VFSS confirmation of aspiration and other abnormal swallowing parameters	Heterogeneous	100%	29%	Not reported	1.40	Yes
Daniels Swallow Screen (Daniels et al., 1998)	VFSS confirmed aspiration	Acute stroke	92%	66%	Not reported	4.46	Yes
MGH-SST (Cohen, 2008)	FEES confirmation of dysphagia and/or penetration-aspiration	Neuroscience admissions	89%	61%	87%	2.28	Yes
3-oz Water Swallow Test (Suiter & Leder, 2008)	FEES immediately beforehand	Heterogeneous	96%	46%	98%	1.80	No
Gugging Swallow Screen (Trapl et al., 2007)	FEES measures of aspiration (P-A scale ≥ 5)	Stroke	100%	50-69%	100%	3.23	Yes

* TOR-BSST© stands for the Toronto Bedside Swallow Screening Test.
‡ The TOR-BSST© was validated in both acute stroke and rehabilitation populations. Only the acute stroke data are reported here. For additional details, refer to Martino et al. (2009a), p. 560. Table 4.

Erratum: Book Review

Title: Science of Successful Supervision and Mentorship

Author: Linda Carozza, Ph.D.

Date: 2010

Publisher: Plural Publishing Inc.

Cost: $75

Reviewer: Ian Roth, MHSc
Toronto Western Hospital

In the September 2011 issue of the Canadian Journal of Speech-Language Pathology and Audiology, Ian Roth reviewed the book Science of Successful Supervision and Mentorship by Dr. Linda Carozza (CJSLPA, 2011, 35, 268-269). It has been brought to our attention that the review overlooks the fact that two chapters of the book were contributed by other authors. Ms. Andrea "Deedee" Moxley, Associate Director for Multicultural Resources at the American Speech-Language-Hearing Association, wrote Chapter 9, entitled Model of Mentorship: Expert Practice. Dr. Patrick R. Walden, Assistant Professor in the Department of Communication Sciences and Disorders, St. John's University in New York, NY, authored Chapter 10, entitled Learning from experience: Future directions for clinical supervision. In his review, Mr. Roth failed to credit Ms. Moxley for her contributions to the discussion on multiculturalism in clinical supervision. Also, the points about supervisees' reflections in terms of learning responses, development and new clinical situations were from Dr. Walden's chapter, and not the writing of Dr. Carozza, as stated in the book review. Mr. Roth and the Canadian Journal of Speech-Language Pathology and Audiology regret this oversight.

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 has established multiple categories of manuscript submission that will permit the broadest opportunity for dissemination of information related to human communication and its disorders. The 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 use the electronic CJSLPA manuscript submission system at http://cjslpa.coverpage.ca to submit articles. If you are unable to use the electronic system, please 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.

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 it 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), 6th 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 electronic copy of the manuscript should be submitted directly to the editor. Author identification for the review process is optional; if blind-review is desired, the documents should be prepared accordingly (cover page and acknowledgments blinded). Responsibility for removing all potential identifying information rests solely with the author(s). All submissions should conform to the publication guidelines of the most current edition of the Publication Manual of the American Psychological Association (APA. The APA manual is available from most university and 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 typedwritten double-spaced and placed at the end of the document. 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 to be included as part of the manuscript must also be submitted in their original file format separate from the manuscipt. 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 CJSLPA 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 page 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 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 page. 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 most current edition of the APA publication manual 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 CJSLPA 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 within the publication.

Participants in Research Humans and Animals

Each manuscript submitted to CJSLPA 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, CJSLPA 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 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 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

Pour soumettre un article, les auteurs doivent utiliser le système de soumission électronique de l'ACOA à l'adresse http://cjslpa.coverpage.ca. Si vous ne pouvez pas utiliser le système électronique, veuillez envoyer par courriel un fichier Word ou WordPerfect contenant le manuscrit, y compris tous les tableaux, les figures ou illustrations et la bibliographie. Adressez le courriel au rédacteur en chef à l'adresse tim.bressmann@utoronto.ca.

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 le publication *Manual of the American Psychological Association (APA)*, 6e 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.

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ORGANISATION DU MANUSCRIT

Tous les textes doivent être écrits 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. Un fichier électonique du manuscrit doit être présenté 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 un fichier électronique 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 les plus récentes de l'APA. Ce manuel est disponible dans la plupart des librairies universitaires et 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, l'adresse complète de l'auteur-contact et l'adresse de courriel de l'auteur contact.

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.

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Dans le processus de présentation, les auteurs doivent déclarer clairement l'existence de tout conflit d'intérêts possibles ou engagement double relativement au manuscrit et de ses auteurs. Cette déclaration est nécessaire afin d'informer la RCOA que l'auteur ou les auteurs peuvent tirer avantage de la publication du manuscrit. Ces avantages pour les auteurs, directs ou indirects, peuvent être de nature financière ou non financière. La déclaration de conflit d'intérêts possibles ou d'engagement double peut être transmise à des conseillers en matière de publication lorsqu'on estime qu'un tel conflit d'intérêts ou engagement double aurait pu influencer l'information fournie dans la présentation ou compromettre la conception, la conduite, la collecte ou l'analyse des données, ou l'interprétation des données recueillies et présentées dans le manuscrit soumis à l'examen. Si le manuscrit est accepté en vue de sa publication, la rédaction se réserve le droit de reconnaître l'existence possible d'un tel conflit d'intérêts ou engagement double.

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Remerciements : Les remerciements doivent être écrits à double interligne sur une page 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.

Références : Les références sont énumérées les unes après les autres, en ordre alphabétique, suivi de l'ordre chronologique sous le nom de chaque auteur. Les auteurs doivent consulter le manuel de l'APA le plus récent pour obtenir la façon exacte de rédiger une citation. Les noms de revues scientifiques et autres doivent être rédigés au long et imprimés en italiques. Tous les ouvrages, outils d'essais et d'évaluation ainsi que les normes (ANSI et ISO) doivent figurer dans la liste de références. Les références doivent être écrits à double interligne.

Participants à la recherche – êtres humains et animaux

Chaque manuscrit présenté à la RCOA en vue d'un examen par des pairs et qui se fonde sur une recherche effectuée avec la participation d'être humains ou d'animaux doit faire état d'un agrément déontologique approprié. Dans les cas où des êtres humains ou des animaux ont servi à des fins de recherche, on doit joindre une attestation indiquant que la recherche a été approuvée par un comité d'examen reconnu ou par tout autre organisme d'évaluation déontologique, comportant le nom et l'affiliation de l'éthique de recherche ainsi que le numéro de l'approbation. Le processus d'examen ne sera pas amorcé avant que cette information ne soit formellement fournie au rédacteur en chef.

Tout comme pour la recherche effectuée avec la participation d'êtres humains, la RCOA exige que toute recherche effectuée avec des animaux soit accompagnée d'une attestation à l'effet que cette recherche a été évaluée et approuvée par les autorités déontologiques compétentes. Cela comporte le nom et l'affiliation de l'organisme d'évaluation de l'éthique en recherche ainsi que le numéro de l'approbation correspondante. On exige également une attestation à l'effet que tous les animaux de recherche ont été utilisés et soignés d'une manière reconnue et éthique. Le processus d'examen ne sera pas amorcé avant que cette information ne soit formellement fournie au rédacteur en chef.

Newfoundland Labrador

CASLPA 2012

to be held in St. John's, Newfoundland and Labrador, promises to be an invaluable professional development opportunity. With a fantastic list of speakers and events to choose from, this conference will be a memorable one.

St. John's, one of the oldest cities in North America, is located on the most easterly tip of the continent, quickly helping one realize that land, sea and sky truly do embrace like old friends. Its picturesque landscape, winding coastlines, and rugged terrain offer incredible scenery for nature lovers. From bird-watching, to boat tours, to the possibility of spotting 10,000 year-old glacial giants in the Atlantic Ocean, there will never be a disappointing moment.

While embracing fellow colleagues and catching up with old friends between conference speakers, enjoy some valuable personal time shopping along the quaint streets of downtown St. John's or walking through beautiful Bowering Park.

Feeling hungry? St. John's offers exciting and diverse dining experiences. Your taste buds will surely be tantalized as you try local delights including cod tongues, toutons, and fish-and-brewis. On your way, take a stroll along the two blocks of bars and pubs which make up George Street; the centre of the city's entertainment district with a unique reputation that has spread far and wide!

One social event you can take advantage of is a *Rally in the Alley*, a wonderful opportunity to experience a wide range of establishments on George Street. Start the evening with supper with the crowd, followed by a tour of many venues along the infamous street!

To find out more about what is happening in St. John's, and within our beautiful province, please visit the following websites:

www.newfoundlandlabrador.com

www.stjohnskiosk.com

St. John's, Newfoundland
May 9–12, 2012
Delta St. John's

Join Us!

Planning is in full swing as we prepare for an unforgettable conference; so don't forget to visit the **CASLPA website** for frequent updates on confirmed speakers, program details and registration information!

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