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Implications des données relatives aux services offerts aux États-Unis sur l'augmentation mondiale du nombre de cas adultes appartenant à des groupes ethniques qui nécessitent des services de neuro-réadaptation

José G. Centeno
Joyce L. Harris

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Abstract

The interaction of worldwide population aging with the concurrent growth in global ethnoracial diversity is estimated to substantially expand ethnogeriatric neurorehabilitation groups in the United States and other diverse high-migration world regions. Assessments of service provision to communicatively impaired multilingual-multiethnic neurorehabilitation caseloads in the United States may generate useful evidence with implications for other diverse adult rehabilitation contexts. This study assessed differences in the extent of professional training and availability of post-graduate professional development offerings that might exist in speech-language pathology service provision to minority adults in general relative to bilingual adults in multiethnic adult neurorehabilitation caseloads in the United States. A 36-question, 6-section survey administered to health care-based speech-language pathologists in the most diverse states in the United States examined service delivery to multiethnic adult neurorehabilitation groups. A data subset from this survey research was statistically assessed using descriptive and inferential statistics to address the target research questions. Results indicate that despite an overall limited exposure to multiethnic adult populations in their training, speech-language pathologists felt better trained to serve minority adults in general relative to bilingual adults. Speech-language pathologists also are interested in post-graduate professional development resources to improve their competencies to serve these two groups. We extrapolate the implications of our findings to the diverse high-migration Canadian context to further illustrate the impact of global ethnogeriatric trends on professional neurorehabilitation services in hyperdiverse areas. Future studies will broaden our preliminary findings to specify additional remedial areas in the services for the growing ethnogeriatric neurorehabilitation caseloads across the world.

Abrégé

On estime que l'interaction entre le vieillissement de la population mondiale et l'augmentation concomitante de la diversité ethnoraciale à l'échelle internationale entraînera une augmentation significative du nombre de personnes âgées appartenant à divers groupes ethniques nécessitant des services de neuro-réadaptation aux États-Unis et ailleurs dans le monde où la migration est forte. Analyser les services de neuro-réadaptation offerts aux États-Unis aux patients multilingues et appartenant à divers groupes ethniques ayant un trouble de la communication peut générer des données utiles à d'autres contextes de réadaptation. La présente étude a analysé les différences quant au degré de préparation professionnelle et aux opportunités de perfectionnement professionnel postuniversitaire sur les services orthophoniques offerts aux adultes appartenant à des minorités ethniques et aux adultes bilingues.
Un sondage comprenant 36 questions réparties dans six sections a été rempli par des orthophonistes travaillant dans des établissements de soins de santé dans les états américains les plus diversifiés. Ce sondage portait sur les services de neuro-réadaptation offerts aux adultes appartenant à divers groupes ethniques. Un sous-ensemble de données provenant de ce sondage a été analysé à l'aide de statistiques descriptives et inférentielles afin de répondre aux questions de recherche ciblées. Les résultats indiquent que, même si l'exposition des orthophonistes aux populations adultes multiculturelles au cours de leur formation était limitée, ils se sentaient mieux formés pour servir des adultes appartenant à des groupes ethniques minoritaires que pour servir des adultes bilingues. Les orthophonistes étaient également intéressés aux ressources de perfectionnement professionnel postuniversitaire afin d'améliorer leurs compétences. Nous étendons les résultats de notre étude au contexte canadien où la migration est forte et diversifiée, afin d'illustrer davantage l'impact des tendances mondiales de vieillissement et diversification de la population sur les services professionnels de neuro-réadaptation offerts dans les régions hautement diversifiées. De futures études permettront d'élargir nos résultats préliminaires afin de préciser les aspects pouvant être améliorés à l'échelle mondiale dans les services de neuro-réadaptation offerts au nombre croissant de personnes appartenant à des groupes ethniques.

The world is rapidly aging and becoming more diverse. Steady rates of aging coupled with the concurrent global increase in ethnoracial diversity are projected to translate into larger ethnogeriatric groups with age-related disabling health conditions, prominently including cardiovascular disease and neurocognitive disorders (Cummings-Vaughn, 2017; Prince et al., 2015). The global population aged ≥ 60 years doubled to reach 962 million from 1980 to 2017 and is estimated to double again to about 2.1 billion by 2050 (United Nations, Department of Economic and Social Affairs, Population Division, 2017). Yet, the ≥ 80 years cohort, the most vulnerable group known as the "oldest-old," is anticipated to grow more than threefold from 137 million to 425 million between 2017 and 2050 (United Nations, Department of Economic and Social Affairs, Population Division, 2017).

Driven by international migration, an exponential increase in global ethnoracial diversity parallels worldwide aging. In many world regions, diversity scenarios consisting of numerous ethnic groups, including Indigenous populations, have expanded as new international migrants arrive, many of which are older individuals and refugee groups (International Organization for Migration, 2017). International migration progressively grew from 173 to 258 million individuals between 2000 and 2017 (United Nations, Department of Economic and Social Affairs, Population Division, 2017). Notably, among international migrants the global population of forcibly displaced people reached a record high of 70.8 million in 2018, up from 43.3 million in 2009 (United Nations High Commissioner for Refugees, 2019). As a result, demographic environments in regions of high incoming migration, such as Asia, Europe, and North America (International Organization for Migration, 2017), have steadily become linguistically, socially, and culturally complex multiethnic communities representing a variety of languages, dialects, levels of multilingualism, socioeconomic circumstances, educational experiences, and cultural norms (Krasnik, Bhopal, Gruer, & Kumanika, 2018).

Global population aging is anticipated to result in a higher prevalence of age-related, long-term disabilities from cardiovascular complications due to stroke and neurocognitive deterioration due to dementia, particularly in minority individuals in multiethnic communities (Feigin et al., 2019; Morgenstern & Kissela, 2015; Nichols et al., 2019). Risk factors for cardiovascular and neurocognitive disorders, such as low physical activity, obesity, hypertension, and coronary heart disease, substantially increase with aging (Howard et al., 2017; Matthews et al., 2019; Obviagele et al., 2013). By 2030, reflecting worldwide population aging, stroke survivors are projected to reach 73 million and individuals with dementia near 75 million (Feigin et al., 2014; World Health Organization [WHO], 2019). In multiethnic communities, certain social, institutional, and cultural health determinants (e.g., socioeconomic circumstances, language barriers, minimal access to health literacy, poor health care) increase the chances of stroke and dementia (Cruz-Flores et al., 2011; Harris & Fleming, 2009; Mulvahill & Cummings-Vaughn, 2017). As the population becomes older and more diverse, persisting high incidence of stroke and dementia, particularly in individuals aged ≥ 75 and in minority groups, is estimated (Chin, Negash, & Hamilton, 2011; Howard & Goff, 2012; Morgenstern & Kissela, 2015).

A high prevalence of stroke and dementia will create larger service demands to address the clinical needs of multiethnic caseloads in adult neurorehabilitation facilities in many world regions (Cummings-Vaughn, 2017; Krueger et al., 2015; Morgenstern & Kissela, 2015; WHO, 2015, 2019). Resulting chronic disabilities from stroke and dementia will require multidisciplinary teams for long-term neurorehabilitation of self-care, mobility, cognition, communication, and feeding complications (Robnett, Brossoie, & Chop, 2020; Yorkston, Bourgeois, & Baylor, 2010). Thus, it becomes increasingly essential to have well-prepared speech-language pathologists (S-LPs) to provide appropriate evidence-based, culturally responsive services to culturally and linguistically diverse (CLD) adult neurorehabilitation caseloads. In this paper, we relate preliminary professional findings on multiethnic neurorehabilitation services in the United States to the similarly diverse neurorehabilitation context in Canada, a high-migration country as the United States, to further illustrate how global ethnogeriatric trends may impact speech-language pathology rehabilitative services worldwide as the population ages and becomes more diverse.

Demographic–Neuroepidemiological Interconnections in the United States

Consistent with worldwide ethnogeriatric trends, the U.S. population simultaneously is aging and becoming increasingly more multiethnic. By 2060, the ≥ 65 years U.S. population is expected to more than double, reaching about 92 million, including a triple growth in the ≥ 85 years cohort to approximately 18.2 million (Ortman, Velkoff, & Hogan, 2014). Ethnoracial minorities currently represent 37% (116.2 million) of the total U.S. population (316.4 million). Hispanics make up the largest minority segment, followed by Blacks or African Americans, Asians, American Indians and Alaska Natives, and Native Hawaiians and other Pacific Islanders. The non-Hispanic White majority makes up 63% (199.3 million) of the population (Humes, Jones, & Ramirez, 2011; United States Census Bureau, 2012).

As seen in much of the world, immigration will continue to be the primary cause of population growth and national ethnoracial change in the United States (Pew Research Center, 2015; United Nations, 2017). By 2060, individuals from CLD backgrounds will make up 57% of the U.S. population (United States Census Bureau, 2012). Regarding adults ≥ 65 years, by 2050 U.S. minorities are estimated to comprise about 40% of this population segment (Federal Inter-agency Forum on Aging, 2012). Ethnoracial diversity in the United States reflects the typical socioeconomic, linguistic, and cultural variability of multiethnic contexts worldwide. In terms of linguistic profiles, these include dialectal speakers of English, monolingual and multilingual users of minority languages, and bilingual speakers of English and a minority language (Centeno, 2015).

Reflecting aging and diversity projections in the country, an estimated increase in the incidence of stroke and dementia (Fleming & Harris, 2017; Koton et al., 2014; Matthews et al., 2019; Winstein et al., 2016) is expected to amplify the need for a larger neurorehabilitation workforce, especially to work with older minority groups. While there will be an additional 3.4 million stroke survivors by 2030 (Obviagele et al., 2013), about 14 million individuals with Alzheimer's disease and related dementia also are estimated by 2060 (Matthews et al., 2019). High numbers of stroke- or dementia-disabled minority individuals in multiethnic U.S. communities are projected (Centeno, 2017; Uomoto & Loughlin, 2016).

A detailed discussion on the effects of race and ethnicity on stroke and dementia epidemiology in the United States is beyond the scope of this article (for exhaustive reviews, see Chin et al., 2011; Cruz-Flores et al., 2011; Matthews et al., 2019; Mozaffarian et al., 2016; Obviagele et al., 2013). Yet, there are epidemiological trends that are worth highlighting as they raise major concerns with relevance to stroke and dementia care in U.S. minority adults. Regarding stroke, ethnoracial disparities in stroke prevalence have been associated with a cluster of key variables including age, sex, race/ethnicity, level of education, and geographic location. Specifically, older adults, Blacks, American Indians/Alaska Natives, persons with lower levels of education, and persons living in the southeastern United States have been reported to have higher stroke prevalence (Centers for Disease Control and Prevention, 2012). Regarding dementia, the pathophysiological pathway of dementia and other related neurocognitive complications is similar across ethnoracial groups. However, socioeconomic and cultural factors, such as educational attainment, wealth, quality and extent in preventive care, physical activity, and biological variables (e.g., genetics), may be responsible for the high prevalence of dementia risk factors in African Americans and Hispanics, which include diabetes, hypertension, and cardiovascular health (Chen & Zissimopoulos, 2018; Chin et al., 2011).

Considering stroke and dementia group data and Census population estimates, including international migration trends, prevalence estimates project that by 2030 as the U.S. population steadily ages, the stroke prevalence in Hispanic men will have the greatest increase followed by other races and ethnicities in the ≥ 65 years segment of the population, especially those ≥ 85 years (Mozaffarian et al., 2016; Obviagele et al., 2013). Regarding dementia, by 2030, as the ≥ 85 years group outpaces other aging groups with dementia, the number of non-Hispanic Whites with dementia will start to plateau while minority populations with dementia will grow, particularly Hispanic individuals (Matthews et al., 2019).

Clinical and Professional Scenario in Ethnoracially Diverse Speech-Language Pathology Neurorehabilitation Services Across the World

The complexity of clinical management in neurogenic communication disorders increases substantially when treating adults from CLD backgrounds. Effective clinical service provision in multiethnic adult environments requires the ability to differentiate between communication dysfunctions as a result of neurological damage and communication differences resulting from social, cultural, and linguistic life experiences (Armstrong, Hersh, Hayward, & Fraser, 2015; Centeno, Ghazi-Saidi, & Ansaldo, 2017; Threats, 2005). Practitioners need unbiased assessment materials and evidence-based intervention procedures to provide appropriate diagnostic and effective therapeutic services (Ansaldo, Marcotte, Scherer, & Raboyeau, 2008; Armstrong et al., 2015; Centeno et al., 2017; Kay-Raining Bird, 2014; Muñoz, 2012). Additionally, practitioners must consider the impact of socioeconomic, sociopolitical, and cultural factors on service delivery to adults from CLD backgrounds (Balcazar, 2010; Kay-Raining Bird, 2011; Penn et al., 2017).

Epidemiological forecasts strongly suggest that the largely adult-based caseload of S-LPs in U.S. health care settings (ASHA, 2013a; Brook, 2015), including neurorehabilitation services, will experience growth in its stroke- and dementia-impaired minority cohort, a pattern similarly expected in many countries (Bennett, Cartwright, & Young, 2017; Krueger et al., 2015; Norris, Jones, Kilbride, & Victor, 2014; WHO, 2015). Yet, despite present and projected demographic and neuroepidemiological trends, the limited research evidence on service provision to minority adults with neurogenic communication impairments in the United States and other similar multiethnic contexts highlights that S-LPs in health care settings have neither adequate professional preparation nor population-specific clinical resources to optimally serve an ethnoracially diverse adult caseload (American Speech-Language-Hearing Association [ASHA], 2011; Brewer, McCann, Worrall, Harwood, 2015; Centeno, 2009, 2015; D'Souza, Kay-Raining Bird, & Deacon, 2012; Hersh, Armstrong, Panak, & Coombes, 2015; Rose, Ferguson, Power, Togher, & Worrall, 2014). Additionally, there is a lack of population-specific evidence to guide best clinical practices for minority adults with neurogenic communication disorders (Beveridge & Bak, 2011; Ellis, 2009). In the current climate of evidence-based practice as an intervention standard (Turkstra, Norman, Whyte, Dijkers, & Hart, 2016), the need for quality research evidence is essential on adult ethnoracially mixed populations in neurorehabilitation.

Aims of the Study

Steady growth in the ethnoracial diversity of aging populations across the world compels systematic scrutiny of current service provision to communicatively disordered multiethnic neurorehabilitation caseloads with the aim of specifying conceptual, professional, and clinical aspects that can benefit from corrective research and training strategies. The purpose of this paper is to (a) discuss preliminary evidence on the current extent of professional preparation and available resources that S-LPs have to serve communicatively disordered adults in multiethnic U.S. neurorehabilitation caseloads and (b) relate that evidence to a similarly diverse rehabilitative context, such as Canada, in order to highlight the professional repercussions of increasing ethnogeriatric neurorehabilitation caseloads worldwide.

We report a data subset from a larger survey that focuses on assessing services for CLD adult U.S. populations with neurogenic communication disorders. Survey responses that extensively targeted the clinical management of bilingual adults are reported elsewhere (i.e., Centeno, 2015). The present article focuses on a small set of survey items that compares differences in the extent of professional preparation and the degree of available clinical resources and professional development opportunities to serve minority adults in general relative to bilingual adults in ethnoracially diverse adult neurorehabilitation contexts.

Consistent with other large CLD environments across the world (Krasnik et al., 2018), extensive diversity in the United States has resulted in widespread bilingualism. Of the 21% (60 million) individuals in the United States who use a minority language, close to 78% (47 million) of them also speak English (Ryan, 2013). The current evidence on systematic professional assessments of services to multiethnic adult neurorehabilitation populations includes no published reports that specify the possible differences and gaps that might exist in the professional preparation and clinical resources to work with minority and bilingual populations in multiethnic neurorehabilitation contexts (e.g., Armstrong et al., 2015; Centeno, 2009, 2015; Rose et al., 2014).

Evidence from this study, while being useful to target remediation areas in training and resource development, may similarly generate valuable information to minimize service disparities in quality and clinical outcomes for ethnoracial minority adults in neurorehabilitation (Ellis, Peach, Hardy, & Lindrooth, 2017; Norris et al., 2014; Uomoto & Loughlin, 2016; Wilk, Cooke, Cooke, Stranges, & Maltby, 2018). Health care disparities in minority ethnoracial groups in part result from the complex interaction of factors encompassing socioeconomic circumstances, insurance, culture, and training limitations among health care providers (Agency for Healthcare Research and Quality, 2020; Frohlich, Ross, & Richmond, 2006; National Institute of Neurological Disorders and Stroke, 2020; WHO, 2015).

Method

A detailed description of the methodological aspects of this larger survey study, which was approved by the first author's Institutional Review Board (protocol # 0511-138, 05/13/2011), is discussed in an earlier publication (i.e., Centeno, 2015). In this article, we summarize those methodological aspects.

Participants

We mailed the survey instrument to 1,000 health care-based S-LPs randomly selected from the ASHA databases of clinicians serving adults. We sent the survey to 250 prospective participants in each of the four states in the United States with the largest immigrant populations and the highest population diversity: California, Florida, New York, and Texas (Humes et al., 2011).

Materials and Procedures

Survey design. A 36-question, six-section survey was developed using the necessary stages of planning, design, review, and revision before final administration of the survey instrument (Centeno, 2015). The survey consisted of close-ended questions (e.g., multiple choice format) and 1 (*least*) to 5 (*most*) self-assessment Likert-type questions. The six sections of the survey were respondents' background, work setting and client caseload, professional training, materials and procedures, service delivery, and suggestions to improve professional preparation to serve minority adults including bilingual persons.

Although the survey primarily aimed to examine areas pertinent to the services with bilingual adults, the survey also included several questions on minority adults in the sections on professional training, service delivery, and suggestions to strengthen professional education. These questions on minority adults, together with similar questions on bilingual speakers, intended to simultaneously gather responses on minority adults in general and bilingual adults to compare S-LPs' extent of professional preparation, satisfaction with available information, and interest in post-graduate resources relevant to the overall minority adult population relative to the bilingual adults receiving services in diverse neurorehabilitation caseloads. We report results on that set of comparative questions in the survey (i.e., Qs. 18–19, 22–23, 27–28, 33–34, and 35–36; see Appendix). One additional question (Q. 30), relevant to available information and resources on bilingual adults from the different ethnic and racial groups, was included in the analysis given the current and projected high numbers of bilingual speakers among the minority adults encountered in diverse neurorehabilitation settings discussed earlier.

Procedures. We mailed prospective participants a cover letter, the survey instrument, and a pre-stamped return envelope. The cover letter explained the rationale of the survey study, asked participants for their consent, and invited each participant to answer the survey anonymously and return it to the first author in the enclosed envelope.

Data Analysis

Descriptive statistics (i.e., percentages, means, standard deviations, and mean ranks) and inferential statistics (i.e., Friedman and Wilcoxon tests) were employed to analyze the results. Responses to closed-ended questions (multiple choice formats) were analyzed using percentages to assess response distributions (Q. 30). Self-assessment Likert-type questions were assessed (a) as percentages of response distributions when the question targeted only one dimension (Qs. 22, 23, 27, 28, 33, 34) and (b) as means, standard deviations, and mean ranks when the question assessed a series of related items whose relative effect could be hierarchically ranked for comparison of frequency (Qs. 18, 19, 35, 36). When comparisons were made among hierarchical rating ranks, the Friedman and Wilcoxon tests were employed to assess if there were significant ranking differences within the factors included in each individual question. Specifically, once we determined that there were significant differences among the items through the Friedman test, we used the Wilcoxon test to examine paired differences. Mean rankings, on which the Friedman and Wilcoxon tests were run, as well as means and standard deviations are provided for readers to appreciate the ranking order and differences.

Results

We statistically assessed 125 surveys (12.5% final response rate) to answer the research questions in this investigation. The limited response rate in this study is consistent with similar aphasia surveys that despite limited response rates have provided valuable preliminary findings (e.g., Hinckley, Hasselkus, & Ganzfried, 2013; Simmons-Mackie, Threats, & Kagan 2005). Thus, results from this initial investigation must be interpreted with this caveat in mind and considered to be preliminary. Responses provided by our informants are deemed representative of speech-language pathology practitioners in the United States working in adult neurorehabilitation contexts. Consistent with the ASHA membership working in health care contexts (ASHA, 2013a), most of our respondents were full-time monolingual Master's-level White female clinicians with 16+ years of experience.

Results are presented in two sections. The first section includes the data on professional preparation relevant to ethnoracial groups covered in coursework and clinical practicum, as well as the extent of training received to serve minority adults versus bilingual adults. The second section covers results on practitioners' overall satisfaction with current post-training information and resources, the extent of information available on each bilingual group from the different ethnic and racial backgrounds, and the degree of interest in post-graduate educational offerings for professional development.

Racial Emphasis and Extent of Professional Preparation on CLD Adult Populations

In terms of the degree that respondents were exposed to minority groups in their professional education (Qs. 18 and 19), the ranks in **Tables 1 and 2** suggest that classroom discussions and clinical training most often focused on White members of the population with Black and Hispanic/Latino individuals as second in frequency, followed by Asian/Pacific Islanders and, finally, Native or Alaska natives (Friedman tests: classroom discussions, $\chi^2 = 302.61$, 4 *df*, $p < .001$, and clinical training, $\chi^2 = 381.90$, 4 *df*, $p < .001$).

Regarding the extent to which respondents felt they were educated to work with minority adults in general and bilingual adults (Qs. 22 and 23), differences in the responses were significant (Wilcoxon z-score = 4.52, $p < .001$). Results shown in **Table 3** suggest that though most practitioners appear to be moderately to greatly prepared to serve minority adults (64.8%), they reported being minimally to moderately prepared to work with bilingual adults (66.4%).

Table 1

Ethnic/Racial Emphasis in Coursework ($N = 124$)

Racial/ethnic category[a]	Never	Infrequently	Sometimes	Frequently	Very frequently	Mean rank	Wilcoxon z(diff) with next	$p(z)$
White						4.37	7.16	.00
n	16	8	10	27	63			
%	12.9	6.5	8.1	21.8	50.8			
Black						3.44	3.04	.00
n	16	27	52	23	6			
%	12.9	21.8	41.9	18.5	4.8			
Hispanic/Latino						3.25	7.49	.00
n	25	28	49	19	3			
%	20.2	22.6	39.5	15.3	2.4			
Asian/Pacific Islander						2.21	5.63	.00
n	53	43	26	2	0			
%	42.7	34.7	21.0	1.6	0.0			
Native American or Alaska native						1.73		
n	78	35	10	1	0			
%	62.9	28.2	8.1	0.8	0.0			

Note. [a]Friedman test: $\chi^2 = 302.61$, 4 *df*, $p < .001$. One respondent did not answer this question.

Post-Training Resources for Clinical Service and Professional Development

On overall satisfaction with present information and resources (Qs. 27 and 28), rankings were significantly different between the two groups (Wilcoxon z-score = 2.50, $p = .012$). As shown in **Table 4**, despite most ratings being low at a dissatisfied–I don't know level, for those respondents that were satisfied they expressed feeling slightly more satisfied to very satisfied with the available information on minority clients in general (17.6%) than on bilingual clients (12.8%).

When asked to rate availability of resources among bilingual groups in the ethnic groups (Q. 30), **Table 5** shows that respondents have the most access to resources and information on adult bilingual speakers who are Hispanic/Latino(a) (47.2%) followed by those that are White (30.4%) or Black (13.6%).

Finally, on post-graduate educational offerings for further professional growth, we first report on overall interest in participating in Continuing Education activities (Qs. 33 and 34). **Table 6** reports frequencies primarily clustered around a moderate level of interest for both minority adults (34.4%) and bilingual adults (33.6%). Differences were not significant between interest in Continuing Education opportunities relevant to minority or bilingual adults.

Next, on specific post-graduate professional opportunities to minimize service gaps on minority individuals as a whole and bilingual adults (Qs. 35 and 36), respondents rated five resources as being most important among the resources listed in the survey. Results in **Tables 7 and 8** suggest that, overall, respondents rated the availability of linguistically and culturally appropriate therapy materials as the resource they would be the most interested in having available to better serve both minority and bilingual adults followed by suitable formal testing instruments to assess these individuals. Differences in the responses were significant (minority adults: $\chi^2 = 131.42$, 4 *df*, $p < .001$; bilingual adults: $\chi^2 = 72.30$, 4 *df*, $p < .001$). Specifically, regarding

Table 2

Ethnic/Racial Emphasis in Clinical Training (*N* = 125)

Racial/ ethnic category[a]	Never	Infrequently	Sometimes	Frequently	Very frequently	Mean rank	Wilcoxon *z*(diff) with next	*p*(*z*)
White						4.80	8.56	.00
n	1	1	1	20	102			
%	0.8	0.8	0.8	16.0	81.6			
Black						3.43	2.88	.00
n	14	30	41	25	15			
%	11.2	24.0	32.8	20.0	12.0			
Hispanic/Latino						3.15	7.09	.00
n	23	32	34	29	7			
%	18.4	25.6	27.2	23.2	5.6			
Asian/Pacific Islander						2.09	5.67	.00
n	59	45	16	4	1			
%	47.2	36.0	12.8	3.2	0.8			
Native American or Alaska native						1.52		
n	98	23	3	1	0			
%	78.4	18.4	2.4	0.8	0			

Note. [a]Friedman test: χ^2 = 381.90, 4 *df*, *p* < .001.

Table 3

Extent of Preparation to Work with Minority and Bilingual Adults (*N* = 125)

	Extent of preparation[a]					Missing
	None 1	Minimal 2	Moderate 3	Great 4	Very great 5	
Minority adults						
n	2	26	41	40	16	0
%	1.6	20.8	32.8	32.0	12.8	0.0
Bilingual adults						
n	6	42	41	27	8	1
%	4.8	33.6	32.8	21.6	6.4	0.8

Note. [a]Wilcoxon *z*-score = 4.52, *p* < .001.

Table 4

Extent of Satisfaction with the Information Available to Serve Minority and Bilingual Adults ($N = 125$)

Group[a]	Very Dissatisfied 1	Dissatisfied 2	I don't know 3	Satisfied 4	Very satisfied 5	Missing
Minority adults						
n	8	39	55	21	1	1
%	6.4	31.2	44.0	16.8	0.8	0.8
Bilingual adults						
n	9	50	50	15	1	0
%	7.2	40.0	40.0	12.0	0.8	0.0

Note. [a]Wilcoxon z-score = 2.50, $p = .012$.

Table 5

Extent of Information Available on Bilingual Speakers from Each Ethnic/Racial Adult Group ($N = 125$)

Racial/ethnic group	*n*	%
Hispanic/Latino(a)	59	47.2
White	38	30.4
Black	17	13.6
Other	1	0.8
Missing	10	8.0

minority adults, participants were most interested in access to appropriate therapy materials, followed by appropriate testing tools, journal articles on minority adults, consultants on minority adults from ASHA or other organizations, and publications on minority adults. For bilingual adults, participants were most interested in access to suitable therapy materials, followed by tests in the client's native language, learning how to use an interpreter/translator, publications on bilingualism, and consultants on bilingualism from ASHA or other organizations.

Discussion

The purpose of this paper was to assess whether in the growing multiethnic adult neurorehabilitation caseloads in the United States there are any differences in the professional preparation, available clinical resources, and professional development opportunities relevant to the services rendered by S-LPs to minority adults relative to bilingual adults. Results support that respondents' professional education, including both coursework and clinical training, was primarily focused on Whites compared to members of other ethnoracial groups. Despite the limited exposure to CLD adult populations in their professional education, practitioners felt moderately to greatly prepared to serve minority adults in general compared to feeling minimally to moderately prepared to work with bilingual adults with neurogenic communication disorders.

Responses overwhelmingly suggested dissatisfaction with the current information and resources available for post-graduate professional development regarding both minority and bilingual adult groups. When comparing resource availability among bilingual groups, most of the information available focused on Hispanic/Latino(a) individuals. Finally, respondents were moderately interested in Continuing Education activities relevant to the target populations of this study. In terms of clinical resources, they ranked linguistically and culturally appropriate therapy materials and testing instruments as the most requested resources, followed by publications and consultants from ASHA or other organizations. Regarding bilingual adults, practitioners additionally expressed interest in receiving

Table 6

Extent of Interest in Continuing Education Activities on Minority and Bilingual Adults (*N* = 125)

	Extent of interest[a]				
	Not at all 1	Mild 2	Moderate 3	Quite 4	Extreme 5
Minority adults					
n	10	31	43	26	15
%	8.0	24.8	34.4	20.8	12.0
Bilingual adults					
n	8	32	42	26	17
%	6.4	25.6	33.6	20.8	13.6

Note. [a]Wilcoxon *z*-score = 1.31, ns.

Table 7

Extent of Interest in Resources to Enhance Services with Minority Adults (*N* = 125)

Resources[a]	Interest level					Mean rank	Wilcoxon *z*(diff) with next	*p*(*z*)
	Not at all	Mildly	Moderately	Quite	Extremely			
Linguistically and culturally appropriate therapy materials						3.80	4.38	.00
n	3	14	21	40	47			
%	2.4	11.2	16.8	32.0	37.6			
Linguistically and culturally appropriate tests						3.49	5.92	.00
n	4	15	28	40	38			
%	3.2	12.0	22.4	32.0	30.4			
Journal articles on minority adults						2.60	0.05	.96
n	5	38	33	33	16			
%	4.0	30.4	26.4	26.4	12.8			
Consultants on minority adults from ASHA or other organizations						2.56	0.11	.92
n	12	31	32	29	21			
%	9.6	24.8	25.6	23.2	16.8			
Publications on minority adults						2.55		
n	9	31	36	32	17			
%	7.2	24.8	28.8	25.6	13.6			

Note. [a]Friedman test: $\chi^2 = 131.42$, 4 *df*, $p < .001$.

Table 8

Extent of Interest in Resources to Enhance Services with Bilingual Adults ($N = 125$)

Resources[a]	Interest level					Mean Rank	Wilcoxon z(diff) with next	$p(z)$
	Not at all	Mildly	Moderately	Quite	Extremely			
Linguistically and culturally appropriate therapy materials						3.78	5.54	.00
n	5	13	16	40	51			
%	4.0	10.4	12.8	32.0	40.8			
Formal tests in the clients' native language						3.12	1.43	.15
n	12	16	26	36	35			
%	9.6	12.8	20.8	28.8	28.0			
Learning how to use an interpreter/translator						2.86	1.71	.09
n	8	25	30	37	25			
%	6.4	20.0	24.0	29.6	20.0			
Publications on bilingualism						2.62	0.02	.98
n	11	27	36	31	20			
%	8.8	21.6	28.8	24.8	16.0			
Consultants and bilingualism from ASHA or other organizations						2.62		
n	15	27	30	27	26			
%	12.0	21.6	24.0	21.6	20.8			

Note. [a]Friedman test: $\chi^2 = 72.30$, 4 df, $p < .001$.

training in how to work effectively with interpreters/translators.

Our results, albeit not directly comparable with ASHA's health care professional assessments, are in line with some of the insights reported by ASHA. ASHA-certified, health care-based S-LPs reported to have average to qualified levels of professional training to address cultural and linguistic influences on service delivery and outcomes (ASHA, 2011, 2013b; Brook, 2015). However, ASHA health care professional assessments (ASHA, 2011, 2013a, 2013b; Brook, 2015), based on a national respondent sample, provide consolidated responses on both pediatric and adult caseloads seen in health care. In contrast, our survey study involving a respondent pool from the four most diverse states in the nation exclusively focused on assessment responses on services with neurologically impaired adults. ASHA's consolidated health care findings, suggesting an average-to-qualified extent of preparation to address both pediatric and adult diversity issues, might reflect the existing larger emphasis on information and clinical resources on ethnically diverse child groups than on adult groups (Hammer, 2012).

Nonetheless, our results are consistent with the scant evidence and professional literature that highlight the curricular limitations in academic and clinical preparation related to minorities and the urgent need to implement innovative programmatic changes that would minimize such educational deficiencies in the United States, particularly on minority adults (Centeno, 2009, 2015; Hammer, 2012; Horton-Ikard, Munoz, Thomas-Tate, & Keller-Bell, 2009; Stockman, Boult, & Robinson, 2004). Academic accreditation standards in the United States mandate professional training programs to include curricular content on the cultural and linguistic factors in communication disorders (Council on Academic Accreditation, 2017). However, these standards offer general guidelines that do not specify the amount or content to include in coursework or clinical practica on adult minority populations. Academic program administrators are interested in having access to specific educational strategies and content that would assist them in the design of appropriate curricular offerings to address educational gaps on minorities in professional preparation (Stockman et al., 2004).

Deficiencies in professional training and resources to optimally serve minority adults with neurogenic communication impairments may be a result of the critical dearth of suitably trained faculty and relevant research that would generate the evidential and conceptual bases to support classroom and clinical instruction as well as diagnostic and therapeutic product development (Centeno, 2015; Harris, 2018; Payne, 2014). Respondents, albeit minimally prepared with service skills for multiethnic adult populations, received more exposure to generalized training on service to minority adults with less emphasis on service training for bilingual speakers. The training difference might stem from limited understanding of how bilingualism may complicate interpreting neurogenic communication disorders in dual-language users as well as from the dearth of research on communicatively impaired bilingual adults with neuropathologies (Centeno, 2015). In addition, despite required clinical training in neurogenic adult communication disorders, often implemented through aphasia management (Garcia, Garrett, Pimentel, & Garcia, 2002), clinical experiences may not involve minority adults. However, when adults from minority groups are included, clinical student experiences due to limited trained faculty and clinical resources might not adequately incorporate the complexities in serving older minority individuals (Centeno, 2015; Wallace, 1997).

That information relevant to Hispanic individuals was the most accessible resource to respondents might be explained by several reasons. Hispanic/Latino(a) individuals may have been a prominent cohort in the respondents' caseloads because Hispanic persons have a high incidence of stroke (Cruz-Flores et al., 2011) and are the largest minority group in the four states where respondents were recruited (United States Census Bureau, 2014). In future investigations, as discussed later, it would be useful to explore if resource availability depends on the extent of diversity or the largest minority adult group in the area.

Although respondents were moderately motivated to participate in Continuing Education opportunities to enhance their work with both minority adults and bilingual adults, they showed the highest interest in having access to appropriate intervention and testing materials, followed by other resources (i.e., journal articles and other publications on minority adults or bilingualism, expert consultants from ASHA or other organizations, and training in interpreter-assisted services to serve bilingual clients). These findings are in line with ASHA health care personnel data. ASHA-certified S-LPs, when serving CLD clients in health care environments, frequently use cultural brokers or interpreters, modified assessment strategies, and referral to bilingual service providers (ASHA, 2013b). These results are consistent with the critical shortage in the evaluation and intervention resources to realistically work with communicatively impaired adults from diverse backgrounds (Harris, 2018; Kiran & Roberts, 2012; Muñoz, 2012) and the frequent necessity to work with interpreters in multilingual CLD health care settings (Isaac, 2005).

In sum, our findings, in contrast to earlier results (i.e., ASHA, 2011, 2013b; Wallace, 1997; Wiener, Obler, & Taylor-Sarno, 1995), provide specific evidential insights on the needs in the clinical management of the growing ethnoracially mixed communicatively impaired adult cohorts in U.S. neurorehabilitation services. Particularly, when services with minority adults as a whole and bilingual speakers in neurorehabilitation are compared, practitioners are minimally trained to serve both groups and are interested in post-graduate professional development opportunities and resources that would improve their competencies to effectively work with minority and bilingual adults with neurogenic communication disabilities in multiethnic neurorehabilitation services. Next, we extrapolate the implications of these findings to the highly diverse Canadian rehabilitative scenario to further exemplify the impact of ethnogeriatric world trends on speech-language pathology neurorehabilitation services.

Implications for Adult Neurorehabilitation Services in Diverse High-Migration World Regions: Canada as an Illustration

Our findings are consistent with international multidisciplinary efforts, including evidence from speech-language pathology, that highlight target educational, research, and clinical areas and strategies to improve the clinical management of ethnically diverse neurologically impaired adult caseloads, such as individuals with communication impairments (Altarriba & Kazanas, 2017; Ansaldo et al., 2008; Armstrong et al., 2015; Brewer et al., 2015; Centeno, 2015; Hersh et al., 2015; Norris et al., 2014; Penn et al., 2017; Rose et al., 2014). Our findings have highlighted remedial areas with great relevance to adult neurorehabilitation services in other high-migration multiethnic regions, particularly because vulnerability to age-related health concerns, including neuropathologies, is high in multiethnic environments (Prince et al., 2015). Disability disproportionally affects older people, people living in poverty, Indigenous individuals (e.g., First Nations, Inuit, and Métis in Canada), refugees, and migrants (Babulal et al., 2019; Centeno, 2017; Petrasek MacDonald, Ward, & Halseth, 2018; WHO, 2015).

Canada is a distinctive example of a hyperdiverse context with growing demands in multiethnic-multilingual adult neurorehabilitation services. Canada, a richly diverse country with large First Nations, Inuit, and Métis populations and immigrant groups (Kay Raining-Bird, 2011, 2014; Statistics Canada, 2018), is the only western country ranked among the 20 most diverse countries in the world (Morin, 2013). Migrant populations in Canada continue to steadily increase to represent a growing percentage of the country's total population. Nearly one in two Canadians could be an immigrant or the child of an immigrant by 2036 (Statistics Canada, 2017). Canada constitutes one of the two largest refugee resettlement countries in the world (International Organization for Migration, 2017). By 2030, about 28% of the Canadian population will be minorities (Sheets & Gallagher, 2013). Reflecting ethnic diversity, 5.8 million individuals in Canada (17.5% of the population) speak at least two languages at home (Statistics Canada, 2019). Regarding older adults, seniors are expected to comprise around 23% to 25% of the population by 2036 and around 24% to 28% in 2061 (Statistics Canada, 2016). Ethnoracial minorities are estimated to be prominently represented in the expanding Canadian geriatric populations as local diversity grows and extensively incoming migration continues (Statistics Canada, 2018).

There is general consensus about the paucity in the literature on age-related neurological complications in Canadian populations, particularly in minority elders (Chiu, Austin, Manuel, & Tu, 2010; Khan, Kobayashi, Lee, & Vang, 2015; Krueger et al., 2015; Petrasek MacDonald et al., 2018). In fact, despite great world ethnoracial diversity, there are substantial gaps in the international scientific literature regarding the impact of ethnic and racial factors in age-related neuropathologies (Babulal et al., 2019; Centeno et al., 2020; Ellis, 2009). However, the limited Canadian health data available highlight valuable trends for neurorehabilitation policy and services. With the country's population aging, stroke prevalence is expected to increase between 62% and 79% from 2013 to 2038 (Krueger et al., 2015), especially for people who identify as First Nations, Inuit, or Métis (Smylie et al., 2018). The prevalence of stroke-related disabilities, including aphasia, is estimated to increase (Dickey et al., 2010). Although cardiovascular risk profiles differ among Canadian ethnic groups (Chiu et al., 2010), cardiovascular disease disproportionally affects 7.1% of First Nations, Inuit, and Métis adults relative to 5.0% of the general Canadian population (Foulds, Bredin, & Warburton, 2018). In terms of dementia, while the rates of dementia have been increasing more rapidly among Canadian First Nations, Inuit, and Métis groups compared to the general population, dementia onset has been reported to occur earlier in First Nations, Inuit, and Métis adults (for a review, see Petrasek MacDonald et al., 2018). These epidemiological and demographic trends in the extensively diverse Canadian population, as in similarly growing hyperdiverse geriatric contexts (e.g., Nichols et al., 2019; Norris et al., 2014), will require a fully prepared speech-language pathology workforce with the necessary professional training and resource armamentarium to meet the clinical needs of expanding neuro-compromised multiethnic elder caseloads. While there is valuable evidence on professional assessments of services for communicatively disordered Canadian CLD caseloads, these studies, however, have either focused on children or reported consolidated child and adult data (Ball & Lewis, 2011; D'Souza et al., 2012; Kerr, Guildford, & Kay-Raining Bird, 2003).

Limitations of the Study

Further investigations are necessary to refine and extend the preliminary findings of the current study. A larger investigation with a national respondent cohort consisting of S-LPs from more racially and geographically diverse backgrounds who work with minority adults may be expected to yield additional insights. Additionally, because the terms *bilingual* and *minority* may not have been distinct and different in the minds of the respondents and, in turn, conflated in the responses, a more detailed survey with more items created to specify differences between these two categories will be valuable. Combined with efforts to enhance the response rate, a national respondent cohort and a longer, more detailed survey may be expected to yield a more extensive, fine-grained response corpus. Similarly, exploring service differences between rural and urban contexts would be helpful to gauge professional and clinical realities in adult neurorehabilitation (see Winstein et al., 2016).

Also, separate studies to examine population-specific and disorder-specific aspects in clinical management and outcomes may uncover additional service issues among the various minority adult groups and among different acquired cognitive-linguistic and feeding disorders encountered in CLD neurorehabilitation adult caseloads. Finally, given the high diversity in the aging population worldwide, international collaborative research efforts that apply similar research methodologies to assess service provision in local multiethnic adult neurorehabilitation caseloads will produce valuable evidence. These efforts will allow the systematic comparison of similarities and differences to generate international and local remedial strategies to address the needs of the rapidly increasing ethnogeriatric neurorehabilitation caseloads across the world (Bennett et al., 2017; Centeno, 2017; Johnson, Onuma, Owolabi, & Sachdev, 2016; WHO, 2019).

Future Directions

Demographic and neuroepidemiological data highlight a growing need for evidence-based, culturally responsive clinical services for the increasing numbers of communicatively impaired adults in ethnoracially diverse neurorehabilitation services worldwide. A broadly based action plan with concerted strategies, developed by professional, academic, clinical, and administrative stakeholders in collaboration with community leaders, is urgently needed to target deficiencies in professional education, research, and service delivery for this expanding population (Centeno, 2015, 2017; Centeno, Kiran, & Armstrong, 2020; Penn et al., 2017; Siyambalapitiya & Davidson, 2015). Ideally, the input from community leaders combined with the expertise of program accrediting officers, academics, researchers, and practitioners, particularly in CLD neurorehabilitation services, should inform all such stakeholder initiatives. Additionally, interprofessional collaborations with practitioners who work with neurologically disabled multiethnic adult caseloads could further enhance efforts to undertake targeted research and programs designed to improve professional education and to develop appropriate clinical strategies and service delivery (Miller et al., 2010; Winstein et al., 2016).

Critically in the strategic plans, the rigorous recruitment to enlarge the pool of practitioners and researchers who work with multiethnic adult populations has paramount importance. In terms of practitioners, membership in professional speech-language organizations may not represent the ethnolinguistic diversity of the country in some situations (Centeno, 2015; Siyambalapitiya & Davidson, 2015), but it may be linguistically diverse in other world regions. For example, ASHA membership only includes 6% clinicians who consider themselves to be bilingual and 8% who are minority individuals (ASHA, 2019, 2020). However, in Canada, where there are two official languages (i.e., English and French), our literature review suggests that bilingual S-LPs may outnumber monolingual S-LPs. Three hundred respondents (78.1%) working with linguistically diverse clients in Canada reported to know two or more languages (D'Souza et al., 2012).

Regarding the research workforce, the critical shortage of investigators with expertise in neurogenic communication disorders in minority adults is another imperative issue to address (Centeno, 2015; Harris, 2018; Payne, 2014). Targeted research is needed to support the evidential bases for the development of educational content and clinical services for communicatively impaired adults from CLD backgrounds. Despite disproportionately large incidence and prevalence of stroke, dementia, and other neurological complications resulting in communication and feeding disorders in multiethnic adult populations, individuals from these groups are inadequately, or infrequently, sampled in adult-neurogenic research (Chin et al., 2011; Ellis, 2009; Petrasek MacDonald et al., 2018). A situation that limits the external validity of the findings and their generalization to ethnoracially mixed adult populations (Harris & Fleming, 2009). To populate the specialized clinical and investigative pools, students' mentored exposure to the clinical needs and research pertinent to ethnoracially diverse adult neurorehabilitation groups, an approach similar to the strategies used in biomedical research to increase the number of minority investigators (Ognibene, Gallin, Baum, Wyatt, & Gottesman, 2016; Valantine & Collins, 2015), could be a strategy to stimulate interest in clinical and research careers in multicultural adult neurorehabilitation among speech-language pathology students (see also ASHA, 2015; McNeil et al., 2013).

All in all, our preliminary findings provide important impetus for additional future research and remedial strategies to meet the clinical demands of the increasing ethnogeriatric groups in neurorehabilitation across the world. These undertakings are in line with world and local policies to strengthen and bring parity to health care in vulnerable populations, including increasing multiethnic aging populations in neurorehabilitation (Agency for Healthcare Research and Quality, 2020; Krasnik et al., 2018; United Nations, 2017; WHO, 2015; Wilk et al., 2018). Global and local demographic-neuroepidemiological scenarios highlight the urgency of these efforts.

References

Agency for Healthcare Research and Quality. (2020). *Priority populations.* Retrieved from https://www.ahrq.gov/priority-populations/index.html

Altarriba, J., & Kazanas, S. A. (2017). Neurorehabilitation with Hispanic/Latino populations: Psychological perspectives on interprofessional communication. *Perspectives of the ASHA Special Interest Groups (SIG 2), 2*(2), 132–141. doi:10.1044/persp2.SIG2.132

American Speech-Language-Hearing Association. (2011). *2011 membership survey. CCC-SLP summary report: Number and types of responses.* Retrieved from https://www.asha.org/uploadedFiles/2011-Membership-Survey-CCC-SLP-Summary-Report.pdf

American Speech-Language-Hearing Association. (2013a). *ASHA SLP health care survey 2013: Caseloads characteristics.* Retrieved from https://www.asha.org/uploadedFiles/2013-SLP-Health-Care-Survey.pdf

American Speech-Language-Hearing Association. (2013b). *SLP health care survey: Number and type of responses.* Retrieved from https://www.asha.org/uploadedFiles/2013-SLP-Health-Care-Survey-Summary-Report.pdf

American Speech-Language-Hearing Association. (2015, August). A closer look at the PhD faculty workforce: Will there be enough PhDs in colleges and universities to meet the teaching and scientific demands of the discipline? Data from ASHA member and affiliate counts provide some insight. *The ASHA Leader, 20*(8). doi:10.1044/leader.AAG.20082015.32

American Speech-Language-Hearing Association. (2019). *ASHA summary membership and affiliation counts, year-end 2018.* Retrieved from https://www.asha.org/uploadedFiles/2018-Member-Counts.pdf

American Speech-Language-Hearing Association. (2020). *Demographic profile of ASHA members providing bilingual services, year-end 2019.* Retrieved from https://www.asha.org/uploadedFiles/Demographic-Profile-Bilingual-Spanish-Service-Members.pdf

Ansaldo, A. I., Marcotte, K., Scherer, L., & Raboyeau, G. (2008). Language therapy and bilingual aphasia: Clinical implications of psycholinguistic and neuroimaging research. *Journal of Neurolinguistics, 21,* 539–557. doi:10.1016/j.jneuroling.2008.02.001

Armstrong, E., Hersh, D., Hayward, C., & Fraser, J. (2015). Communication disorders after stroke in Aboriginal Australians. *Disability and Rehabilitation, 37,* 1462–1469. doi:10.3109/09638288.2014.972581

Babulal, G. M., Quiroz, Y. T., Albensi, B. C., Arenaza-Urquijo, E., Astell, A. J., Babiloni, C., ... O'Bryant, S. E. (2019). Perspectives on ethnic and racial disparities in Alzheimer's disease and related dementias: Update and areas of immediate need. *Alzeimer's & Dementia, 15,* 292–312. doi:10.1016/j.jalz.2018.09.009

Balcazar, F. (2010). Introduction: Examining the nexus of race, culture, and disability. In F. E. Balcazar, Y. Suarez-Balcazar, T. Taylor-Ritzler, & C. B. Keys (Eds.), *Race, culture and disability: Rehabilitation science and practice* (pp. 1–11). Sudbury, MA: Jones & Bartlett Learning.

Ball, J., & Lewis, M. (2011). "An altogether different approach": Roles of speech-language pathologists in supporting Indigenous children's language development. *Canadian Journal of Speech-Language Pathology and Audiology, 35,* 144–158.

Bennett, M., Cartwright, J., & Young, J. (2017). Is the speech-language pathology profession prepared for an ageing population? An Australian survey. *International Journal of Speech-Language Pathology, 21,* 153–162. doi:10.1080/17549507.2017.1413135

Beveridge, M. E. L., & Bak, T. H. (2011). The languages of aphasia: Bias and diversity. *Aphasiology, 25,* 1451–1468. doi:10.1080/02687038.2011.624165

Brewer, K. M., McCann, C. M., Worrall, L. E., & Harwood, M. L. N. (2015). New Zealand speech-language therapists' perspectives on services for Māori with aphasia. *Speech, Language, and Hearing, 18,* 140–147. doi:10.1179/2050572814Y.0000000060

Brook, G. (2015). *SLP health care survey report: Caseload characteristics trends 2005-2015.* Retrieved from the American Speech-Language-Hearing Association website: https://www.asha.org/uploadedFiles/2015-SLP-Health-Care-Survey-Caseload-Trends.pdf

Centeno, J. G. (2009). Issues and principles in service delivery to communicatively impaired minority bilingual adults in neurorehabilitation. *Seminars in Speech and Language, 30,* 139–152. doi:10.1055/s-0029-1225951

Centeno, J. G. (2015). Assessing services with communicatively impaired bilingual adults in culturally and linguistically diverse neurorehabilitation programs. *Journal of Communication Disorders, 58,* 58–73. doi:10.1016/j.jcomdis.2015.10.005

Centeno, J. G. (2017). Guest Editor's column: Clinical management of communicatively-impaired adult neurorehabilitation caseloads in a diverse aging world. *Perspectives of the ASHA Special Interest Groups (SIG 2), 2*(2), 88–90. doi:10.1044/persp2.SIG2.88

Centeno, J. G., Ghazi-Saidi, L., & Ansaldo, A. I. (2017). Aphasia in multilingual populations. In I. Papathanasiou & P. Coppens (Eds.), *Aphasia and related neurogenic communication disorders* (2nd ed., pp. 331–350). Burlington, MA: Jones & Bartlett Learning.

Centeno, J. G., Kiran, S., & Armstrong, E. (2020). Epilogue: Harnessing the experimental and clinical resources to address service imperatives in multiethnic aphasia caseloads. Aphasiology, *34(11), 1451–1455.* doi:10.1080/10.1080/02687038.2020.1781421

Centers for Disease Control and Prevention. (2012). Prevalence of stroke—United States, 2006–2012. *Morbidity and Mortality Weekly Report, 61,* 379–382.

Chen, C., & Zissimopoulos, J. M. (2018). Racial and ethnic differences in trends in dementia prevalence and risk factors in the United States. *Alzheimer's & Dementia: Translational Research & Clinical Interventions, 4,* 510–520. doi:10.1016/j.trci.2018.08.009

Chin, A. L., Negash, S., & Hamilton, R. (2011). Diversity and disparity in dementia: The impact of ethnoracial differences in Alzheimer's disease. *Alzheimer Disease & Associated Disorders, 25,* 187–195. doi:10.1097/WAD.0b013e318211c6c9

Chiu, M., Austin, P. C., Manuel, D. G., & Tu, J. V. (2010). Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. *Canadian Medical Association Journal, 182,* E301–E310. doi:10.1503/cmaj.091676

Council on Academic Accreditation. (2017). *Standards for accreditation for graduate education programs in audiology and speech-language pathology.* Retrieved from https://caa.asha.org/wp-content/uploads/Accreditation-Standards-for-Graduate-Programs.pdf

Cruz-Flores, S., Rabinstein, A., Biller, J., Elkind, M. S. V., Griffith, P., Gorelick, P. B., ... Valderrama, A. L. (2011). Racial-ethnic disparities in stroke care: The American experience. A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke, 42,* 2091–2116. doi:10.1161/STR.0b013e3182213e24

Cummings-Vaughn, L. (2017). Demographic trends in aging. In L. Cummings-Vaugh & D. M. Cruz-Oliver (Eds.), *Ethnogeriatrics: Healthcare needs of diverse populations* (pp. 35–49). New York, NY: Springer.

Dickey, L., Kagan, A., Lindsay, M. P., Fang, J., Rowland, A., & Black, S. (2010). Incidence and profile of inpatient stroke-induced aphasia in Ontario, Canada. *Archives of Physical Medicine and Rehabilitation, 91,* 196–202. doi:10.1016/j.apmr.2009.09.020

D'Souza, C., Kay-Raining Bird, E., & Deacon, H. (2012). Survey of Canadian speech-language pathology service delivery to linguistically diverse clients. *Canadian Journal of Speech-Language Pathology and Audiology, 36,* 18–39.

Ellis, C. (2009). Does race/ethnicity really matter in adult neurogenics? *American Journal of Speech-Language Pathology, 18,* 310–314. doi:10.1044/1058-0360(2009/08-0039)

Ellis, C., Peach, R. K., Hardy, R. Y., & Lindrooth, R. C. (2017). The influence of race on SLP utilization and costs among persons with aphasia. *Aphasiology, 31,* 1433–1440. doi:10.1080/02687038.2017.1303440

Federal Interagency Forum on Aging-Related Statistics. (2012). *Older Americans 2012: Key indicators of well-being.* Retrieved from https://agingstats.gov/docs/PastReports/2012/OA2012.pdf

Feigin, V. L., Forouzanfar, M. H., Krishnamurti, R., Mensah, G. A., Connor, M., Bennet, D. A., ... Murray, C. (2014). Global and regional burden of stroke during 1990–2010: Findings from the Global Burden Disease Study 2010. *The Lancet, 383,* 245–255. doi:10.1016/S0140-6736(13)61953-4

Feigin, V. L., Nichols, E., Alam, T., Bannick, M. S., Beghi, E., Blake, N., ... Vos. T. (2019). Global, regional, and national burden of neurological disorders, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology, 18,* 459–480. doi:10.1016/S1474-4422(18)30499-X

Fleming, V. B., & Harris, J. L. (2017). Toward identifying mild cognitive impairment in Hispanic and African American adults. *Perspectives of the ASHA Special Interest Groups (SIG 2), 2*(2), 110–116. doi:10.1044/persp2.SIG2.110

Foulds, H. J. A., Bredin, S. S. D., & Warburton, D. E. R. (2018). Cardiovascular dynamics of Canadian Indigenous peoples. *International Journal of Circumpolar Health, 77,* 1–12. doi:10.1080/22423982.2017.1421351

Frohlich, K. L., Ross, N., & Richmond, C. (2006). Health disparities in Canada today: Some evidence and a theoretical framework. *Health Policy, 79,* 132–143. doi:10.1016/j.healthpol.2005.12.010

Garcia, J. M., Garrett, K. L., Pimentel, J. T., & Garcia, R. G. (2002). Clinical services for aphasia: A survey of university clinics. *Aphasiology, 16,* 715–726. doi:10.1080/02687030143000852

Hammer, C. S. (2012). Do demographic and cultural differences exist in adulthood? *American Journal of Speech-Language Pathology, 21,* 181–182. doi:10.1044/1058-0360(2012/ed-03)

Harris, J. L. (2018). Multicultural and multilinguistic issues. In L. L. LaPointe & J. A. G. Stierwalt (Eds.), *Aphasia and related neurogenic language disorders* (5th ed., pp. 55–64). New York, NY: Thieme.

Harris, J. L., & Fleming, V. B. (2009). Toward model-driven interventions for African-Americans with cognitive-communicative disorders. *Seminars in Speech and Language, 30,* 207–216. doi:10.1055/s-0029-1225957

Hersh, D., Armstrong, E., Panak, V., & Coombes, J. (2015). Speech-language pathology practices with indigenous Australians with acquired communication disorders. *International Journal of Speech-Language Pathology, 17,* 74–85. doi:10.3109/17549507.2014.923510

Hinckley, J. J., Hasselkus, A., & Ganzfried, E. (2013). What people living with aphasia think about the availability of aphasia resources. *American Journal of Speech-Language Pathology, 22,* S310–S317. doi:10.1044/1058-0360(2013/12-0090)

Horton-Ikard, R., Munoz, M. L., Thomas-Tate, S., & Keller-Bell, Y. (2009). Establishing a pedagogical framework for the multicultural course in communication sciences and disorders. *American Journal of Speech-Language Pathology, 18,* 182–196. doi:10.1044/1058-0360(2008/07-0086)

Howard, G., & Goff, D. C. (2012). Population shifts and the future of stroke: Forecasts of the future burden of stroke. *Annals of the New York Academy of Sciences, 1268,* 14–20. doi:10.1111/j.1749-6632.2012.06665.x

Howard, G., Safford, M. M., Moy, C. S., Howard, V., Kleindorfer, D. O., Unverzagt, F. W., ... Cushman, M. (2017). Racial differences in the incidence of cardiovascular risk factors in older Black and White adults. *Journal of the American Geriatrics Society, 65,* 83–90. doi:10.1111/jgs.14472

Humes, K. R., Jones, N. A., & Ramirez, R. R. (2011). *Overview of race and Hispanic origin: 2010. 2010 Census Briefs – C2010BR-02.* Washington, DC: U.S. Census Bureau. https://www.census.gov/library/publications/2011/dec/c2010br-02.html

International Organization for Migration. (2017). *World migration report 2018.* New York, NY: International Organization for Migration. https://www.iom.int/sites/default/files/country/docs/china/r5_world_migration_report_2018_en.pdf

Isaac, K. M. (2005). Managing linguistic diversity in the clinic: Interpreters in speech-language pathology. In M. J. Ball (Ed.), *Clinical sociolinguistics* (pp. 265–280). Malden, MA: Blackwell.

Johnson, W., Onuma, O., Owolabi, M., & Sachdev, S. (2016). Stroke: A global response is needed. *Bulletin of the World Health Organization, 94,* 634–634A. doi:10.2471/BLT.16.181636

Kay-Raining Bird, E. (2011). Health, education, language, dialect, and culture in First Nations, Inuit, and Métis communities in Canada: An overview. *Canadian Journal of Speech-Language Pathology and Audiology, 35,* 110–124.

Kay-Raining Bird, E. (2014). A resource kit: To assist speech-language pathologists and audiologists in providing informed services to First Nations, Inuit, and Métis people. *Canadian Journal of Speech-Language Pathology and Audiology, 38,* 238–250.

Kerr, M. A., Guildford, S., & Kay-Raining Bird, E. (2003). Standardized language test use: A Canadian survey. *Journal of Speech-Language Pathology and Audiology, 27,* 10–28.

Khan, M., Kobayashi, K., Lee, S. M., & Vang, Z. (2015). (In)visible minorities in Canadian health data and research. *Population Change and Lifecourse Strategic Knowledge Cluster Discussion Paper Series, 3*(1), 1–33.

Kiran, S., & Roberts, P. M. (2012). What do we know about assessing language impairment in bilingual aphasia. In M. R. Gitterman, M. Goral, & L. K. Obler (Eds.), *Aspects of multilingual aphasia* (pp. 35–50). Clevedon, United Kingdom: Multilingual Matters.

Koton, S., Schneider, A. L. C., Rosamond, W. D., Shahar, E., Sang, Y., Gottesman, R. F., & Coresh, J. (2014). Stroke incidence and mortality trends in US communities, 1987 to 2011. *Journal of the American Medical Association, 312,* 259–268. doi:10.1001/jama.2014.7692

Krasnik, A., Bhopal, R. S., Gruer, L., & Kumanika, S. K. (2018). Advancing a unified, global effort to address health disadvantages associated with migration, ethnicity, and race. *European Journal of Public Health, 28*(Suppl.), 1–2. doi:10.1093/eurpub/cky046

Krueger, H., Koot, J., Hall, R. E., O'Callaghan, C., Bayley, M., & Corbett, D. (2015). Prevalence of individuals experiencing the effects of stroke in Canada: Trends and projections. *Stroke, 46,* 2226–2231. doi:10.1161/STROKEAHA.115.009616

Matthews, K. A., Xu, W., Gaglioti, A. H., Holt, J. B., Croft, J. B., Mack, D., & McGuire, L. C. (2019). Racial and ethnic estimates of Alzheimer's disease and related dementias in the United States (2015-2060) in adults aged ≥ 65 years. *Alzheimer's & Dementia, 15,* 17–24. doi:10.1016/j.jalz.2018.06.3063

McNeil, M. R., Nunez, L., Armiento-DeMaria, M. T., Chapman, K. L., DiLollo, A., Ferraro, J. A., ... Robertson, S. (2013). *Strategic plan to increase the student pipeline and workforce for PhD researchers and faculty researchers.* Retrieved from the American Speech-Language-Hearing Association website: https://www.asha.org/uploadedFiles/Report-2013-AAB-PhD-Report-Strategic-Plan.pdf

Miller, E. L., Murray, L., Richards, L., Zorowitz, R. D., Bakas, T., Clark, P., & Billinger, S. A. (2010). Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient: A scientific statement from the American Heart Association. *Stroke, 41,* 2402–2448. doi:10.1161/STR.0b013e3181e7512b

Morgenstern, L. B., & Kissela, B. M. (2015). Stroke disparities: A large global problem that must be addressed. *Stroke, 46,* 3560–3563. doi:10.1161/STROKEAHA.115.009533

Morin, R. (2013, July). The most (and least) culturally diverse countries in the world. *FactTanks: News in numbers.* Retrieved from http://pewrsr.ch/13MQHbT

Mozaffarian, D., Benjamin E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... Turner M. B. (2016). Heart disease and stroke statistics—2016 update: A report from the American Heart Association. *Circulation, 133,* e38–e360. doi:10.1161/CIR.0000000000000350

Mulvahill, J. S., & Cummings-Vaughn, L. (2017). Epidemiology of aging: Racial/ethnic specific disease prevalence. In L. Cummings-Vaughn & D. M. Cruz-Oliver (Eds.), *Ethnogeriatrics: Healthcare needs of diverse populations* (pp. 115–144). New York, NY: Springer.

Muñoz, M. L. (2012). The clinical management of anomia in bilingual speakers of Spanish and English. In M. R. Gitterman, M. Goral, & L. K. Obler (Eds.), *Aspects of multilingual aphasia* (pp. 69–88). Clevedon, United Kingdom: Multilingual Matters.

National Institute of Neurological Disorders and Stroke. (2020). *NINDS stroke disparities.* Retrieved from https://www.ninds.nih.gov/Current-Research/Focus-Tools-Topics/Health-Disparities

Nichols, E., Szoeke, C. E. I., Vollset, S. E., Abbasi, N., Abd-Allah, F., Abdela, J., ... Murray, C. J. L. (2019). Global, regional, and national burden of Alzheimer's disease and other dementias, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology, 18,* 88–106. doi:10.1016/S1474-4422(18)30403-4

Norris, M., Jones, F., Kilbride, C., & Victor, C. (2014). Exploring the experience of facilitating self-management with minority stroke survivors: A qualitative study of therapists' perceptions. *Disability and Rehabilitation, 36,* 2252–2261. doi:10.3109/09638288.2014.904936

Obviagele, B., Goldstein, L. B., Higashida, R. T., Howard, V. J., Claiborne Johnston, S., Khavjou, O. A., ... Trogdon, J. G. (2013). Forecasting the future of stroke in the United States: A policy statement from the American Heart Association and American Stroke Association. *Stroke, 44,* 2361–2375. doi:10.1161/STR.0b013e31829734f2

Ognibene, F. P., Gallin, J. I., Baum, B. J., Wyatt, R. G., & Gottesman, M. M. (2016). Outcomes from the NIH clinical research training program: A mentored research experience to enhance career development of clinician-scientists. *Academic Medicine, 91,* 1684–1690. doi:10.1097/ACM.0000000000001245

Ortman, J. M., Velkoff, V. A., & Hogan, H. (2014). *An aging nation: The older population in the United States.* Population estimates and projections. Retrieved from United States Census Bureau website: https://www.census.gov/prod/2014pubs/p25-1140.pdf

Payne, J. C. (2014). *Adult neurogenic language disorders: Assessment and treatment. A comprehensive ethnobiological approach* (2nd ed.). San Diego, CA: Plural.

Penn, C., Armstrong, B., Brewer, K., Purves, B., McAllister, M., Hersh, D., ... Lewis, A. (2017). Decolonizing speech-language pathology practice in acquired neurogenic disorders. *Perspectives of the ASHA Special Interest Groups (SIG 2), 2*(2), 91–99. doi:10.1044/persp2.SIG2.91

Petrasek MacDonald, J., Ward, V., & Halseth, R. (2018). *Alzheimer's disease and related dementias in Indigenous populations in Canada: Prevalence and risk factors.* Retrieved from the National Collaborating Centre for Aboriginal Health: https://www.ccnsa-nccah.ca/docs/emerging/RPT-Alzheimer-Dementia-MacDonald-Ward-Halseth-EN.pdf

Pew Research Center. (2015). *Modern immigration wave brings 59 million to U.S., driving population growth and change through 2065: Views of immigration's impact on U.S. society mixed.* Retrieved from https://www.pewresearch.org/hispanic/2015/09/28/modern-immigration-wave-brings-59-million-to-u-s-driving-population-growth-and-change-through-2065/

Prince, M. J., Wu, F., Guo, Y., Gutierrez Robledo, L. M., O'Donnell, M., Sullivan, R., & Yusuf, S. (2015). The burden of disease in older people and implications for health policy and practice. *The Lancet, 385,* 549–562. doi:10.1016/S0140-6736(14)61347-7

Robnett, R. H., Brossoie, N., & Chop, W. C. (2020). *Gerontology for the health care professional* (4th ed.). Burlington, MA: Jones & Bartlett Learning.

Rose, M., Ferguson, A., Power, E., Togher, L., & Worrall, L. (2014). Aphasia rehabilitation in Australia: Current practices, challenges and future directions. *International Journal of Speech-Language Pathology, 16,* 169–180. doi:10.3109/17549507.2013.794474

Ryan, C. (2013). *Language use in the United States: 2011. American Community Survey Reports.* Retrieved from the United States Census Bureau website: https://www2.census.gov/library/publications/2013/acs/acs-22/acs-22.pdf

Sheets, D. J., & Gallagher, E. M. (2013). Aging in Canada: State of the art and science. *The Gerontologist, 53,* 1–8. doi:10.1093/geront/gns150

Simmons-Mackie, N., Threats, T. T., & Kagan, A. (2005). Outcome assessment in aphasia: A survey. *Journal of Communication Disorders, 38,* 1–27. doi:10.1016/j.jcomdis.2004.03.007

Siyambalapitiya, S., & Davidson, B. (2015). Managing aphasia in bilingual and culturally and linguistically diverse individuals in an Australian context: Challenges and future directions. *Journal of Clinical Practice in Speech Language Pathology, 17*(1), 13–19.

Smylie, J., O'Brien, K., Xavier, C. G., Anderson, M., McKnight, C., Downey, B., & Kelaher, M. (2018). Primary care intervention to address cardiovascular disease medication health literacy among Indigenous peoples: Canadian results of a pre-post-test-design study. *Canadian Journal of Public Health, 109,* 117–127. doi:10.17269/s41997-018-0034-9

Statistics Canada. (2016). *An aging population.* Retrieved from https://www150.statcan.gc.ca/n1/pub/11-402-x/2010000/chap/pop/pop02-eng.htm

Statistics Canada. (2017). *Study: A look at immigration, ethnocultural diversity and languages in Canada up to 2036, 2011 to 2036.* Retrieved from https://www150.statcan.gc.ca/n1/daily-quotidien/170125/dq170125b-eng.htm

Statistics Canada. (2018). *Ethnic diversity and immigration.* Retrieved from https://www150.statcan.gc.ca/n1/pub/11-402-x/2011000/chap/imm/imm-eng.htm

Statistics Canada. (2019). *Linguistic characteristics of Canadians.* Retrieved from https://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-314-x/98-314-x2011001-eng.cfm

Stockman, I. J., Boult, J., & Robinson, G. (2004, July). Multicultural issues in academic and clinical education: A cultural mosaic. *The ASHA Leader, 9*(13), 6–22. doi:10.1044/leader.FTR5.09132004.6

Threats, T. (2005). Cultural sensitivity in health-care settings. *Perspectives on Communication Disorders and Sciences in Culturally and Linguistically Diverse Populations, 12*(3), 3–6. doi:10.1044/cds12.3.3

Turkstra, L. S., Norman, R., Whyte, J., Dijkers, M. P., & Hart, T. (2016). Knowing what we're doing: Why specification of treatment methods is critical for evidence-based practice in speech-language pathology. *American Journal of Speech-Language Pathology, 25,* 164–171. doi:10.1044/2015_AJSLP-15-0060

United Nations. (2017). *Transforming our world: The 2030 agenda for sustainable development.* Retrieved from https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

United Nations, Department of Economic and Social Affairs, Population Division. (2017). *World population ageing 2017 - Highlights.* Retrieved from https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf

United Nations High Commissioner for Refugees. (2019). *Global trends: Forced displacement in 2018.* Retrieved from https://www.unhcr.org/5d08d7ee7.pdf

United States Census Bureau. (2012). *U.S census projections show a slower growing, older, more diverse nation a half century from now.* Retrieved from https://www.census.gov/newsroom/releases/archives/population/cb12-243.html#:~:text=12%2C%202012-,U.S.%20Census%20Bureau%20Projections%20Show%20a%20Slower%20Growing%2C%20Older%2C%20More,by%20the%20U.S.%20Census%20Bureau.

Uomoto, J. M., & Loughlin, J. (2016). Neuroepidemiology and racial disparities in neurorehabilitation care. In J. M. Uomoto (Ed.), *Multicultural rehabilitation: Clinical principles for rehabilitation professionals* (pp. 3–24). New York, NY: Springer.

Valantine, H. A., & Collins, F. S. (2015). National Institutes of Health addresses the science of diversity. *Proceedings of the National Academy of Sciences, 112,* 12240–12242. doi:10.1073/pnas.1515612112

Wallace, G. L. (1997). An introduction to multicultural neurogenics. In G. L. Wallace (Ed.), *Multicultural neurogenics: A resource for speech-language pathologists providing services to neurologically impaired adults from culturally and linguistically diverse backgrounds* (pp. 3–20). San Antonio, TX: Communication Skill Builders.

Wiener, D., Obler, L. K., & Taylor-Sarno, M. (1995). Speech/language management of the bilingual aphasic in a U.S. urban rehabilitation hospital. In M. Paradis (Ed.), *Aspects of bilingual aphasia* (pp. 37–56). Tarrytown, NY: Elsevier.

Wilk, P., Cooke, M., Cooke, S., Stranges, S., & Maltby, A. (2018). Reducing health disparities among indigenous populations: The role of collaborative approaches to improve public health systems. *International Journal of Public Health, 63,* 1–2. doi:10.1007/s00038-017-1028-8

Winstein, C. J., Stein, J., Arena, R., Bates, B., Cherney, L. R., Cramer, S. C., ... Zorowitz, R. D. (2016). Guidelines for adult stroke rehabilitation and recovery: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke, 47,* e98–e169. doi:10.1161/STR.0000000000000098

World Health Organization. (2015). *WHO global disability action plan 2014-2021: Better health for all people with disability.* Retrieved from https://www.who.int/publications/i/item/who-global-disability-action-plan-2014-2021

World Health Organization. (2019). *Dementia.* Retrieved from https://www.who.int/news-room/fact-sheets/detail/dementia

Yorkston, K. M., Bourgeois, M. S., & Baylor, C. R. (2010). Communication and aging. *Physical Medicine and Rehabilitation Clinics, 21,* 309–319. doi:10.1016/j.pmr.2009.12.011

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Disclosures

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Appendix
Survey Questions

Professional Training

18. Use the scale below to indicate the frequency that information on each of the following ethnic/racial groups was discussed in ***your coursework*** during your professional training:

Never	Infrequently	Sometimes	Frequently	Very frequently
1	2	3	4	5

a) White 1 2 3 4 5

b) Hispanic/Latino(a) 1 2 3 4 5

c) Black (African-American, Caribbean Black, African) 1 2 3 4 5

d) Asian/Pacific Islander (Filipino, Chinese, Asian Indian, Hawaiian, Samoan, etc.) 1 2 3 4 5

e) Native American or Alaskan Native 1 2 3 4 5

f) Other (please specify): ____________________________ 1 2 3 4 5

19. Use the scale below to indicate the frequency that members of each of the following ethnic/racial groups was included in ***your clinical caseload*** during your professional training:

Never	Infrequently	Sometimes	Frequently	Very frequently
1	2	3	4	5

a) White 1 2 3 4 5

b) Hispanic/Latino(a) 1 2 3 4 5

c) Black (African-American, Caribbean Black, African) 1 2 3 4 5

d) Asian/Pacific Islander (Filipino, Chinese, Asian Indian, Hawaiian, Samoan, etc.) 1 2 3 4 5

e) Native American or Alaskan Native 1 2 3 4 5

f) Other (please specify): ____________________________ 1 2 3 4 5

Service Delivery

22. On the scale below, circle the number that indicates the extent you feel prepared to work with adults from minority groups ***(i.e., Hispanics, Asians, African-Americans, etc.):***

None or No extent	Small extent	Moderate extent	Great extent	Very great extent
1	2	3	4	5

23. On the scale below, circle the number that indicates the extent you feel prepared to work with ***bilingual adults:***

None or No extent	Small extent	Moderate extent	Great extent	Very great extent
1	2	3	4	5

Suggestions and Modifications

27. On the scale below, circle the number that indicates how satisfied you feel with the amount of information and resources available to enhance speech-language services ***with adults from minority groups (i.e., Hispanics, Asians, African-Americans, etc.):***

Very dissatisfied	Dissatisfied	I don't know	Satisfied	Very satisfied
1	2	3	4	5

28. On the scale below, circle the number that indicates how satisfied you feel with the amount of information and resources available to enhance speech-language services with ***bilingual adults:***

Very dissatisfied	Dissatisfied	I don't know	Satisfied	Very satisfied
1	2	3	4	5

30. Of all the bilingual adults with whom you have worked, ***circle the group*** for which you have had access to the most resources and information (books, journal articles, assessment tools, therapy materials, etc.).

a) White

b) Hispanic/Latino(a)

c) Black (African-American, Caribbean Black, African)

d) Asian/Pacific Islander (Filipino, Chinese, Asian Indian, Hawaiian, Samoan, etc.)

e) Native American or Alaskan Native

f) Other (please specify): ______________________________

33. On the scale below, circle the number that corresponds to the extent of your interest in participating in Continuing Education opportunities related to ***adults from minority groups (i.e., Hispanics, Asians, African-Americans, etc.):***

Not at all interested	Mildly interested	Moderately interested	Quite interested	Extremely interested
1	2	3	4	5

34. On the scale below, circle the number that corresponds to the extent of your interest in participating in Continuing Education opportunities related to ***bilingual adults:***

Not at all interested	Mildly interested	Moderately interested	Quite interested	Extremely interested
1	2	3	4	5

35. Use the scale below to indicate your interest in the following professional resources to enhance speech-language services with ***adults from minority groups (i.e., Hispanics, Asians, African-Americans, etc.):***

Not at all interested	Mildly interested	Moderately interested	Quite interested	Extremely interested
1	2	3	4	5

a) Presentations on minority adults at ASHA conventions	1	2	3	4	5
b) Conferences on minority adults	1	2	3	4	5
c) Publications on minority adults	1	2	3	4	5
d) Linguistically and culturally appropriate tests	1	2	3	4	5
e) Linguistically and culturally appropriate therapy materials	1	2	3	4	5
f) College courses on minority adults	1	2	3	4	5
g) Journal articles on minority adults	1	2	3	4	5
h) Consultants on minority adults from ASHA or other organizations	1	2	3	4	5
i) Hands-on clinical training with minority adults	1	2	3	4	5
j) Other (please specify): ____________________________	1	2	3	4	5

36. Use the scale below to indicate your interest in the following professional resources to enhance speech-language services with ***bilingual adults:***

Not at all interested	Mildly interested	Moderately interested	Quite interested	Extremely interested
1	2	3	4	5

a) Presentations on bilingual adults at ASHA conventions	1	2	3	4	5
b) Conferences on bilingual adults	1	2	3	4	5
c) Publications on bilingualism	1	2	3	4	5
d) Formal tests in the client's native language	1	2	3	4	5
e) Linguistically and culturally appropriate therapy materials	1	2	3	4	5

f) College courses on bilingual adults	1	2	3	4	5
g) Journal articles on bilingual adults	1	2	3	4	5
h) Learning a foreign language	1	2	3	4	5
i) Learning how to use an interpreter/translator	1	2	3	4	5
j) Consultants in bilingualism from ASHA or other organizations	1	2	3	4	5

Introducing the Coding Observations of Parent–Child Interactions (COPI): An Observational Measure of the Parental Behaviours That Matter for Language Development

Présentation de l'outil *Comportements observés du parent en interaction avec l'enfant* (COPI) : un outil permettant d'observer les comportements parentaux importants pour le développement langagier

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Abstract

Previous studies have highlighted domains of parent–child interactions associated with language development among preschool-aged children, namely responsiveness, support to learning, affect, and control. Although many tools have been developed, no single tool has been validated among young children to allow a comprehensive observation of the parental behaviours linked with early language development. The Maternal Behavior Rating Scale-Revised (Mahoney, 2008) presents good content validity. However, since it was not specifically designed for the observation of parental behaviours involved in child language outcomes, an adaptation was necessary. This led to the validation of a new tool named the Coding Observations of Parent–Child Interactions. This tool includes 10 parental behaviours divided into four domains of parent–child interactions: responsive behaviours (sensitivity to the child's interests, responsivity, reciprocity, inventiveness); control (directiveness, pace); support to learning (stimulation); and affect (warmth, enjoyment, acceptance). A factor analysis conducted with 95 children (M_{age} = 42.07 months, $SD = 0.28$) and one of their parents confirmed the factorial structure of the tool. Its reliability was demonstrated through high inter-rater (87%–93%, $p < .001$) and intra-rater (88%–98%, $p < .001$) agreement. The validation of this tool among a population of 42-month-old children from the general population and their families suggests that it can serve as a valid and reliable method for observing the main parental behaviours of interest for the language development of preschool aged-children. It could therefore be a useful tool for researchers and clinicians interested in early language development.

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Des études antérieures ont mis en évidence les domaines de l’interaction parent-enfant associés au développement langagier des enfants d’âge préscolaire, soit la réponse à l’enfant, le soutien aux apprentissages, l’affect et le contrôle. Quoique de nombreux outils aient été développés, aucun outil permettant d’observer de façon exhaustive les comportements parentaux associés au développement langagier précoce n’a été validé auprès de jeunes enfants. L’outil *Maternal Behavior Rating Scale-Revised* (Mahoney, 2008) présente une bonne validité de contenu. Toutefois, cet outil n’a pas été conçu pour observer spécifiquement les comportements parentaux importants pour le développement langagier; une adaptation était donc nécessaire. Cela a mené à la validation d’un nouvel outil intitulé *Comportements observés du parent en interaction avec l’enfant*. Cet outil permet l'observation de 10 comportements parentaux répartis dans quatre domaines de l’interaction parent-enfant : la réponse à l’enfant (sensibilité aux intérêts de l’enfant, adéquation des réponses, réciprocité, créativité), le contrôle (directivité, rythme), le soutien aux apprentissages (stimulation) et l’affect (chaleur, plaisir et acception). Une analyse factorielle a été réalisée avec les données recueillies auprès de 95 enfants ($M_{âge}$ = 42,07 mois, *É-T* = 0,28) et de l’un de leurs parents, ce qui nous a permis de confirmer la structure factorielle de l’outil. La fiabilité de cet outil a été montrée grâce aux fidélités interjuges (87%–93%, $p < 0,001$) et intrajuges (88%–98%, $p < 0,001$) élevées obtenues. La validation de cet outil, qui a été réalisée avec un échantillon d’enfants âgés de 42 mois issus de la population générale et leur famille, suggère qu’il s’agit d’une méthode valide et fiable pour observer les principaux comportements parentaux associés au développement langagier des enfants d’âge préscolaire. Ainsi, cet outil pourrait s’avérer utile pour les chercheurs et cliniciens s’intéressant au développement langagier précoce.

A wide range of studies have highlighted the important role of parent–child interactions on child language development. Specifically, current literature points to four main domains of parent–child interactions which are involved in the language development of preschool-aged children, namely response to the child (responsiveness), support to learning, affect, and control (e.g., Guttentag et al., 2014; Levickis et al., 2014; Roberts & Kaiser, 2011). Interventions aimed at developing the language of young children—whether in prevention programs or programs targeting children with language difficulties—encourage parents to adopt behaviours related to these domains (DeVeney et al., 2017; Kaiser & Roberts, 2013; Trivette & Dunst, 2014).

To help parents adopt specific behaviours, prior observation of parent–child interactions with appropriate methods must be conducted. However, to this day, clinicians and researchers in the field of child language development do not have access to any tools designed to observe the parental behaviours which contribute significantly to early language development. This kind of observational tool would be useful in clinical contexts because it could help plan interventions geared towards tailoring parental behaviours to the child's specific developmental needs. A reliable and systematic observation of parental behaviours has the potential to lead to the identification of families who may be good candidates for interventions aimed at fostering the language development of their child, and to more targeted interventions. By including specific definitions and measures of all the parental behaviours involved in language development, such a tool would also support research in speech-language pathology. In light of these considerations, the goal of this article is to present a new observational measure of the parental behaviours associated with early language development, adapted from the Maternal Behavior Rating Scale-Revised (MBRS-R; Mahoney, 2008). This work was approved by the main author (G. Mahoney, personal communication, May 26, 2016).

Domains of Parent-Child Interactions Associated with Language Development

Responsiveness can be described as parenting that is prompt, contingent on the child's current focus of attention, and appropriate to the child's needs (Tamis-LeMonda et al., 2001). Responsiveness refers to a wide range of parental abilities, such as maintaining joint attentional focus with the child, commenting on the child's play and interests, and responding to the child's communicative acts or behaviours using semantically contingent and/or appropriate responses. Responsive behaviours encourage communicative exchanges during which children initiate a topic of interest and parents respond in a way that is meaningful to the child (Hudson et al., 2015). Such mutual turn-taking between the parent and child supports the child's development of conversational structures and allows children to be highly receptive to new words and language in their role as listeners (Smith et al., 2018).

Support to learning refers to how parents interact with the child in a way that promotes cognitive and/or language development and learning (e.g., explanations, supporting concept development and reasoning skills, giving constructive feedback, adding information). Stimulation techniques geared specifically towards the child's language, such as labelling objects, are other examples of support to learning known to foster language abilities specifically (Cleave et al., 2015).

Affection expressed towards the child also creates a secure relational foundation between parent and child, which allows the children to explore their environment freely (Guttentag et al., 2014; Levickis et al., 2014; Moss et al., 2014). Recent studies have specifically shown that parental behaviours such as warmth and positive regard towards the child are associated with numerous positive outcomes in children's language development (Guttentag et al., 2014; Perkins et al., 2013).

Finally, several studies have investigated the links between *controlling* behaviours, such as directiveness, expressed by the parent towards the child and language development. Directiveness refers to the degree to which the parent requests, commands, suggests, and/or physically prompts to direct the infant's immediate attention, behaviour, or play. Typically, child-centered and non-intrusive behaviours have been shown to support language development more favourably than intrusive or directive behaviours which redirect the child's current focus of attention. Such directive behaviours have often been regarded as hindering language performance because they may reduce periods of joint attention, complexify the task of mapping words to situational referents, and put higher cognitive demands on the child's language processing skills (Akhtar et al., 1991; Tomasello & Farrar, 1986). However, other findings suggest that some levels or types of directive behaviours (e.g., supportive vs. intrusive directiveness; successful vs. unsuccessful redirectives) may, on the contrary, support language development (Flynn & Masur, 2007; Masur et al., 2005; Shimpi et al., 2012). The child's age, cultural background, and level of language skills may play an important role in the relationship between directiveness and language development. Nonetheless, these studies indicate that control is an important aspect of parent–child interaction when focusing on the associations between parental behaviours and language development.

Observational Tools Including Measures of the Parental Behaviours That Foster Early Language Development

A review of current literature was conducted to verify the existence of observational tools including measures of the aforementioned domains of parent–child interactions. Two observational tools were identified, namely, the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al., 2013) and the Maternal Behavior Rating Scale (MBRS; Mahoney et al., 1986).

The PICCOLO is a checklist including 29 items distributed across three of the four domains of parent–child interactions that are of interest for language development (i.e., affection, responsiveness, and teaching). The psychometric properties of the PICCOLO are considered robust (Roggman et al., 2013). Only positive behaviours adopted by parents are considered in this checklist, which uses yes/no responses to indicate whether a given behaviour is observed or not. The presence or absence of a behaviour does not provide any qualitative information (e.g., timing, duration, level of fit with current activity), which limits intervention planning. Likert-type measuring scales (Likert, 1932) provide a more nuanced assessment of the frequency of occurrence and magnitude of a given behaviour.

The MBRS is a global rating scale which was developed to observe parental behaviours in dyads including children at risk for developmental delays. This tool, as well as its most recent and revised version, the MBRS-R (Mahoney, 2008), have been widely used in research contexts (e.g., Chiarello et al., 2006; Kim & Mahoney, 2004; Moore et al., 1998; Sénéchal et al., 2013). The MBRS-R has never been validated, and its authors do not recommend using its current version for evaluation or family assessment purposes because they do not consider it reliable and valid enough for making judgments regarding parent–child relationships (Mahoney et al., 1996). The MBRS-R allows the observation of 12 distinct behaviours that have been reported in the child development literature as having significant influences on the development of young children (Mahoney et al., 1986). Based on a factor analysis, these 12 behaviours contribute to four interactive styles (domains of parent–child interactions; Boyce et al., 1996, as cited in Mahoney et al., 1998): (a) responsive/child-oriented behaviours (sensitivity to the child's interests, responsivity, reciprocity); (b) directive behaviours (directiveness, pace); (c) achievement orientation (achievement, verbal praise); and (d) affect (expressiveness, warmth, enjoyment, inventiveness/creativity, acceptance). Definitions and indicators are provided for each of the parental behaviours, with examples to facilitate scoring. A 5-point Likert scale is used to assign a score to each behaviour, ranging from 1 (*very low*) to 5 (*very high*), which allows for a qualitative measure of the parental behaviours of interest.

Covering the four theoretical constructs of interest, namely responsive and directive behaviours, behaviours that support learning, and affect, the MBRS-R presents good content validity with regard to the parental behaviours involved in child language outcomes. It could be a relevant tool for both researchers and clinicians interested in the early language development of preschool-aged children. However, the MBRS-R includes some overlap in the definitions of the specific parental behaviours it includes. Most importantly, some parental behaviours included in this tool, such as expressiveness (i.e., intensity and animation) or verbal praise, are not theoretically associated with the language development of preschool-aged children. Furthermore, the MBRS-R includes a mid-scale position (3), which may lead to difficulties in scoring. When an odd number of criteria are used, participants tend to interpret the central category in different ways—neutral, no opinion, not applicable, partly agree/partly disagree, unsure, undecided, confused, need more information—such that it is not truly in line with the other response categories (Chyung et al., 2017). In the context of parent–child interaction, the goal is to estimate the degree to which a parent adopts a given behaviour, meaning that the mid-scale position may not be informative.

Lotzin et al. (2015) stated that the use and refinement of an established tool with evidence of validity might be a better investment of time and resources than the ongoing development of new assessment tools. Following this statement, an adaptation of the MBRS-R was undertaken in order for this observation scale to meet the needs of the research and clinical field of child language.

Adapting the MBRS-R to the Context of Language Development

The adaptation of the MBRS-R was carried out by the first three authors, who are speech-language pathologists and researchers in the field of early childhood development. The use of three experts increases the content validity of the adaptation procedure (Lotzin et al., 2015). The coding of 48 videos of parent–child interactions using the MBRS-R by the second author led to the identification of overlaps among two of the 12 parental behaviours measured by the tool, namely verbal praise (e.g., Praise may be given for compliance, achievement or for the child being himself) and acceptance (e.g., Acceptance is measured primarily in terms of how parents' nonverbal and verbal behaviours accept and affirm the child for who he/she is or what he/she is currently doing). Consequently, they were collapsed into a single behaviour, *acceptance*, leading to the elimination of one of the 12 original behaviours.

The first and second authors also reviewed the definitions and added examples which better reflected the parental behaviours of interest for language outcomes, in light of the current literature and previous studies in the field of parent–child interactions and typical language development. For example, reciprocal behaviours that specifically foster language development, such as interacting without interrupting the child and asking open-ended questions that help maintain or pursue the ongoing interaction, were added as examples of the behaviour *reciprocity*. Similarly, examples of responsivity that specifically pertain to language, such as repeating or recasting what the child says, as well as interpreting his/her utterances, were added. All of the revised definitions and examples were then submitted to researchers in the fields of speech and language pathology, child and family psychology, and early language development to validate their accuracy and relevance in relation to early language development. Lastly, these definitions were submitted to childhood clinicians, namely speech-language pathologists and psychologists, to confirm their clarity.

The second step of the adaptation process concerned the reorganization of the Likert scale to include four, rather than five, response categories for each behaviour (1 = *never*, 2 = *sometimes*, 3 = *often*, and 4 = *always*). The third and final step involved adapting the indicators (statements) provided for each of the possible scores for the remaining 11 parental behaviours. The MBRS-R included indicators which took into account both frequency and quality of behaviours for a given dimension (e.g., “Enjoyment occurs in the context of a warm relaxed atmosphere. Parent manifests delight fairly frequently;” Enjoyment = 4), as well as indicators which only took into account frequency (e.g., “Parent occasionally manifests delight in child being himself;” Enjoyment = 3) or quality of behaviours (e.g., “Parent may appear rejecting of the child as a person;” Enjoyment = 1). These inconsistencies complexified coding, which compromised the accuracy of the ratings and thus, the reliability of the tool. To facilitate its use and minimize subjectivity, it was decided that each indicator would be standardized to include both frequency of occurrence and quality (or appropriateness) of a given behaviour.

Following this adaptation process, the observational tool included 11 of the 12 behaviours measured by the MBRS-R, as well as a Likert scale including four possible scores. This version of the tool was tested by analyzing 12 more videos, coded independently by the first three authors. Some remaining disagreements in coding resulted, after discussion among the three coders, in slight final adjustments to the definitions and indicators for the four possible response categories associated with each parental behaviour. The coding of an additional 10 videos revealed satisfactory agreement among the three coders; thus, this version of the tool became the focus of the current validation study. This new observational measure of parental behaviours was entitled the Coding Observations of Parent–Child Interactions (COPI). A validation of the COPI among a population of 42-month-old French-speaking children from a non-clinical population and their families followed.

Method

The sample included 95 monolingual French-speaking children (45 boys, 50 girls) aged, on average, 42.07 months (*SD* = 0.28), and one of their parents. These participants were recruited through educational childcare settings in the Québec city and Montréal areas (Québec, Canada) as part of the comparison group of a longitudinal study on the language development of neglected children aged 3 to 5 years (Early Longitudinal LAnguage and Neglect [ELLAN] study; Sylvestre et al., 2014). Data for the current validation study was collected at the second measurement time of the ELLAN Study. This study was approved by the Research Ethics Committees of the Québec (CJQ-IU-2014-03) and Montréal (CJM-IU 14-05-06) Youth Centres.

Participant characteristics are presented in **Table 1**. The families are mainly nuclear (93.7%) and include two or less children (77.9%). More than 70% of mothers have a university certificate, diploma, or degree (70.5%), while this proportion is 49.4% among fathers. Most families (70.2%) benefit from incomes over $80,000 annually. In terms of family structure, the current sample appears to be representative of families living in the province of Québec, where an estimated 87% of children aged 0 to 4 years live in two-parent households, and 84% of families are composed of two children or less (Institut de la statistique du Québec, 2018a). Similar trends were observed for the percentage of children living in low-income households, that is, 3.3% in the current sample and 5.8% in the general Québec population (Institut de la statistique du Québec, 2018b, 2018c). Data on the educational level of parents with children is currently not available at the provincial level.

Materials and Procedures

The videos used to code parental behaviours consisted of 15 minutes of free play between the parent and child, recorded at the end of a 2-hour home visit as part of the ELLAN study. Participants were offered a choice of toys (i.e., a farmhouse including characters and animals, a puzzle, a ball, a toy kitchen and food set, a book, a stuffed teddy

Table 1

Participant Characteristics

Variables	*n* (%)
Participating parent ($N = 95$)	
Mother	81 (85.3)
Father	13 (13.7)
Legal tutor	1 (1.05)
Type of family ($N = 95$)	
Nuclear (two parents)	89 (93.7)
Single parent	6 (6.3)
Number of children in the family ($N = 95$)	
1 or 2	74 (77.9)
3 or more	21 (22.1)
Education level of the responding parent ($N = 95$)	
High school or professional studies	28 (29.5)
University certificate, diploma, or degree	67 (70.5)
Education level of the other parental figure ($N = 89$)[a]	
High school or professional studies	45 (50.6)
University certificate, diploma, or degree	44 (49.4)
Gross household income ($N = 94$)	
≤ $39 999[b]	4 (4.2)
$40 000–79 999	24 (25.5)
≥ $80 000	66 (70.2)
Low income households[c] ($N = 91$)	3 (3.3)

Note. [a]The adjusted totals account for missing data. [b]Amounts are in Canadian Dollars (CAD). [c]The low-income cut-off is calculated based on gross household income and the size of the household (Institut de la statistique du Québec, 2019).

bear, and a "Mr. Potato Head") to standardize the free-play setting. Parents were instructed to play with their child as usual, without paying attention to the camera. Parental behaviours were then coded using the COPI. The middle portion of each recording, that is, from the beginning of the 4th minute to the 11th minute (for a total of 7 minutes) was coded. If the child or parent was temporarily absent during this given period, the corresponding duration was added and coded after the 11th minute, until 7 minutes of parent–child interactions had been coded.

Data Analysis

Following the adaptation process of the COPI, the entire sample of 95 videos was recoded by the second author. The analyses were then performed using IBM SPSS Statistics software (version 24.0) and R statistical software (version 3.4.3). Following descriptive analyses, a measure of sampling adequacy was calculated using the Kaiser-Meyer-Olkin index (Kaiser, 1974). A principal component analysis was then conducted using a varimax rotation with Kaiser normalization. Based on the factorial structure of the original tool (i.e., MBRS-R), the extraction included a fixed number of four factors. In the context of principal component analysis, saturations above .63 are considered very good and those above .71 are considered excellent (Comrey & Lee, 1992). Cronbach's alpha was also calculated to measure internal consistency of the scale items. Cronbach's alpha values above .70 are considered satisfactory (Nunnally, 1978).

Inter-rater agreement was calculated for 20 of these 95 videos (21% of the sample), which were coded independently by the first two authors. Each of these authors also recoded 10 of these 20 videos 1 month later to measure the intra-rater agreement for each rater. Inter- and intra-rater agreement were calculated using the quadratic weighting method and Gwet's AC2 statistic. Like the classical Cohen's kappa, the Gwet's AC2 statistic is a measure of rater agreement but is more robust than the classical statistic (Wongpakaran et al., 2013). A weighting method was applied by assigning a weight of 1 for perfect agreement and .80 for a one-point difference between the raters' scores. Deviations of 2 or 3 points were given a null weight. In this study, Gwet's AC2 coefficients greater than .70 were considered acceptable.

Results

A Kaiser-Meyer-Olkin index of .798 confirmed sampling adequacy and quality. The factor loadings following varimax rotations revealed that the COPI respected the factorial structure of the MBRS-R. Four behaviours of the COPI loaded onto the Response to the Child domain, two on the Control domain, one on the Support to Learning domain, and three others on the Affect domain. Nine of the 11 behaviours of the COPI loaded onto the same four factors as the MBRS-R. Inventiveness, which originally belonged to the Affect domain of the MBRS-R, loaded mainly onto the Response to the Child factor of the COPI (.707) rather than Affect (.141). This behaviour was thus reattributed to the Response to the Child dimension of the COPI. Also, considering that "expressiveness" was weakly distributed among the four factors, this behaviour did not add any useful information to the observations of parent–child interactions and was thus removed from the COPI. This brought the total number of items included in the COPI to 10. Following these changes, a second factorial analysis was conducted with the remaining 10 items of the scale (**Table 2**). The final version of the COPI is thus comprised of 10 parental behaviours divided into four domains of parent–child interactions (**Table 3**). Overall, both raters used all 4 points of the Likert scale. Internal consistency for all four subscales of the final version of the COPI ($\alpha = .84$ to .88) is considered excellent (Nunnally, 1978).

Results for intra-rater agreement are shown in **Table 4**. Overall, the intra-rater agreement was between .88 and .98, which is considered excellent. A single value (Rater 1, "Enjoyment," AC2 = .69) was slightly lower than the established threshold for acceptable values (i.e., .70). However, for this behaviour, Rater 1 used only three of the four possible scores on the Likert scale, with a score of 1 never being attributed, which highly influences Gwet's AC2 statistic. The associated confidence interval for this behaviour was quite wide [.42, .96]. The lower bounds of the confidence intervals for the remaining 10 behaviours were often close to .70.

Table 5 reports the results for inter-rater agreement. This agreement was also very high and significant ($p < .001$) for all 10 parental behaviours of the COPI. The percentage of agreement ranged from 87% to 93% and was much higher than the agreement by chance, which was, on average, 47.5% (range = 41%–53%).

Discussion

The goal of this study was to develop a tool for observing the parental behaviours that foster language development and validate it among a population of preschool-aged children from the general (non-clinical) population. This tool, named the COPI, was adapted from the MBRS-R (Mahoney, 2008). The final version of the COPI includes 10 parental behaviours distributed among four domains of parent–child interactions: Response to the Child (sensitivity to the child's interests, responsivity, reciprocity, inventiveness); Control (directiveness, pace); Support to Learning (stimulation); and Affect (warmth, enjoyment, acceptance). Both French and English versions of each component of the COPI—definitions of the four domains and 10 parental behaviours, and indicators associated with each possible score (1 to 4) on these behaviours—are available upon request from the corresponding author.

The factorial structure of the COPI is robust and the four domains are clearly distinct from one another, as shown by the principal component analysis. This suggests that using specific subscales (domains) of the COPI independently may be feasible in a clinical or research context. The indicators used to score each parental behaviour appear reliable, as confirmed by the high rates of inter- and intra-rater agreement. Overall, both raters used all 4 points of the Likert scale, further suggesting that the COPI allows for a nuanced analysis of parental behaviours.

The results of the current study suggest that the COPI can serve as a valid and reliable method for observing the parental behaviours that foster language development in a population of preschool-aged children in a research context. It is important to mention that perfect inter-rater agreement is highly unlikely in the context of observations of parent–child interactions. However, in this validation study, the scores of both raters were consistently within one Likert point of one another, which is similar to the results of other observational tools used to measure adult–child interactions (e.g., Pianta et al., 2008).

Table 2

Factor Loadings for Principal Component Analysis with Varimax Rotation of the COPI Behaviours

Domains	Factor loading			
Parental behaviours	1	2	3	4
Factor 1: Response to the child				
Sensitivity to child	**.78**	.10	.14	.41
Responsivity	**.81**	.01	.16	.34
Reciprocity	**.88**	.17	.05	.24
Inventiveness	**.66**	-.30	-.24	.21
Factor 2: Control				
Directiveness	.13	**.92**	-.13	.10
Pace	-.07	**.93**	-.03	.00
Factor 3: Support to learning				
Stimulation	.07	-.15	**.94**	.13
Factor 4: Affect				
Enjoyment	.39	-.13	-.15	**.83**
Warmth	.27	.03	.27	**.82**
Acceptance	.39	.28	.12	**.72**

Note. N = 95. Factor loadings above .63 are in bold. COPI = Coding Observations of Parent–Child Interactions.

Table 3

Definitions of the Four Domains and 10 Parental Behaviours of the COPI

	Response to the child
Sensitivity to the child's interests	Parent's awareness and understanding of what captures the child's attention (game, activity, interests, etc.) Examples of sensitivity to the child include the parent's verbal comments about what the child is interested in, his/her ability to monitor the child's activity or behaviour, the position adopted by the parent to visually monitor the child's actions as well as the parent's general commitment and engagement in the child's activity. Note: Sensitive behaviours are observed independently of directive behaviours, that is, a parent can be both very directive in the choice of an activity and sensitive to what the child does or says during the activity once engaged.

Table 3 (Continued)

Definitions of the Four Domains and 10 Parental Behaviours of the COPI

Responsivity	Consistency and relevance of the parent's responses to the child's behaviours. Responses are relevant when they are related to the child's actions, requests, and intentions, and allow the ongoing conversation or activity to continue. Responsivity is observed in relation to child behaviours that both *demand a response (direct demands)* from adults as well as behaviours that *may not be specifically directed* toward the adult *(indirect demands)*. Child behaviours include play and social activity as well as facial expressions, vocalizations, gestures, signs of discomfort, body language, requests, and demands. Relevant responses include, for example, actions or comments related to the child's actions/comments, repeating or rephrasing what the child says, expansions and interpretations of their utterances, and the parent's actions in response to the child's direct or indirect requests.
Reciprocity	Parent's ability to engage the child or engage with the child in a collaborative and balanced exchange, that is, where parent and child take part in the ongoing activity in equal parts, oriented towards a common goal. Examples of reciprocity include interacting without interrupting the child, asking open-ended questions that help maintain or pursue the ongoing interaction, creating balanced turn-taking or conversations, and successfully engaging the child in lasting interactive sequences.
Inventiveness	Variety of strategies used by the parent to capture the child's interest. Examples of inventiveness include the ability to use a toy or object in many different ways, to invent games with or without objects, to combine different toys or to use them in an unconventional way, and to find innovative solutions or ideas related to the child's activity or interests.
	Control
Directiveness	Frequency of requests, orders, suggestions, advice/clues, or other ways of directing the child's activity or immediate behaviour. Examples of directiveness include initiating a new activity when there has been no previous sign of inertia and/or resistance shown by the child, telling the child what to do, making frequent suggestions, and directing the minute details of the child's free play.
Pace	Rate of the parent's behaviour. This item allows the observation of the pace and rhythm of the parent's verbal (flow and abundance of speech) and nonverbal (gestures, movements, actions) behaviours. This item is rated independently from the child and does not observe the extent to which the parent's pace matches the child's pace.
	Support to learning
Stimulation	Parent activities/comments that stimulate the child's sensorimotor (visual, auditory, tactile, motor) and cognitive (including language) development. This item allows the observation of the amount of stimulation offered by the parent as well as the energy the parent strives to exert towards promoting and encouraging the child's development. Stimulation is measured by the extent to which the parent fosters sensorimotor and cognitive development whether through play, instruction, training, or sensory stimulation. Examples of stimulation include teaching new words/concepts to the child, describing their function, explaining/demonstrating how a game or task is completed, scaffolding, offering constructive feedback to the child, etc. Note 1: Some behaviours that support learning may not be sensitive to the child's interest, but they must nevertheless be coded in this item. Note 2: Putting the child's knowledge to test by asking closed (non-supportive) questions (e.g., asking the child to name things/colours/letters) without either teaching something new or giving supportive feedback to the child, is not considered an appropriate example of supportive learning and should not be coded here.

Table 3 (Continued)

Definitions of the Four Domains and 10 Parental Behaviours of the COPI

	Affect
Enjoyment	Enjoyment expressed by the parent towards the child. This item allows the observation of parents' enjoyment expressed in response to the child (actions and behaviour) rather than in response to the game or the activity. Examples of enjoyment may include smiling, sincere laughter, and a high level of engagement by the parent in the child's play, in a relaxed atmosphere.
Warmth	Positive attitude expressed towards the child. Frequency and intensity of the expression of positive feelings and demonstrations of affection towards the child are considered. Examples of warmth include physical proximity, pats, lap-holding, caresses, kisses, hugs, tone of voice, and verbal endearments.
Acceptance	Verbal and nonverbal parental behaviours that indicate to the child that he/she is accepted as he/she is, and that his/her behaviours, words, ideas, actions, and decisions are valued. Examples of acceptance include a parent frequently expressing his/her agreement by acknowledging what the child says or suggests ("that's a good idea," "you're right," "that's true"), accepting/engaging in the child's ideas/suggestions that might be silly or foolish, or by offering verbal or nonverbal praise to the child ("well done," "good job").

Note. COPI = Coding Observations of Parent–Child Interactions.

Table 4

Intra-rater Agreement on the 10 Parental Behaviours of the COPI

Parental behaviours	AC2	95% CI	% agreement	% agreement by chance	*p*
Sensitivity to child's interests					
Rater 1	.90	[.75, 1]	.96	.60	< .001
Rater 2	.88	[.73, 1]	.94	.50	< .001
Responsivity					
Rater 1	.96	[.86, 1]	.98	.52	< .001
Rater 2	.88	[.74, 1]	.94	.50	< .001
Reciprocity					
Rater 1	.76	[.53, 1]	.92	.66	< .001
Rater 2	.76	[.57, .94]	.88	.51	< .001
Inventiveness					
Rater 1	.88	[.69, 1]	.96	.66	< .001
Rater 2	.82	[.63, 1]	.90	.46	< .001
Directiveness					
Rater 1	.82	[.66, .99]	.92	.55	< .001
Rater 2	.83	[.66, .99]	.92	.54	< .001

Table 4 (Continued)

Intra-rater Agreement on the 10 Parental Behaviours of the COPI

Parental behaviours	AC2	95% CI	% agreement	% agreement by chance	*p*
Pace					
Rater 1	.83	[.67, .98]	.92	.55	< .001
Rater 2	.83	[.67, .98]	.92	.54	< .001
Stimulation					
Rater 1	.81	[.64, .97]	.90	.48	< .001
Rater 2	.84	[.68, 1]	.92	.49	< .001
Enjoyment					
Rater 1	.69	[.42, .96]	.90	.68	< .001
Rater 2	.88	[.73, 1]	.94	.50	< .001
Warmth					
Rater 1	.88	[.73, 1]	.94	.52	< .001
Rater 2	.91	[.78, 1]	.96	.54	< .001
Acceptance					
Rater 1	.84	[.69, .99]	.92	.49	< .001
Rater 2	.88	[.72, 1]	.94	.51	< .001

Note. COPI = Coding Observations of Parent–Child Interactions; AC2 = Gwet's AC2 agreement coefficient; CI = Confidence interval.

Table 5

Inter-rater Agreement on the 10 Parental Behaviours of the COPI

Parental behaviours	AC2	95% CI	% agreement	% agreement by chance	*p*
Sensitivity to child's interests	.79	[.69, .89]	.89	.47	< .001
Responsivity	.82	[.73, .91]	.90	.44	< .001
Reciprocity	.78	[.68, .88]	.87	.42	< .001
Inventiveness	.81	[.72, .91]	.89	.41	< .001
Directiveness	.83	[.73, .93]	.92	.53	< .001
Pace	.84	[.74, .94]	.92	.51	< .001
Stimulation	.79	[.69, .89]	.89	.48	< .001
Enjoyment	.80	[.70, .90]	.90	.50	< .001
Warmth	.78	[.69, .87]	.89	.50	< .001
Acceptance	.86	[.76, .96]	.93	.50	< .001

Note. COPI = Coding Observations of Parent–Child Interactions; AC2 = Gwet's AC2 agreement coefficient; CI = Confidence interval.

Although it remains to be confirmed through studies conducted in clinical settings, the three first authors, who have extensive clinical experience in speech-language pathology, consider that its use in a clinical setting is promising. Despite the unavoidable degree of subjectivity inherent to such observations, the detailed definitions of the domains and parental behaviours, as well as the precision of the indicators and examples provided for the four possible scores on each behaviour, allow for coding that closely reflects the observed behaviour. By allowing a judgment on the frequency of occurrence and magnitude (intensity) of a given behaviour on a 4-point Likert scale, the COPI allows for more qualitative and nuanced measures of each behaviour, compared to other tools focusing on identifying the presence or absence of such behaviours. Provided they are trained on the conceptual bases of the tool and the coding procedures of the COPI using video recordings and that satisfactory inter-rater agreement is obtained, this tool could be used by early childhood special educators, early interventionists, teachers, or any other qualified professional.

Coding with the COPI is not time-consuming as approximately 10 minutes were needed to code a 7-minute video. Real-time coding, without recording parent–child interactions, might also be feasible for experienced professionals. Although levels of inter- and intra-rater agreement were high in this validation study, they remain to be measured with other speech-language pathologists in clinical contexts, and for real-time coding. Indeed, it is important to remember that in this study, the inter-rater agreement was obtained by the same researchers who developed the definitions and examples of the COPI behaviours during the adaptation phase. This is likely to have led to a higher agreement than the one obtained by two raters who have not benefited from the discussions around these parental behaviours.

Finally, it is important to remember that the objective of this tool is not to evaluate parental behaviours. Rather, it is to observe them at a specific time and provide a common language with which to describe certain parental behaviours that are important when focusing on language outcomes for children. These observations made synchronously with the assessment of the child's developmental needs could help determine which behaviours are already adopted in a developmentally appropriate way by the parent, as well as those which are never, or seldom present. Such a tool can also help identify behaviours that are already adopted by the parent, but for which adjustments (e.g., dosage) could be made to better meet the child's needs (Baker, 2012; Lotzin et al., 2015; Warren et al., 2007). The diversity and specificity of the parental behaviours observed using the COPI could help establish specific, measurable objectives of increasing complexity.

We conducted the development and validation study of the COPI with parents of 42-month-old children from the general population who did not present biological or environmental risk factors with regard to language development. Although this first step of the validation process confirms that using the COPI is a simple and feasible way to observe parental behaviours within these families, its validity remains to be demonstrated with other subgroups of the population (e.g., low SES families and families from other cultural backgrounds).

Finally, observations of parental behaviours using the COPI must also be conducted while keeping in mind the context in which such observations are made. Contextual factors such as the physical location in which these observations are conducted (e.g., clinical setting, at home), the available materials or ongoing activity, and even factors related to the child or parent's current state (e.g., energy levels, physical or psychological well-being) should be taken into account when interpreting these measures.

Conclusion

The COPI is a systematic and structured observational measure of 10 parental behaviours, divided among four domains of parent–child interactions that are associated with language development among preschool-aged children. The results of this adaptation and validation study suggest that the COPI shows valid construct and structure. The specific and operational indicators of the 10 parental behaviours of interest, which include examples that specifically pertain to language development, resulted in satisfactory inter-rater agreement upon these measures. The COPI can be a useful observational tool of the parental behaviours of interest when focusing on child language development, for both clinical settings and research contexts. This tool helps provide a much needed common language with which to describe certain aspects of parent–child interactions which are important for language development. Its reliability, as demonstrated by the current study, can lead to more systematic observations of parental behaviours in a clinical context and, consequently, has the potential to lead to more targeted and individualized interventions adressed to children and their families.

References

Akhtar, N., Dunham, F., & Dunham, P. J. (1991). Directive interactions and early vocabulary development: The role of joint attentional focus. *Journal of Child Language, 18*(1), 41–49. https://doi.org/10.1017/S0305000900013283

Baker, E. (2012). Optimal intervention intensity. *International Journal of Speech-Language Pathology, 14*(5), 401–409. https://doi.org/10.3109/17549507.2012.700323

Chiarello, L. A., Huntington, A., & Bundy, A. (2006). A comparison of motor behaviors, interaction, and playfulness during mother-child and father-child play with children with motor delay. *Physical & Occupational Therapy in Pediatrics, 26*(1–2), 129–151. https://doi.org/10.1080/J006v26n01_09

Chyung, S. Y., Roberts, K., Swanson, I., & Hankinson, A. (2017). Evidence-based survey design: The use of a midpoint on the Likert scale. *Performance Improvement, 56*(10), 15–23. https://doi.org/10.1002/pfi.21727

Cleave, P. L., Becker, S. D., Curran, M. K., Van Horne, A. J. O., & Fey, M. E. (2015). The efficacy of recasts in language intervention: A systematic review and meta-analysis. *American Journal of Speech-Language Pathology, 24*(2), 237–255. https://doi.org/10.1044/2015_AJSLP-14-0105

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd ed.). Psychology Press.

DeVeney, S. L., Hagaman, J. L., & Bjornsen, A. L. (2017). Parent-implemented versus clinician-directed interventions for late-talking toddlers: A systematic review of the literature. *Communication Disorders Quarterly, 39*(1), 293–302. https://doi.org/10.1177/1525740117705116

Flynn, V., & Masur, E. F. (2007). Characteristics of maternal verbal style: Responsiveness and directiveness in two natural contexts. *Journal of Child Language, 34*(3), 519–543. https://doi.org/10.1017/S030500090700801X

Guttentag, C. L., Landry, S. H., Williams, J. M., Baggett, K. M., Noria, C. W., Borkowski, J. G., Swank, P. R., Farris, J. R., Crawford, A., Lanzi, R. G., Carta, J. J., Warren, S. F., & Ramey, S. L. (2014). "My baby & me": Effects of an early, comprehensive parenting intervention on at-risk mothers and their children. *Developmental Psychology, 50*(5), 1482–1496. https://doi.org/10.1037/a0035682

Hudson, S., Levickis, P., Down, K., Nicholls, R., & Wake, M. (2015). Maternal responsiveness predicts child language at ages 3 and 4 in a community-based sample of slow-to-talk toddlers. *International Journal of Language & Communication Disorders, 50*(1), 136–142. https://doi.org/10.1111/1460-6984.12129

Institut de la statistique du Québec. (2018a). Familles de recensement selon la structure et le nombre d'enfants de tous âges, Canada et provinces, 2016. [Family census according to family structure and number of children of all ages, Canada and provinces, 2016]. http://web.archive.org/web/20181207011003/http://www.stat.gouv.qc.ca/statistiques/population-demographie/familles-menages/tableau_11.htm

Institut de la statistique du Québec. (2018b). Nombre de familles à faible revenu, selon le type de famille, régions administratives et ensemble du Québec, 2011-2015. [Number of low-income families, according to family type, administrative regions and entire province of Quebec, 2011–2015). http://web.archive.org/web/20181129164427/http://www.stat.gouv.qc.ca/statistiques/profils/comp_interreg/tableaux/nbr_familles.htm

Institut de la statistique du Québec. (2018c). Taux de faible revenu, selon le type de famille, régions administratives et ensemble du Québec, 2011-2015. [Proportions of low-income families, according to family type, administrative regions and entire province of Québec, 2011–2015]. http://web.archive.org/web/20181207005802/http://www.stat.gouv.qc.ca/statistiques/profils/comp_interreg/tableaux/mfr_taux.htm

Institut de la statistique du Québec. (2019). Seuils du faible revenu, MFR-seuils avant impôt, selon la taille du ménage, Québec, 1996–2017. http://web.archive.org/web/20200215000541/https://www.stat.gouv.qc.ca/statistiques/conditions-vie-societe/revenu/faible-revenu/seuilsmfr_qcavi_.htm

Kaiser, A. P., & Roberts, M. Y. (2013). Parents as communication partners: An evidence-based strategy for improving parent support for language and communication in everyday settings. *Perspectives on Language Learning and Education, 20*(3), 96–111. https://doi.org/10.1044/lle20.3.96

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36.

Kim, J.-M., & Mahoney, G. (2004). The effects of mother's style of interaction on children's engagement: Implications for using responsive interventions with parents. *Topics in Early Childhood Special Education, 24*(1), 31–38. https://doi.org/10.1177/02711214040240010301

Levickis, P., Reilly, S., Girolametto, L., Ukoumunne, O. C., & Wake, M. (2014). Maternal behaviors promoting language acquisition in slow-to-talk toddlers: Prospective community-based study. *Journal of Developmental and Behavioral Pediatrics, 35*(4), 274–281. https://doi.org/10.1097/DBP.0000000000000056

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 22*(140), 5–55.

Lotzin, A., Lu, X., Kriston, L., Schiborr, J., Musal, T., Romer, G., & Ramsauer, B. (2015). Observational tools for measuring parent–infant interaction: A systematic review. *Clinical Child and Family Psychology Review, 18*, 99–132. https://doi.org/10.1007/s10567-015-0180-z

Mahoney, G. (2008). *The Maternal Behavior Rating Scale–Revised.* Unpublished instrument. Available from the author, Mandel School of Applied Social Sciences, Case Western Reserve University, Cleveland, OH 44106.

Mahoney, G., Boyce, G., Fewell, R. R., Spiker, D., & Wheeden, C. A. (1998). The relationship of parent-child interaction to the effectiveness of early intervention services for at-risk children and children with disabilities. *Topics in Early Childhood Special Education, 18*(1), 5–17. https://doi.org/10.1177%2F027112149801800104

Mahoney, G., Powell, A., & Finger, I. (1986). The Maternal Behavior Rating Scale. *Topics in Early Childhood Special Education, 6*(2), 44–56. https://doi.org/10.1177/027112148600600205

Mahoney, G., Spiker, D., & Boyce, G. (1996). Clinical assessments of parent–child interaction: Are professionals ready to implement this practice? *Topics in Early Childhood Special Education, 16*(1), 26–50. https://doi.org/10.1177/027112149601600105

Masur, E. F., Flynn, V., & Eichorst, D. L. (2005). Maternal responsive and directive behaviours and utterances as predictors of children's lexical development. *Journal of Child Language, 32*(1), 63–91. https://doi.org/10.1017/S0305000904006634

Moore, J. B., Saylor, C. F., & Boyce, G. C. (1998). Parent-child interaction and developmental outcomes in medically fragile, high-risk children. *Children's Health Care, 27*(2), 97–112. https://doi.org/10.1207/s15326888chc2702_2

Moss, E., Tarabulsy, G. M., St-Georges, R., Dubois-Comtois, K., Cyr, C., Bernier, A., St-Laurent, D., Pascuzzo, K., & Lecompte, V. (2014). Video-feedback intervention with maltreating parents and their children: Program implementation and case study. *Attachment & Human Development, 16*(4), 329–342. https://doi.org/10.1080/14616734.2014.912486

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.

Perkins, S. C., Finegood, E. D., & Swain, J. E. (2013). Poverty and language development: Roles of parenting and stress. *Innovations in Clinical Neuroscience, 10*(4), 10–19. http://innovationscns.com/

Pianta, R. C., LaParo, K. M., & Hamre, B. K. (2008). *Classroom assessment scoring system (CLASS) manual, pre-K.* Paul H. Brookes Publishing.

Roberts, M. Y., & Kaiser, A. P. (2011). The effectiveness of parent-implemented language interventions: A meta-analysis. *American Journal of Speech-Language Pathology, 20*(3), 180–199. https://doi.org/10.1044/1058-0360

Roggman, L. A., Cook, G. A., Innocenti, M. S., Jump Norman, V., & Christiansen, K. (2013). Parenting interactions with children: Checklist of observations linked to outcomes (PICCOLO) in diverse ethnic groups. *Infant Mental Health Journal, 34*(4), 290–306. https://doi.org/10.1002/imhj.21389

Sénéchal, C., Larivée, S., & Thermidor, G. (2013). Des parents co-thérapeutes, une solution gagnante pour le traitement des enfants autistes. [Parents as co-therapists: A winning solution for treating autistic children]. *Annales Médico-psychologiques, 171*(9), 603–609. https://doi.org/10.1016/j.amp.2012.11.013

Shimpi, P. M., Fedewa, A., & Hans, S. (2012). Social and linguistic input in low-income African American mother–child dyads from 1 month through 2 years: Relations to vocabulary development. *Applied Psycholinguistics, 33*(4), 781–798. https://doi.org/10.1017/S0142716411000567

Smith, J., Levickis, P., Eadie, T., Bretherton, L., Conway, L., & Goldfeld, S. (2018). Associations between maternal behaviors at 1 year and child language at 2 years in a cohort of women experiencing adversity. *Infancy, 23*(1), 74–102. https://doi.org/10.1111/infa.12200

Tamis-LeMonda, C. S., Bornstein, M. H., & Baumwell, L. (2001). Maternal responsiveness and children's achievement of language milestones. *Child Development, 72*(3), 748–767. https://doi.org/10.1111/1467-8624.00313

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development, 57*(6), 1454–1463. https://doi.org/10.2307/1130423

Trivette, C. M., & Dunst, C. J. (2014). Community-based parent support programs. *Encyclopedia on Early Childhood Development*. http://www.child-encyclopedia.com/parenting-skills/according-experts/community-based-parent-support-programs

Warren, S. F., Fey, M. E., & Yoder, P. J. (2007). Differential treatment intensity research: A missing link to creating optimally effective communication interventions. *Developmental Disabilities Research Reviews, 13*(1), 70–77. https://doi.org/10.1002/mrdd.20139

Wongpakaran, N., Wongpakaran, T., Wedding, D., & Gwet, K. L. (2013). A comparison of Cohen's Kappa and Gwet's AC1 when calculating inter-rater reliability coefficients: A study conducted with personality disorder samples. *BMC Medical Research Methodology, 13*(61), 1–7. https://doi.org/10.1186/1471-2288-13-61

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Act Early Autism Project: The Feasibility of an Early Pathway to Care for Toddlers at Risk of Autism Spectrum Disorder

Le projet *Act Early Autism* : faisabilité d'une trajectoire de soins qui vise la prise en charge précoce des enfants à risque d'avoir un trouble du spectre de l'autisme

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Abstract

The *Act Early Autism Project* created and assessed an early pathway to care for toddlers whose parents had informed concerns about their development. The three-step pathway included (1) reliable education provided to the broad Ottawa community about recognizing early signs of Autism Spectrum Disorder, (2) an invitation to a responsive two-level screening for Autism Spectrum Disorder, and (3) the provision of an in-home parent-mediated intervention for those positively identified at risk. This paper describes our evaluation of the pathway feasibility as 15 toddlers progressed to early intervention within 1 year. Parents used a first level paper screening tool to report their concerns to knowledgeable professionals about their toddlers' development and to identify risk for Autism Spectrum Disorder. Professionals then provided second level observational screening to obtain more detailed information about the skills and behaviours of those toddlers identified as high risk at first level screening. A 12-week parent-mediated intervention followed positive second level screening. Pre- and post-standardized parent report measures revealed changes in child behaviours during and immediately following the intervention. Autism Diagnostic Observation Schedule results following the study supported the *Act Early Autism Project* pathway to care as they provided a confirming diagnosis for all children who completed the pathway. Finally, parent perspectives of the pathway were elicited and are discussed.

Abrégé

Le projet *Act Early Autism* a créé et évalué une trajectoire de soins qui visait la prise en charge précoce des enfants dont les parents s’inquiétaient de leur développement. Cette trajectoire comprenait trois étapes : (1) une distribution d’informations fiables à la population de la grande région d’Ottawa sur la façon de reconnaître les signes précoces du trouble du spectre de l’autisme, (2) une invitation à effectuer un test de dépistage du trouble du spectre de l’autisme réalisé en deux étapes et (3) la mise en place d’une intervention réalisée à la maison par les parents des enfants identifiés comme étant à risque d’avoir un trouble du spectre de l’autisme. Cet article décrit la faisabilité de cette trajectoire en examinant le cheminement de 15 enfants lors de leur prise charge précoce qui s’est échelonnée sur un an. Les parents ont d’abord rempli un questionnaire de dépistage visant à transmettre leurs inquiétudes concernant le développement de leur enfant à un professionnel expérimenté et à identifier si leur enfant était à risque d’avoir un trouble du spectre de l’autisme. Les professionnels ont ensuite effectué un dépistage en observant les habiletés et comportements des enfants identifiés comme étant à risque d'avoir un trouble du spectre de l’autisme dans la première étape du dépistage afin d’obtenir des informations détaillées sur ces aspects. Ce second dépistage a été suivi d’une intervention de 12 semaines menée par les parents. Les résultats obtenus pré- et post-intervention à des questionnaires parentaux normalisés ont révélé des changements dans les comportements des enfants pendant et immédiatement après l’intervention. Les résultats obtenus avec l’outil *Autism Diagnostic Observation Schedule* à la fin de l’étude corroborent l’efficacité de la trajectoire de soins du projet *Act Early Autism* puisque tous les enfants ayant participé à toutes les étapes de la trajectoire ont vu leur diagnostic confirmé. Enfin, les points de vue des parents sur la trajectoire ont été recueillis et discutés.

Early screening, diagnostics, and interventions can be accessed by speech-language pathologists (S-LPs) to reliably assist very young children with developmental challenges, including Autism Spectrum Disorder (ASD). Yet, parents and speech-language pathology clinicians may not be aware of current evidence to help them navigate the best available pathways to early intervention (Barnard-Brak et al., 2017; Camarata, 2014). The recent evolution and expansion of ASD diagnostic criteria means there are now broader evidence-based definitions for identification and more reliable early indicators of risk (Zwaigenbaum, Bauman, Choueiri, et al., 2015). However, the rapid development of evidence also means an evidence-to-practice gap that is fully recognized in the field of early intervention (Dingfelder & Mandell, 2011; Lau et al., 2014; Wetherby et al., 2018). Parents and professionals may not be up to date with the changes and may be hesitant when making crucial decisions for toddlers' early interventions (Camarata, 2014; Canadian Association of Speech-Language Pathologists and Audiologists, 2006; Zwaigenbaum, Bauman, Stone, et al., 2015). Thus, informed community awareness becomes an important consideration to enlighten unfortunate "wait-and-see" responses and expedite appropriate choices for early intervention (Lau et al., 2014; Wetherby et al., 2018).

Early identification, including broad community awareness and accurate screening, followed by evidence-based early intervention need to be easily accessible to parents who have concerns (Wetherby et al., 2018). Educated, proactive responses to developmental challenges like ASD can result in optimum long-term outcomes for children (Dawson et al., 2010; Piccininni et al., 2017; Wetherby et al., 2014). The *Act Early Autism Project* aimed to (a) pilot an investigation on how to close the research-to-practice gap for parents and clinicians and (b) provide preliminary evidence for a practical, seamless pathway to evidence-based early intervention for families with toddlers showing concerning behaviours associated with ASD.

ASD as defined by the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) is a neurodevelopmental disorder that is diagnosed in at least 1 in 66 children, 5–17 years of age, in Canada (Ofner et al., 2018). When left untreated in the early years, ASD can result in cascading deficits in cognition, language, socialization, and adaptive behaviour (Dawson et al., 2012; Wetherby et al., 2007). Children can be identified as at risk of ASD before, and diagnosed by, the age of 2 years because of specific differences in early social orienting, language, and cognitive skill development, as well as unusual body movements, atypical emotional regulation, and reduced motor control in some infants (Dawson et al., 2012; Zwaigenbaum, Bauman, Choueiri, et al., 2015). Parents may have early concerns in these areas but wait to report them, sometimes on advice of professionals, until children are older and more likely to be positively identified with ASD (Ozonoff et al., 2009; Zubler, 2019; Zwaigenbaum, Bauman, Choueiri, et al., 2015).

The State of Early Intervention for ASD

Though research confirms that early intervention gives children with ASD the best chance for a positive developmental trajectory (i.e., Dawson et al., 2010; Guralnick, 2011; Landa et al., 2013; Wetherby et al., 2014, 2018), in Canada as in other countries children are not diagnosed with ASD as early as they could be (Leew et al., 2012). For example, in the United States concerns about development were retrospectively found in the health records of 85% of children at age 3 years who were later diagnosed with ASD (Zubler, 2019). Only 42% of those 3-year-old children had received a comprehensive developmental assessment by age 3. Canadian children also do not receive timely identification for several reasons, including a lack of current and coordinated information across pediatric providers, a shortage of trained clinicians, long waiting lists, a lack of coordination between agencies, and location-specific access barriers (Ouellette-Kuntz et al., 2009). Moreover, there are significant inter-regional differences in age of diagnosis across Canada (Ouellette-Kuntz et al., 2009). The median age of diagnosis for children with ASD in Canada ranges from 39 to 55 months of age depending on where the child lives; only 19% of children in Canada are identified by 36 months of age and those diagnoses are only in some provinces (Autism Canada, n.d.; Ofner et al., 2018). Even with a valid early diagnosis, Canadian children and families may experience long delays entering interventions especially as toddlers (National Autism Center, n.d; Wetherby et al., 2018). Since children can be identified as high risk of ASD before 2 years of age and should begin early intervention immediately following identification, Canada needs to facilitate feasible pathways to care and collaborative partnerships among community providers and other experts in the field of ASD (Nachshen et al., 2008).

Reliable parent-mediated early interventions that are straightforward and supportive for parents and that affect basic developmental changes for children, setting them on positive trajectories, do exist (e.g., Landa, 2018; Wetherby et al., 2018; Zwaigenbaum, Bauman, Choueiri, et al., 2015). Providing appropriate and specific early intervention for toddlers with ASD helps them establish foundational learning that diminishes later cascading developmental deficits; that is, parent-mediated interventions in the early years can be impactful beginnings to development

(Wetherby et al., 2018; Zwaigenbaum, Bauman, Stone, et al., 2015). The negative effects of inaction may later become acutely salient for children with ASD because their reduced motivation for social interaction, combined with narrowly focused interests, results in them having missed crucial foundational learning opportunities (Camarata, 2014; Dawson et al., 2012; Landa et al., 2013; Wetherby et al., 2018).

S-LPs in ASD Early Interventions

Since parents often become concerned about their child's development during the first 2 years of life (Nachshen et al., 2008; Ozonoff et al., 2009) when social and pragmatic communication behaviours, such as positive affect sharing, coordinated eye gaze, communicative gestures, and language, do not develop as expected (Shumway & Wetherby, 2009; Wetherby & Prizant, 2002), S-LPs often deliver the important initial early assessments and referrals. Indeed, a key diagnostic criterion for children with ASD includes persistent deficits in the acquisition and use of nonverbal and verbal social communication (American Psychiatric Association, 2013). Moreover, ASD may be comorbid with other speech-language developmental disorders that S-LPs identify as primary disorders (American Speech-Language-Hearing Association, n.d.), so it is important for them to be current with developments in identification and intervention. Also, S-LPs often establish important ongoing partnerships with families after assessment and so are well-positioned to help them access appropriate pathways to interventions. Knowledgeable S-LPs are essential for mobilizing vital knowledge about ASD early interventions to benefit their young clients with ASD.

Historically, S-LPs have used increasingly robust methods to train parents to enhance their early interactions with their children, supporting goals of increased social communication and language development (Carter et al., 2011; The Hanen Centre, n.d.; Hwang et al., 2013; MacDonald, 1989; MacDonald & Carroll, 1992; Pickles et al., 2016; Prizant et al., 2003). These methods merge well with current early intervention evidence for children with ASD (American Speech-Language-Hearing Association, n.d.). The extensive body of evidence for parent-mediated interventions includes studies across professions that validate intervention strategies focusing on reciprocal, responsive, parent–child interactions (e.g., Harvard University: Center on the Developing Child, 2007; Kaiser et al., 2000; Natrasony & Teitelbaum, 2016; Rogers & Dawson, 2009; Yoder & Warren, 2002). Parent training is known to be effective in promoting the achievement of family-identified goals for the child (Hwang et al., 2013; Roberts & Kaiser, 2011), enhancing parent–child relationships (Carter et al., 2011), and importantly, improving parents' abilities, confidence, and satisfaction with care (Oono et al., 2013). Additionally, early childhood professionals have learned that parents want integral information and education within their assessment and treatment experiences as support for them to ensure continuity of care (Natrasony & Teitelbaum, 2016).

Benefits of Parent Education

Providing reliable information to parents results in their decreased stress and better knowledge about their child's development (Carter et al., 2011; M. A. Feldman & Werner, 2002). A Canadian study that investigated a parent-centred treatment for young children with physical disabilities discovered that parents valued learning how to communicate with their infant or toddler by acknowledging behavioural cues. They reported learning positive and age-appropriate behaviour management strategies in enhanced interactions (Natrasony & Teitelbaum, 2016). It seems that when parents and families of children with disabilities learn how to best interact with their child, their stress decreases (Hendriks et al., 2000).

Parents are important facilitators in early interventions because they have the most consistent time to positively and naturally practice with their children (Brookman-Frazee & Koegel, 2004; Minjarez et al., 2013). Oono et al. (2013) found evidence for the effectiveness of parent-mediated interventions within the crucial parent–child interactions for child language comprehension and the reduction in ASD severity. However, even though the results with the child can be rewarding in terms of improved scores on test measures, the impact on their parents and families may be uniquely complicated and challenging (Brookman-Frazee & Koegel, 2004). Oono et al.'s (2013) findings reinforced the need for early intervention that develops parental interaction skills to enhance their child's development, but also highlighted the need to monitor levels of parental stress. Indeed, studying effects on parents when family coaching and teaching imposes responsibility on them is in progress across different fields.

The Act Early Autism Project

The *Act Early Autism Project* explored a potential continuous pathway to care that might address current barriers to early identification of risk and to early intervention for toddlers at high risk of ASD in Canada. Broad knowledge mobilization through television interviews, strategically placed information posters (see **Figure 1**), community talks, and open invitations for queries provided up-to-date information about early signs of ASD. To achieve our goal of reducing false positive screenings for ASD, we implemented a two-level screening process (Khowaja et al., 2018). First, the project sent a validated parent-report

Figure 1

A screening and parent-training program for toddlers aged **12 to 24 months** with early signs of Autism Spectrum Disorders.

If you have concerns about your child's development,

this project may help.

Some children show these signs of Autism between the ages of 12 to 24 months:

Social Interaction
- Less eye gaze
- Fewer warm, joyful expressions
- Less sharing of interest or enjoyment
- Lack of response to name

Communication
- Fewer "showing" gestures
- Lack of pointing
- Less nonverbal communication
- Unusual voice pattern (odd pitch, intonation, rhythm)
- Difficulty understanding simple language

Behavior and play development
- Repetitive movements of body, arms, hands, or fingers
- Unusual choice of play items, or ways of playing (like spinning objects, lining up objects)
- Repeated and/or rigid routines

If any of these signs describe your child, you may be eligible to participate in this project.

Contact us
for more information and to talk to us about available services in the Ottawa region. If you do not qualify for this project, we can help connect you with other services.

Screening
We will screen your child's communication, social and play skills. If you qualify, you and your child will soon participate in a free parent-training program.

Parent-Training Program
With a therapist, you will learn how to help your child learn language, social and play skills in daily routines.

The program provides ten weekly sessions in your home.

ACT EARLY
autism project

(613) 286-8079 www.actearlyautism.ca

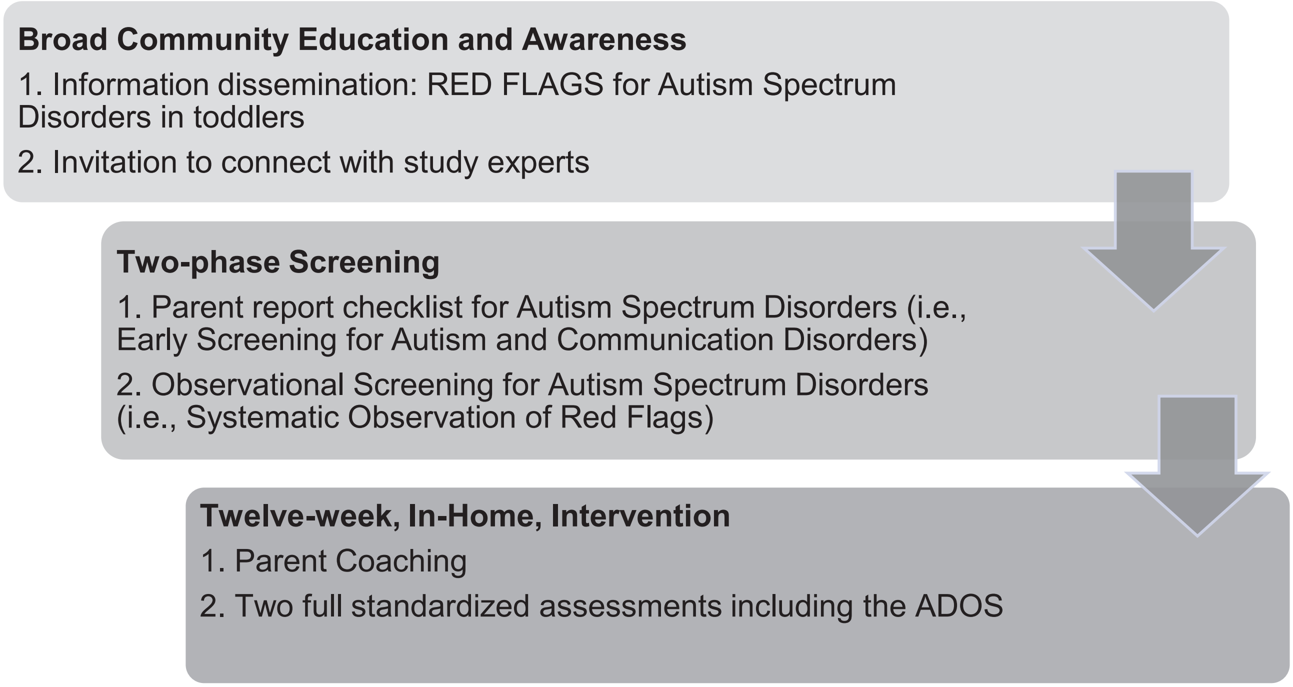
Community partners
Children's Hospital of Eastern Ontario
Pinecrest-Queensway Community Health Centre
Emerging Minds Treatment Centre for Children and Youth

Funded by The Provincial Centre of Excellence for Child and Youth Mental Health at CHEO

Recruitment poster distributed throughout the community for the Act Early Autism study screening tool by mail to anyone who contacted the study office, and we scored all returned forms. Then, children found to be at risk of ASD by parent report were given a second level observational screening for ASD by study professionals. Toddlers who presented significant red flags at the second level screening and whose families met study criteria were invited to participate in a low-intensity parent-mediated intervention, provided in families' homes. All steps in the pathway were meant to be seamless, without waiting. Moreover, the project elicited parents' opinions and perspectives to inform the process and to consider the impact of the pathway on their toddlers, themselves, and their families.

Our main objective was to explore the feasibility and accuracy of providing a continuous pathway to early intervention for toddlers at risk of ASD. Specific aims were to (a) examine numbers and proportions of children who were identified, received the intervention, and were subsequently confirmed as having ASD through gold-standard assessment tools and (b) determine if the parent-mediated early intervention was related to secondary changes in toddlers' development by examining changes on parent report measures. **Figure 2** outlines the *Act Early Autism Project* pathway to care; each assessed step provided key information about feasibility at that point, leading to and through the early intervention.

Figure 2



Steps in the Act Early Autism Project pathway to care

Method

Using descriptive methods, we explored a continuous pathway to parent-mediated early intervention for toddlers at high risk of ASD. This pathway went from community-wide information translation and mobilization about early signs of ASD, including an open invitation for any inquiries, to a responsive two-level screening for ASD, ending with the provision of a low-intensity 12-week parent-mediated intervention for toddlers who screened positive. We explored available data at each pathway step to inform (a) feasibility of the pathway, (b) utility of the tools, (c) secondary child behavioural changes, and (d) a confirmation of screened ASD status through an assessment that included the Autism Diagnostic Observation Schedule (ADOS). Some data is expressed in simple proportions, but wherever possible we analyzed the data using conservative, appropriate statistical tests. Finally, we explored social validity of the pathway by eliciting and examining a sample of parents' candid opinions about their experiences regarding progression through the pathway. Full descriptions of data collected at each step are provided below.

Identification by Community Education and Screening

Step one on the pathway was a 3-month long community education and awareness initiative aimed to provide up-to-date information to the public, parents, educators, and health professionals about evidence-based early signs of ASD. In all community-based meetings and/or via professionally designed information posters that included best evidence early red flags for ASD, people were invited to contact the project for further information and/or to participate in the identification and intervention steps, if appropriate. The community education/awareness initiative included ethically approved information posters which were strategically placed throughout the community in day cares, nursery schools, pediatrician offices, early years centres, and community centres **(Figure 1)**; local television interviews with lead investigators; and newspaper articles. The project coordinator received 47 telephone inquiries during the 3-month information/education step. As mentioned, the poster was placed throughout the Ottawa area for 3 months presenting evidence-based early red flags and an invitation to call the *Act Early Autism Project* for more information.

Step two on the pathway included the Early Screening for Autism and Communication Disorders (ESAC; Wetherby et al., 2009) and the Systematic Observation of Red Flags (SORF; Dow et al., 2017; McCoy et al., 2009; Wetherby et al., 2004) as first and second level screening tools, respectively. The first level ESAC (Wetherby et al., 2009) is a parent questionnaire that screens and rates early red flags of ASD in toddlers using 47 research-tested items. The ESAC covers two critical diagnostic domains of ASD as presented in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013). The SORF uses the Communication and Symbolic Behaviour Scales (Wetherby & Prizant, 2002) protocol to elicit behaviours and then observational scoring of the video-taped session. It includes 29 items covering diagnostic criteria of ASD as presented in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013).

Thirty-two ESACs were returned and scored. After scoring, we flagged 29 toddlers as high-risk for ASD and an S-LP in a clinic administered the second level screening tool. Second level screening involved scoring the behaviour sampling protocol of the Communication and Symbolic Behaviour Scales (Wetherby & Prizant, 2002) using the SORF (Dow et al. 2017; McCoy et al., 2009; Wetherby et al., 2004). The SORF includes 29 diagnostic items for ASD (American Psychiatric Association, 2013) to rate early red flags of ASD from the video recorded Communication and Symbolic Behaviour Scales behaviour sample. Categories of behaviours are grouped into five composite areas: (a) reciprocal social interaction, (b) unconventional gestures, (c) unconventional sounds and words, (d) repetitive behaviours and restricted interests, and (e) emotional regulation. The SORF rates the presence of behaviours that are atypical (i.e., rarely if ever displayed by children developing typically) and the absence of behaviours that are typical (i.e., usually displayed by children developing typically). A cut-off score of eight or more red flags indicates a risk for ASD status, thus warranting assessment for a diagnosis of ASD (Dow et al., 2017; McCoy et al., 2009). The SORF has good psychometric properties as a second level screen for ASD (Dow et al., 2017, 2020; Wetherby et al., 2008).

Intervention Inclusion and Exclusion Criteria

When toddlers screened positive for risk of ASD at both screening levels and families met the intervention inclusion criteria, they were immediately invited to receive the intervention as part of the study. Inclusion criteria included (a) toddlers were at least 14 months old when they began the intervention, (b) parents agreed to participate in research, (c) parents attended an information session, (d) parents agreed to commit to 12 weeks of coaching in their homes (including two assessments), (e) the child had no significant health or physical (e.g., hand use, ambulatory) concerns, (f) the child had no known, comorbid, biological-genetic conditions (e.g., Down Syndrome, Fragile X), (g) English was the child's and family's first language, and (h) the child was not enrolled in an intensive co-occurring intervention (i.e., more than 10 hours per week). When they met inclusion criteria and accepted the invitation to the early intervention, they were formally enrolled in the study for pre–post data collection and analyses.

Intervention

At step three on the pathway, we used the parent-mediated Early Start Denver Model (P-ESDM; Rogers, Dawson, & Vismara, 2012) as our early intervention because of its home-based curriculum and abbreviated coaching intensity to equip parents with immediate interactive tools shown to improve both parent and child behaviours during the intervention (Rogers, Dawson, & Vismara, 2012). The power of the model to affect children's behaviour was demonstrated in Rogers et al. (2019), which showed for the first time a direct positive relationship between parent fidelity of implementation and child growth. Also, parents in P-ESDM have shown high parent–therapist alliances (Rogers, Estes, et al., 2012) with no increase in stress while learning the intervention (Estes et al., 2014). The study provided a 1-hour session with either an S-LP or an occupational therapist and 10, 1-hour sessions in the families' homes with a trained coach.

The P-ESDM model integrates applied behaviour analysis principles with developmental, relationship-based methods, thus providing a comprehensive, manualized, and structured intervention for children with ASD, ages 12 to 48 months (Rogers & Dawson, 2009). The coaches taught parents to use a child-centred, responsive, interactive style while targeting individualized child goals. Parents learned age-appropriate applied behaviour analysis strategies and how to create, embed, and generalize learning opportunities for their toddlers in their daily lives. Parents learned to engage their toddlers in shared experiences to encourage imitation, communication, social-emotional, and play skills (Rogers, Dawson, & Vismara, 2012).

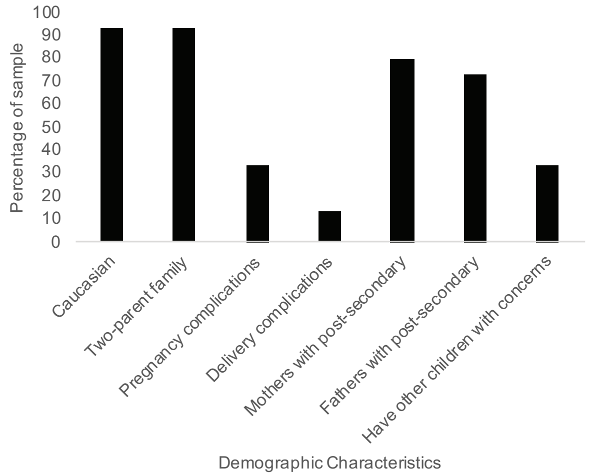
Two trained parent coaches achieved 85% treatment fidelity criteria through instruction provided by a P-ESDM trained lead investigator prior to working with families. The parent coaches were supervised throughout the study by the same lead investigator to ensure ongoing compliance with the intervention. The coaches were early childhood educators with previous training in applied behaviour analysis. Coaches collaborated with the families to establish three to five goals using the ESDM Curriculum Checklist, a criterion-referenced list of skills in developmental sequence, in eight domains, across four levels (Rogers & Dawson, 2009). One new strategy per week was introduced (Rogers, Dawson, & Vismara, 2012). If necessary, the coach would provide a hands-on demonstration of a strategy, but usually parents were coached about how to interact with their toddler. Parents were encouraged to practice all strategies in their natural environments each week, building on previous learnings. Handouts that reinforced new concepts and strategies were provided to support weekly practice (Rogers, Dawson, & Vismara, 2012).

Toddler participants in the intervention (*N* = 15) ranged in age from 16–27 months (*M* = 20.3 months; *SD* = 3.38); thirteen were boys (87%); and all lived in English as first language homes. Parents reported retrospectively that they first noted a developmental concern when their toddler was about 12 months of age (*M* = 10.64; *SD* = 5.42). Demographic information for the intervention parent participants is presented in **Figure 3**.

Child Measures

Standardized parent report measures were administered pre- and post-intervention to determine if there were any behavioural changes for the toddlers and to assess the efficacy of the intervention on child behaviour changes. Child changes were secondary to the early intervention which was delivered by the parents. Additionally, the gold standard ADOS was administered at post-intervention to determine the accuracy of our two-level screening in directing families to the early intervention for ASD.

Figure 3



Percentages of parents who took part in the Act Early intervention who present with certain demographic characteristics.

MacArthur Bates Communication Development Inventory

The words and gestures form (Fenson et al., 2007) is a checklist of 396 possible words for parents to report current expressive and receptive vocabulary and gestures in toddlers ages 8–37 months. The MacArthur Bates Communication Development Inventory (MBCDI) is psychometrically sound, as shown by reports that raw scores in young children with ASD are concurrently associated with vocabulary in language samples and in predicting later language in children with ASD (H. M. Feldman et al., 2005; Luyster et al., 2009).

Mullen Scales of Early Learning

The Mullen Scales of Early Learning (MSEL; Mullen, 1995) is a standardized and normed developmental assessment for children, ages birth through 68 months. It provides an overall index of ability (early learning composite score) and subscale scores for receptive language, expressive language, visual reception, and fine motor skills. The MSEL was administered by a qualified psychologist.

Vineland Adaptive Behavior Scales, Second Edition

The Vineland Adaptive Behavior Scales, Second Edition (VABS II; Sparrow et al., 1984) consists of four major domains: communication, socialization, daily living skills, and motor skills (age < 6 years), all of which contribute to an adaptive behaviour composite score, as well as an optional maladaptive behaviour domain. The VABS II provides an adaptive behaviour composite score, domain and subdomain scores, and age equivalents. The VABS II provides supplementary norms for children with autism (Carter et al., 1998). It demonstrates good psychometric properties including internal consistency, inter-rater reliability, and content validity (Carter et al., 1998). It was administered to the primary caretaker.

ADOS

The ADOS (Lord et al., 1999) was administered to toddlers who completed the intervention to determine or rule out a diagnosis of ASD, to support the screening steps implemented in the pathway to care. The ADOS is a standardized, clinician-administered observation tool, designed to press for social communication and restricted–repetitive behaviours related to ASD. It includes three core areas of observation: language and communication, reciprocal social interaction, and stereotyped/restricted behaviours or interests. Its algorithm scores have acceptable internal consistency and excellent inter-rater and test-retest reliability and excellent diagnostic validity for ASD versus non-spectrum conditions. A qualified psychologist administered the ADOS.

Parent Measures

Standardized self-report measures and a focus group discussion were used to explore parents' experiences in the pathway to care. We evaluated their stress, their opinions about how they were treated in the process, and their candid responses to questions about how the process affected them, their toddler, and their families. The stress measure was administered pre- and post-intervention since parents were learning to be agents of the intervention.

Parenting Stress Index

The Parenting Stress Index (PSI; Abidin, 2012; Loyd & Abidin, 1985) is a screening and triage instrument that measures relative degree of stress in a parent–child system. It is frequently used in ASD studies with parents of children ages 1 month to 12 years and is often used for pretest–posttest measurement in research. The PSI may identify issues that can lead to problems in the child's or parent's behaviour. It focuses on three major domains of stress: child characteristics, parent characteristics, and situational/demographic life stress. The PSI can produce profiles for the child subscales of distractibility/hyperactivity, adaptability, reinforces parent, demandingness, mood, and acceptability and on parent subscales of competence, isolation, attachment, health, role restriction, and spouse/parenting partner relationship. PSI domain and subscale scores may be confidently used to provide information about specific sources of stress in a parent–child system. Its reported reliability for the child subscale is .78–.88 and for the parent subscale is .75–.87 (Abidin, 2012). Reliability coefficients for the two domains and the total stress scale are .96 or greater, indicating a high degree of internal consistency. The PSI was administered to mothers and fathers of toddlers in the intervention following the intervention step.

Measure of Processes of Care

The Measure of Processes of Care (MPOC-20; King et al., 1995) is a parent questionnaire used to assess the family-centred behaviours of health care providers in interventions. With permission from CanChild, we administered an adapted version of the MPOC-20 following the intervention to assess parents' perceptions of the care they and their toddlers received along the pathway. The MPOC-20 is validated for parents who have children ranging in age from 0 to 17+ years who have neurodevelopmental disabilities or maxillofacial disorders. For the present study, parents were asked to indicate their extent of agreement to various questions about their experiences along the pathway.

Parent Focus Group

A one-time, 1-hour long focus group, led by a professional facilitator who was not involved in the study, occurred with five randomly selected mothers. Questions presented to the mothers were designed to elicit their opinions and experiences about the *Act Early Autism Project* pathway to care. The conversation was recorded for transcription and transcribed in real time for later examination and categorization. Topics addressed concerned major steps on the pathway to care: (a) parents' experiences from concerns to intervention, (b) child outcomes, (c) intervention strategies, and (d) written materials. **Table 1** summarizes all measures used in the *Act Early Autism Project*.

Results

Public Education and Screening

Numbers and proportions of toddlers who screened positive for high risk of ASD at the Level 1 screening suggested that the 3-month broad-reach community education blitz resulted in knowledgeable inquiries by parents. The community education blitz resulted in 29 of 32 toddlers (91%) identified as being at high risk for ASD. Following the Level 2 observational screening using the SORF, 24 of the 29 toddlers (83%) presented with significant red flags for ASD. Therefore, 90% of the toddlers who completed the Level 1 informed parent-report screening were positive for risk of ASD and/or developmental delay

Table 1

Summary of Child, Parent, and Data Measures Used in the Act Early Autism Project

Child	Parents	Coaches	When measure was used
1. ESAC* 2. SORF*			Screening
1. MBCDI* 2. MSEL 3. VAB II*	1. PSI 2. MPOC		Pre-intervention
1. MBCDI* 2. MSEL 3. VAB II* 4. ADOS*	1. PSI 2. MPOC 3. Focus group	Criteria treatment fidelity 1. Descriptive	Post-intervention

Note. *notable findings. ESAC = Early Screening for Autism and Communication Disorders; SORF = Systematic Observation of Red Flags; MBCDI = MacArthur Bates Communicative Development Inventory; MSEL = Mullen Scales of Early Learning; VAB II = Vineland Adaptive Behavior Scales – 2nd Edition; ADOS = Autism Diagnostic Observation Schedule; PSI = Parenting Stress Index; MPOC = Measure of Processes of Care.

and 83% of those who completed Level 2 screening were confirmed as high-risk for ASD.

Seventeen of 24 families with toddlers who screened at high risk at Level 2 screening also met the *Act Early Autism Project* inclusion criteria and were enrolled in the intervention. Seven eligible families declined participation because they chose to pursue other treatment options, lived too far away to be able to receive the intervention, or disagreed with the screening outcome. Toddler participants at screening were 14–29 months of age (M = 20.28; SD = 4.42). A Kruskall-Wallis test showed no differences on either screening measure between children who completed the intervention and those who declined or were lost to attrition (ESAC: p = .23; SORF: p = .12).

The numbers of participants entering and progressing through the pathway to care are summarized in **Table 2**. Proportions show feasibility of the pathway to care at this point in terms of differential identification and direction to appropriate early intervention

Intervention

Toddlers

Descriptive statistical analyses were performed on available pre- and post-data to evaluate secondary changes in child behaviours at this final step of the pathway to care. Because of the small sample size, missing child and parent data from families who did not return for follow-up, children who were unable to complete an assessment according to standardized procedures, and non-normal distributions of some variables, we performed non-parametric Wilcoxon Signed Rank tests. This test allowed us to compare repeated measures on our single sample to assess whether the population mean ranks differed from pre- to post-intervention (i.e., a paired difference test). Test results are tentative given the type and status of our data.

MBCDI and VABS II. Toddlers' social communication, expressive and receptive vocabulary, developmental, and behavioural/adaptive functioning were compared from pre- to post-intervention (on an individual basis, after 12 weeks of early intervention) using the MBCDI and the VABS II. Eleven of the 15 toddlers who completed the intervention had pre- and post-MBCDI; seven had both for the VABS II. For the 11 toddlers with MBCDI pre- and post-scores, raw scores for phrases and words understood, words produced, and gestures used changed positively from pre- to post-intervention according to parent report. Our large standard deviations represent a wide range of scores amongst a small sample, common in exploratory studies. Moreover, all toddlers whose chronological ages still fell within the testing limits of the MBCDI were within expected normative ranges for gestures-used at the post-intervention assessment.

One significant change was found on the VABS II for motor skills and it was a decrease (p = .02). Different *ns* reflect missing data at the post-assessment and are problematic for analyses. Only significant changes are presented in **Table 3**. All other changes in other domains were not significant.

The MSEL. No significant changes in development were found using the MSEL for the 11 children who completed

Table 2

Numbers and Proportions of Participants Progressing Through the Pathway to Care

Pathway milestones	*n*	Proportion
Completed Level 1 screening	32	1.0
Children screened high risk ASD at Level 1	29	0.90 (29/32)
Children confirmed high risk ASD at Level 2 screening	24	0.83 (24/29)
Families entering the intervention	17	0.70 (17/24)
Families lost to attrition	2	0.12 (02/17)
Families completed the intervention	15	0.88 (15/17)
Diagnostic evaluation with ADOS	15	1.0 (15/15)

Note. ASD = Autism Spectrum Disorder; ADOS = Autism Diagnostic Observation Schedule.

Table 3

Changes in Communication and Adaptive Behaviour Developmental Domains

Measure	*N*	Pre-score *M* (*SD*)	Post-score *M* (*SD*)	Wilcoxon signed-rank *p*
MBCDI Raw score	11			
Phrases understood		10.55 (5.99)	17.82 (7.65)	< .01*
Words understood		81.55 (73.21)	167.55 (106.36)	.01*
Words produced		7.18 (12.08)	86.27 (122.26)	< .01*
Gestures used		19.45 (7.15)	32.82 (13.51)	.01*
VAB II Standard score	7			
Motor sub-score		88.00 (13.25)	33.86 (4.53)	.02**

Note. *p < .05; **negative change. MBCDI = MacArthur Bates Communicative Development Inventory; VAB II = Vineland Adaptive Behavior Scales – 2nd Edition.

a post-intervention MSEL assessment. Twenty is the lowest score that the MSEL can reliably specify at this age, and since some children did not reach this basal in some developmental domains, we created a developmental quotient score (i.e., Age Equivalency/Chronological Age x 100) using age equivalency scores for comparisons (see Rogers, Estes, et al., 2012). A developmental quotient was computed for each subscale and for a composite—the mean of the five subscales. **Table 4** presents the findings.

Functional Communication. Some parents reported during their focus group about qualitative changes they observed in their toddlers' communication behaviour over the short term of intervention, adding social validity to our study. Eleven of 15 parents reported that their toddler had begun to appropriately use word approximations or words in their communication with others. The development from no words to beginning words signals an important milestone that can represent potential emergence of oral language aptitude; for a child with ASD and language delays, this may be noteworthy. The proportion of children who were reported by their parents to have reached important communication milestones by the completion of the study are summarized in **Table 5**.

ADOS. All 15 children who completed the *Act Early Autism Project* intervention were administered the ADOS after their 12-week early intervention. All 15 met the cut-off criteria for ASD. These results confirm parents' very early concerns at the community education phase of the study and the reliability of the *Act Early Autism Project* two-level screening step.

Parents

PSI. No significant changes were observed from pre- to post-early intervention for parents' stress, measured by the

Table 4

Comparisons of Mullen Scales of Early Learning Developmental Quotients (DQ) From Pre-to Post-Intervention

DQ	*n*	Pre-DQ *M* (*SD*)	Post-DQ *M* (*SD*)	Wilcoxon signed-rank *p*
Gross motor	7	70.39 (26.23)	72.31 (16.79)	.24
Visual reception	11	68.89 (31.30)	61.57 (29.03)	.33
Fine motor	5	76.80 (21.40)	79.11 (7.84)	.89
Receptive language	14	38.05 (28.28)	46.10 (31.53)	.08
Expressive language	14	46.58 (26.79)	46.15 (24.48)	.73

Note. Different *n* values represent missing basals or missing post-assessment data.

Table 5

Social-Communication Milestones Achieved by Toddlers at Pre- and Post-Intervention

Milestone	Proportion of children at pretest (*n* = 15)	Proportion of children at posttest (*n* = 11)	Proportion change
Respond to name	.60	.91	+.31
Respond to "no-no"	.80	.91	+.11
Respond to "there's mommy/daddy"	.47	.91	+.44
Imitation	.29	.73	+.44
Labelling	.07	.36	+.29

PSI. There were no differences between participants who reported at both pre- and post-early intervention, and those who did not (Mann Whitney U test: $p = .23–1.0$ for mothers; $p = .37–.95$ for fathers).

MPOC-20. Ten parents used a 7-point Likert response scale to indicate their agreement with statements related to care, ranging from to *a very great extent* (7) to *not at all* (1). A zero meant the question was *not applicable*. Parents rated the following aspects of the pathway to care: (a) enabling and partnership, (b) providing general information, (c) providing specific information about their child, (d) coordinated and comprehensive care for the child and family, and (e) respectful and supportive care. We used individual raw scores and means for exploration rather than converting to subscale scores because we used an adapted version of the MPOC-20 for this study which meant that usual subscale computations were unavailable. We chose to use a stringent lower range score of 2 or less to indicate an area that parents considered insufficient care since our *N* was small and the mean would not conservatively reflect a need for future study. Six of the 14 available items (43%) had a lower range score of 2 or less which we feel suggests areas in early intervention to improve. **Table 6** presents the MPOC-20 items and scores.

Focus Group. Five randomly selected mothers participated in a 1-hour follow-up focus group where they answered directed questions about their experiences through the pathway to care. Mothers expressed tiredness, feelings of stress, and being misunderstood by others before they became and remained more positive as they learned to help their child, especially in view of their initial concerns and the changes they observed in their children's social communication during the early intervention. Parents reported more and better interactions with their toddlers, and more child-initiated attention and affection. They found the personal coaching and support helpful and the written materials acceptable.

Table 6

Adapted MPOC-20 Raw Score Ranges

Graded item	Range
To what extent do the people who work with your child...	
1. help you to feel more competent as a parent?	2–7*
2. provide you with written information about the strategies you were taught in coaching sessions?	6–7
3. help you understand how the use of teaching strategies will help your child develop?	5–7
4. provide a caring, supportive, atmosphere rather than just give you information?	5–7
5. make sure that at least one team member is someone who works with you and your family throughout the study?	6–7
6. fully explain the teaching strategies to you?	6–7
7. provide enough time to talk so you don't feel rushed?	5–7
8. treat you as an equal partner in developing goals for your child?	1–7*
9. provide you with written information about your child's goals and progress?	3–7
10. help you improve your interactions with your child?	3–7
11. help you feel more "connected" to your child?	2–7*
12. fully explain the initial evaluation results?	2–7*
13. fully explain the research process?	2–7*
14. give you information about the types of services offered in your community that will help you address other issues your child is experiencing?	1–6*

Note. *Area of potential future study and improvement for parent-mediated early intervention. MPOC = Measure of Processes of Care.

Discussion

The *Act Early Autism Project* pathway to care aimed to provide an unencumbered way to provide community education on the early signs of ASD, validate parents' early concerns, and quickly steer them to an appropriate intervention given that current early intervention for ASD work reveals that quick responses as soon as concerns are noted give children a better chance of development (Zwaigenbaum, Bauman, Choueiri, et al., 2015). The *Act Early Autism Project* received 47 calls from the greater Ottawa community during the Step 1 3-month long education blitz. At the Step 2 screening–identification of high risk, 29 children were flagged using the first level parent report paper screening; 24 were subsequently confirmed as high risk through the second level observational screening. At Step 3 intervention, 17 families were eligible and invited to enroll in the parent mediated early intervention. Within 1 year of initiating the *Act Early Autism Project* pathway, 15 toddlers under the age of 36 months had completed 3 months of evidence-based early intervention with their parents and received a definitive diagnosis of ASD, possibly leading to a more positive trajectory by capitalizing on the brain's neuroplasticity at younger ages (Zwaigenbaum, Bauman, Stone, et al., 2015).

In the parent-mediated early intervention, parents were taught P-ESDM strategies to use within their natural interactions to encourage interactional social-communication behaviours in their toddler (Rogers, Dawson, & Vismara, 2012). During the *Act Early Autism Project* low-intensity, low-dose intervention, parents reported positive changes in their interactions with their toddlers and their toddlers' communication behaviours. In a focus group, a sample of the parents reported feeling positive about the pathway and the early intervention, suggesting that an early informed, responsive, and continuous pathway towards integral care can effect positive changes for families with toddlers at risk for ASD.

The Role of S-LPs

The *Act Early Autism Project* presents interesting considerations for speech-language pathology practice and future research in Canada. The first point of access to early intervention services for young children with developmental issues, including those with ASD, is often through speech and language programs. Thus, S-LPs can be strategic to (a) educate communities and families with reliable information about early signs and evidence-based treatments, (b) differentially identify ASD with valid screening tools, (c) ensure that very young children at high risk of ASD are appropriately referred to expert colleagues and to early intervention quickly, and (d) advocate their community for harmonization and coordination of information and services for toddlers at risk and their families. S-LPs can be vital leaders in ASD early intervention pathways because they can respond sensitively to parents' early inquiries and concerns and critically evaluate interventions with the aim to match individual families to appropriate early interventions. Consequently, the onus is on us to stay current with the ever-evolving evidence. When children receive appropriate and timely care, they experience improved reciprocal interactions with caregivers creating positive foundations for learning.

Community Information

We feel that the broad community awareness initiative was essential to the quality of inquiries we received and enhanced the speed and efficacy of the screening step. Parents received evidence-based information that confirmed or relieved their concerns and helped them begin the pathway through valid identification toward an appropriate intervention. At a time when early identification and intervention were not widely available to families, 90% of our respondents screened positive for a developmental delay, including ASD, and 83% were confirmed, through valid second level observational screening, as high risk for ASD. We feel this demonstrates success of our pathway to care because these children got a 2-year edge on their early learning interactions compared to a "wait-and-see" approach with invaluable time to act and intervene wasted.

Screening

S-LPs need to be aware of evidence-based early red flags that require further investigation so that high-risk children are set on early pathways to intervention. The use of valid screening tools should be universally understood and trusted among speech-language pathology practices and based on recent evidence. Valid screening needs to be understood as essential in an efficient pathway as it serves to direct children, families, and clinicians to the most appropriate assessments and interventions quickly.

A serendipitous finding in our study of the screening step was the discovery of five commonly occurring ASD-specific early marker behaviours in our toddlers using the SORF (American Psychiatric Association, 2013). These behaviours were (a) abnormal gaze; (b) lack of sharing interest and/or enjoyment; (c) lack of coordination of gaze, facial expression, gesture, and vocalization; (d) lack of the showing gesture; and (e) repetitive movement with objects. These red flags relate to diagnostic markers identified in other early ASD screening studies in Canada (McCoy et al., 2009; Zwaigenbaum, Bauman, Stone, et al., 2015). The first four are features of early joint attention which is important to language and communication development (Murza et al., 2016) and also noted in other research (Zwaigenbaum, Bauman, Choueiri, et al., 2015). We found that the SORF effectively confirmed high risk of ASD in our small sample. Therefore, we recommend further research regarding the use of the SORF by S-LPs as a quick indicator for further focused diagnosis for toddlers demonstrating red flags for ASD (Dow et al., 2017).

Parent-Mediated Intervention

Parent-mediated interventions for children with communication and language acquisition delays are effective in establishing foundational learning opportunities within early interactions (Camarata, 2014; Oono et al., 2013; Rogers, Estes, et al., 2012; Wetherby et al., 2014, 2018). Increasing parental competence through parent-mediated intervention empowers them in the belief that they can be positive agents of change in their children's lives (Guimond et al., 2008). Enhancing ASD early intervention by providing training for all family members and including peer group supports may be a means to further develop parental (and system) capacity. Parent training in groups as well as in-home training improves caregivers' ability to interact with their infants and toddlers in positive ways and helps to increase their knowledge of age appropriate behaviour and development (Natrasony & Teitelbaum, 2016). It may also reduce feelings of isolation and increase perceptions of family and community understanding. Evidence suggests that increasing parental competence promotes their belief that they can assist in their children's development (Guimond et al., 2008). Group education for parents can result in decreased stress, increased positive feelings about interventions, increased knowledge of early child development, and in cost effectiveness for the system (Furlong et al., 2012). Treatment fidelity measures must be explored and included in these early interventions to ensure accuracy and dosage, just as clinicians are trained.

Future Directions for Parent-Mediated Early Intervention

The continuous *Act Early Autism Project* pathway to care appears to have helped parents by validating their earliest concerns while also relieving their initial anxiety about how to immediately and appropriately provide for their toddler. Although the *Act Early Autism Project* intervention did not target or intervene for parental stress, our findings suggest that mediating parents' stress should be a focus in parent-mediated interventions and future studies. Families who enter parent-mediated early intervention for their toddler with ASD take on major responsibilities for treatment outcomes, which could possibly add to existing high stress (Costa et al., 2017). Our early intervention involved weekly parent training, support, and encouragement and was provided in family homes, making transitions and generalizations to family activities easier. Yet, as noted in other studies, parents' stress levels did not change. Though positive about the *Act Early Autism Project* intervention, parents reported in focus group conversations new family stress because of the intervention that was not captured by the PSI measure.

Nascent research indicates reduced stress and improved mental health for parents of children with ASD when they participate in group discussions, general counselling, and/or interactive training. Parents who receive interactive training show additional benefits in reduced anxiety, insomnia, somatic symptoms, and family dysfunction (Tonge et al., 2006). Moreover, intervention dose does not appear to affect parent stress (Brookman-Frazee & Koegel, 2004; M. A. Feldman & Werner, 2002). Robust measurement and monitoring of parent and family well-being in parent-mediated interventions needs to be considered when designing treatment plans for young children, for setting priorities for dose, and for follow-up evaluation (Bonis & Sawin, 2016; Tonge et al., 2006). More diverse and robust measures for parent well-being could be added to monitor treatment success and to explore parental well-being by child treatment interactions.

Limitations and Future Directions for Research

This exploratory pilot study has several obvious limitations. The short timeframe did not allow for a high intensity–high dose intervention which would have resulted in a clearer picture of parent and child behavioural changes (Pickles et al., 2016; Wetherby et al., 2018). Our timeframe limited our ability to conduct more intensive, objective assessments and long-term follow-up of participants. With more time and larger sample sizes in a follow-up study, more rigorous outcome measures could be applied and analyzed to add confidence in the findings. Further, we advocate for early screening and intervention partnerships with publicly funded programming for greater outreach to families of culturally and socioeconomically different backgrounds than the majority of Caucasian, two-parent household families that made up our sample.

Parent report measures, such as the MBCDI, capture clinically important information about children's developing abilities in early language, including vocabulary comprehension, production, gestures, and grammar. We recognize that though parent report measures are readily acceptable in clinical settings they are not considered rigorous for research and this adds an element of caution to interpretation of our results. For future research we would aim to strengthen clinical evidence of the MBCDI and MSEL Receptive results by including objective and rigorous measures for all child developmental domains. We realize these are necessary to support child change indicated by parent report measures, especially when parents are the direct objects of the intervention and growth may be secondary to parent sensitivity and responsivity training or to child maturation.

There were no measures of parents' treatment fidelity. Thus, judgements about parents' skill development directly affecting toddlers' changes were not possible. Toddlers may have received different doses of the intervention depending on parents' treatment fidelity relating to consistent training and then use of strategies. Furthermore, no data were collected for individual coaches' treatment fidelity to confirm that the intervention provided to all parents was consistent. In the future, these measures will be important to consider in the exploration of interaction effects: of coaches' behaviour with parents' and parents' with toddlers.' Finally, parent report measures can be valuable, but may have been biased and reflected their own responsivity development, rather than actual toddler development. Objective measurements and tests of generalization need to be included in future assessment batteries. Moreover, frequent behavioural measurements throughout the study would have been beneficial.

The status of our data relating to a small sample size at intervention meant insufficient statistical power to detect child changes with confidence. As a non-experimental, exploratory study, examining differential treatment effects or causation was beyond our scope. Weak findings have been reported elsewhere with low-dose, low-intensity, parent-mediated early intervention for ASD (Carter et al., 2011; Rogers, Estes, et al., 2012; Wetherby et al., 2018).

Conclusion

Foundations for lifelong development are established during the first 3 years of life in language, cognition, and social communication. The *Act Early Autism Project* demonstrated a feasible pathway to care for toddlers with ASD to overcome current barriers to early intervention and help families access evidence-based identification and intervention resources as soon as they had concerns about their child, thus ensuring optimal learning foundations. There continues to be a need for robust evidence about how to choose, access, and implement parent-mediated early interventions to ensure positive developmental trajectories for toddlers with ASD and attend to family well-being. S-LPs can serve an important role in leading best practice and embedding research in their practice to garner evidence of effective crucial early starts in foundational development for toddlers with ASD.

References

Abidin, R. R. (2012). *Parenting Stress Index* (4th ed.). Psychological Assessment Resources.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.) https://doi.org/10.1176/appi.books.9780890425596

American Speech-Language-Hearing Association. (n.d.). *Autism.* https://www.asha.org/PRPSpecificTopic.aspx?folderid=8589935303&section=Treatment#Family_Involvemen

Autism Canada. (n.d.). *Screening tools.* https://autismcanada.org/autism-explained/screening-tools/

Barnard-Brak, L., Richman, D., Ellerbeck, K., & Moreno, R. (2017). Health care provider responses to initial parental reports of autism spectrum disorder symptoms: Results from a nationally representative sample. *Child and Adolescent Mental Health, 22*(1), 30–35. https://doi.org/10.1111/camh.12194

Bonis, S. A., & Sawin, K. J. (2016). Risks and protective factors for stress self-management in parents of children with autism spectrum disorder: An integrated review of the literature. *Journal of Pediatric Nursing, 31*(6), 567–579. https://doi.org/10.1016/j.pedn.2016.08.006

Brookman-Frazee, L., & Koegel, R. L. (2004). Using parent/clinician partnerships in parent education programs for children with autism. *Journal of Positive Behavior Interventions, 6*(4), 195–213. https://doi.org/10.1177/10983007040060040201

Camarata, S. (2014). Early identification and early intervention in autism spectrum disorders: Accurate and effective? *International Journal of Speech-Language Pathology, 16*(1), 1–10. https://doi.org/10.3109/17549507.2013.858773

Canadian Association of Speech-Language Pathologists and Audiologists. (2006, November 9). *CASLPA brief to the Standing Senate Committee on Social Affairs, Science and Technology: Funding for the treatment of autism.* Speech-Language and Audiology Canada. https://www.sac-oac.ca/system/files/resources/SenateCommittee_bried_nov2006.pdf

Carter, A. S., Messinger, D. S., Stone, W. L., Celimli, S., Nahmias, A. S., & Yoder, P. (2011). A randomized controlled trial of Hanen's 'More Than Words' in toddlers with early autism symptoms. *The Journal of Child Psychology and Psychiatry, 52*(7), 741–752. https://doi.org/10.1111/j.1469-7610.2011.02395.x

Carter, A. S., Volkmar, F. R., Sparrow, S. S., Wang, J.-J., Lord, C., Dawson, G., Fombonne, E., Loveland, K., Mesibov, G., & Schopler, E. (1998). The Vineland Adaptive Behavior Scales: Supplementary norms for individuals with autism. *Journal of Autism & Developmental Disorders, 28*(4), 287–302. https://doi.org/10.1023/A:1026056518470

Costa, A. P., Steffgen, G., & Ferring, D. (2017). Contributors to well-being and stress in parents of children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 37,* 61–72. https://doi.org/10.1016/j.rasd.2017.01.007

Dawson, G., Bernier, R., & Ring, R. H. (2012). Social attention: A possible early indicator of efficacy in autism clinical trials. *Journal of Neurodevelopmental Disorders, 4*(11), 1–12. https://doi.org/10.1186/1866-1955-4-11

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., Donaldson, A., & Varley J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics, 125*(1), 17–23. https://doi.org/10.1542/peds.2009-0958

Dingfelder, H. E., & Mandell, D. S. (2011). Bridging the research-to-practice gap in autism intervention: An application of diffusion of innovation theory. *Journal of Autism & Developmental Disorders, 41*(5), 597–609. https://doi.org/10.1007/s10803-010-1081-0

Dow, D., Day, T. N., Kutta, T. J., Nottke, C., & Wetherby, A. M. (2020). Screening for autism spectrum disorder in a naturalistic home setting using the Systematic Observation of Red Flags (SORF) at 18–24 months. *Autism Research, 13*(1), 122–133. https://doi.org/10.1002/aur.2226

Dow, D., Guthrie, W., Stronach, S. T., & Wetherby, A. M. (2017). Psychometric analysis of the Systematic Observation of Red Flags for autism spectrum disorder in toddlers. *Autism, 21*(3), 301–309. https://doi.org/10.1177/1362361316636760

Estes, A., Vismara, L., Mercado, C., Fitzpatrick, A., Elder, L., Greenson, J., Lord, C., Munson, J., Winter, J., Young, G., Dawson, G., & Rogers, S. (2014). The impact of parent-delivered intervention on parents of very young children with autism. *Journal of Autism and Developmental Disorders, 44*(2), 353–365. https://doi.org/10.1007/s10803-013-1874-z

Feldman, H. M., Dale, P. S., Campbell, T. F., Colborn, D. K., Kurs-Lasky, M., Rockette, H. E., & Paradise, J. L. (2005). Concurrent and predictive validity of parent reports of child language at ages 2 and 3 years. *Child Development, 76*(4), 856–868. https://doi.org/10.1111/j.1467-8624.2005.00882.x

Feldman, M. A., & Werner, S. E. (2002). Collateral effects of behavioral parent training on families of children with developmental disabilities and behavior disorders. *Behavioral Interventions, 17*(2), 75–83. https://doi.org/10.1002/bin.111

Fenson, L., Marchman V. A., Thal, D. J., Dale, P. S., Reznick, J. S., & Bates, E. (2007). *The MacArthur-Bates Communicative Development Inventories: Second Edition. User's guide and technical manual.* Brookes.

Furlong, M., McGilloway, S., Bywater, T., Hutchings, J., Smith, S. M., & Donnelly, M. (2012). Behavioural and cognitive-behavioural group-based parenting programmes for early-onset conduct problems in children aged 3 to 12 years. *Campbell Systematic Reviews, 8*(1), 1–239. https://doi.org/10.4073/csr.2012.12

Guimond, A. B., Wilcox, M. J., & Lamorey, S. G. (2008). The Early Intervention Parenting Self-Efficacy Scale (EIPSES): Scale construction and initial psychometric evidence. *Journal of Early Intervention, 30*(4), 295–320. https://doi.org/10.1177/1053815108320814

Guralnick, M. J. (2011). Why early intervention works: A systems perspective. *Infants & Young Children, 24*(1), 6–28. https://doi.org/10.1097/IYC.0b013e3182002cfe

The Hanen Centre. (n.d.). *The Hanen centre.* http://www.hanen.org/

Harvard University: Center on the Developing Child. (2007). *InBrief: Early childhood program effectiveness.* https://developingchild.harvard.edu/resources/inbrief-early-childhood-program-effectiveness/

Hendriks, A. H. C., De Moor, J. M. H., Oud, J. H. L., & Franken, W. M. (2000). Service needs of parents with motor or multiply disabled children in Dutch therapeutic toddler classes. *Clinical Rehabilitation, 14*(5), 506–517. https://doi.org/10.1191/0269215500cr353oa

Hwang, A.-W., Chao, M.-Y., & Liu, S.-W. (2013). A randomized controlled trial of routines-based early intervention for children with or at risk of developmental delay. *Research in Developmental Disabilities, 34*(10), 3112–3123. https://doi.org/10.1016/j.ridd.2013.06.037

Kaiser, A. P., Hancock, T. B., & Nietfeld, J. P. (2000). The effects of parent-implemented enhanced milieu teaching on the social communication of children who have autism. *Early Education and Development, 11*(4), 423–446. https://doi.org/10.1207/s15566935eed1104_4

Khowaja, M., Robins, D. L., & Adamson, L. B. (2018). Utilizing two-tiered screening for early detection of autism spectrum disorder. *Autism, 22*(7), 881–890. https://doi.org/10.1177/1362361317712649

King, S., Rosenbaum, P., & King, G. (1995). *The Measure of Processes of Care-20: A means to assess family-centred behaviours of health care providers.* McMaster University, Neurodevelopmental Clinical Research Unit.

Landa, R. J. (2018). Efficacy of early interventions for infants and young children with, and at risk for, autism spectrum disorders. *International Review of Psychiatry, 30*(1), 25–39. https://doi.org/10.1080/09540261.2018.1432574

Landa, R. J., Gross, A. L., Stuart, E. A., & Faherty, A. (2013). Developmental trajectories in children with and without autism spectrum disorders: The first 3 years. *Child Development, 84*(2), 429–442. https://doi.org/10.1111/j.1467-8624.2012.01870.x

Lau, R., Stevenson, F., Ong, B. N., Dziedzic, K., Eldridge, S., Everitt, H., Kennedy, A., Kontopantelis, E., Little, P., Qureshi, N., Rogers, A., Treweek, S., Peacock, R., & Murray, E. (2014). Addressing the evidence to practice gap for complex interventions in primary care: A systematic review of reviews protocol. *BMJ Open, 4*(6), 1–6. http://dx.doi.org/10.1136/bmjopen-2014-005548corr1

Leew, S., Baker, K., Bond, S., Fong A., Heinrichs, R., Lock, K., Nelles, T., Reid, J., & Di Gironimo, C. (2012, October). *Position paper on early identification of speech & language disorders.* Speech-Language and Audiology Canada. https://www.sac-oac.ca/sites/default/files/resources/EarlyID-PositionPaper-ENGLISH.pdf

Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). *Autism Diagnostic Observation Schedule*. Western Psychological Services.

Loyd, B. H., & Abidin, R. R. (1985). Revision of the Parenting Stress Index. *Journal of Pediatric Psychology, 10*(2), 169–177. https://doi.org/10.1093/jpepsy/10.2.169

Luyster, R., Gotham, K., Guthrie, W., Coffing, M., Petrak, R., Pierce, K., Bishop, S., Esler, A., Hus, V., Oti, R., Richler, J., Risi, S., & Lord, C. (2009). The Autism Diagnostic Observation Schedule - toddler module: A new module of a standardized diagnostic measure for autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39*(9), 1305–1320. http://doi.org/10.1007/s10803-009-0746-z

MacDonald, J. D. (1989). *Becoming partners with children: From play to conversation.* Special Press.

MacDonald, J. D., & Carroll, J. Y. (1992). A partnership model for communicating with infants at risk. *Infants and Young Children, 4*(3), 20–30.

McCoy, D., Wetherby, A. M., & Woods, J. (2009, May 7–9). *Screening children between 18 and 24 months using the Systematic Observation of Red Flags (SORF) for ASD: A follow-up study* [Oral presentation]. International Meeting for Autism Research. Chicago, IL, United States.

Minjarez, M. B., Mercier, E. M., Williams, S. E., & Hardan, A. Y. (2013). Impact of pivotal response training group therapy on stress and empowerment in parents of children with autism. *Journal of Positive Behavior Interventions, 15*(2), 71–78. https://doi.org/10.1177/1098300712449055

Mullen, E. M. (1995). *Mullen Scales of Early Learning.* American Guidance.

Murza, K. A., Schwartz, J. B., Hahs-Vaughn, D. L., & Nye, C. (2016). Joint attention interventions for children with autism spectrum disorder: A systematic review and meta-analysis. *International Journal of Language and Communication Disorders, 51*(3), 236–251. https://doi.org/10.1111/1460-6984.12212

Nachshen, J., Garcin, N., Moxness, K., Tremblay, Y., Hutchinson, P., Lachance, A., Beaurivage, M., Breitenbach, M., Bryson, S., Burack, J., Caron, C., Condillac, R. A., Cornick, A., Ouellette-Kuntz, H., Joseph, S., Rishikof, E., Sladeczek, I. E., Steiman, M., Tidmarsh, L., ... Ruttle, P. L. (2008). *Screening, assessment, and diagnosis of autism spectrum disorders in young children: Canadian best practice guidelines.* Miriam Foundation. https://www.goldlearningcentre.com/handbook_english_web-final.pdf

National Autism Center at May Institute. (n.d.). *National Standards Project.* https://www.nationalautismcenter.org/national-standards-project/

Natrasony, C., & Teitelbaum, D. (2016). Watch Me Move: A program for parents of young children with gross-motor delays. *Physical & Occupational Therapy in Pediatrics, 36*(4), 388–400. https://doi.org/10.1080/01942638.2016.1205163

Ofner, M., Coles, A., Decou, M. L., Minh, D. T., Bienek, A., Snider, J., & Ugnat, A-M. (2018, March). *Autism spectrum disorder among children and youth in Canada 2018: A report of the National Autism Spectrum Disorder Surveillance System.* Public Health Agency of Canada. https://www.canada.ca/en/public-health/services/publications/diseases-conditions/autism-spectrum-disorder-children-youth-canada-2018.html

Oono, I. P., Honey, E. J., & McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews.* https://doi.org/10.1002/14651858.CD009774.pub2

Ouellette-Kuntz, H. M. J., Coo, H., Lam, M., Yu, C. T., Breitenbach, M. M., Hennessey, P. E., Holden J. J. A., Brown, H. K., Noonan, A. L., Gauthier, R. B., & Crews, L. R. (2009). Age at diagnosis of autism spectrum disorders in four regions of Canada. *Canadian Journal of Public Health, 100*(4), 268–273. https://doi.org/10.1007/BF03403945

Ozonoff, S. J., Young, G. S., Steinfeld, M. B., Hill, M. M., Cook, I., Hutman, T., MacAri, S., Rogers, S. J., & Sigman, M. (2009). How early do parent concerns predict later autism diagnosis? *Journal of Developmental and Behavioral Pediatrics, 30*(5), 367–375. https://doi.org/10.1097/DBP.0b013e3181ba0fcf

Piccininni, C., Bisnaire, L., & Penner, M. (2017). Cost-effectiveness of wait time reduction for intensive behavioral intervention services in Ontario, Canada. *JAMA Pediatrics, 171*(1), 23–30. https://doi.org/10.1001/jamapediatrics.2016.2695

Pickles, A., Le Couteur, A., Leadbitter, K., Salomone, E., Cole-Fletcher, R., Tobin, H., Gammer, I., Lowry, J., Vamvakas, G., Byford, S., Aldred, C., Slonims, V., McConachie, H., Howlin, P., Parr, J. R., Charman, T., & Green, J. (2016). Parent-mediated Social Communication Therapy for young children with autism (PACT): Long-term follow-up of a randomized controlled trial. *The Lancet, 388*(10059), 2501–2509. https://doi.org/10.1016/S0140-6736(16)31229-6

Prizant, B. M., Wetherby, A. M., Rubin, E., & Laurent, A. C. (2003) The SCERTS Model: A transactional, family-centered approach to enhancing communication and socioemotional abilities of children with autism spectrum disorder. *Infants & Young Children, 16*(4), 296–316. https://doi.org/10.1097/00001163-200310000-00004

Roberts, M. Y., & Kaiser, A. P. (2011). The effectiveness of parent-implemented language interventions: A meta-analysis. *American Journal of Speech-Language Pathology, 20*(3), 180–199. https://doi.org/10.1044/1058-0360(2011/10-0055)

Rogers, S. J., & Dawson, G. (2009). *The Early Start Denver Model for young children with autism: Promoting language, learning, and engagement.* Guilford Press.

Rogers, S. J., Dawson, G., & Vismara, L. A. (2012). An early start for your child with autism: Using everyday activities to help kids connect communicate and learn. Guilford Press.

Rogers, S. J., Estes, A., Lord, C., Vismara, L., Winter, J., Fitzpatrick, A., Guo, M., & Dawson, G. (2012). Effects of a brief Early Start Denver Model (ESDM)–based parent intervention on toddlers at risk for autism spectrum disorders: A randomized controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 51*(10), 1052–1065. https://doi.org/10.1016/j.jaac.2012.08.003

Rogers, S. J., Estes, A., Vismara, L., Munson, J., Zierhut, C., Greenson, J., Dawson, G., Rocha, M., Sugar, C., Senturk, D., Whelan, F., & Talbott, M. (2019). Enhancing low-intensity coaching in parent implemented Early Start Denver Model intervention for early autism: A randomized comparison treatment trial. *Journal of Autism and Developmental Disorder, 49*(2), 632–646. https://doi.org/10.1007/s10803-018-3740-5

Shumway, S., & Wetherby, A. M. (2009). Communicative acts of children with autism spectrum disorders in the second year of life. *Journal of Speech, Language, and Hearing Research, 52*(5), 1139–1156. https://doi.org/10.1044/1092-4388(2009/07-0280)

Sparrow, S. S., Balla, D. A., & Cicchetti, D. V. (1984). *Vineland Adaptive Behavior Scales.* American Guidance Service.

Tonge, B., Brereton, A., Kiomall, M., Mackinnon, A., King, N., & Rinehart, N. (2006). Effects on parental mental health of an education and skills training program for parents of young children with autism: A randomized controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 45*(5), 561–569. https://doi.org/10.1097/01.chi.0000205701.48324.26

Wetherby, A. M., Brosnan-Maddox, S., Peace, V., & Newton, L. (2008). Validation of the infant–toddler checklist as a broadband screener for autism spectrum disorders from 9 to 24 months of age. *Autism, 12*(5), 487–511. https://doi.org/10.1177/1362361308094501

Wetherby, A. M., Guthrie, W., Woods, J., Schatschneider, C., Holland, R. D., Morgan, L., & Lord, C. (2014). Parent-implemented social intervention for toddlers with autism: An RCT. *Pediatrics, 134*(6), 1084–1093. https://doi.org/10.1542/peds.2014-0757

Wetherby, A. M., Lord, C., Woods, J., Guthrie, W., Pierce, K., Shumway, S., Thurm, A., & Ozonoff, S. (2009, May 7–9). *The Early Screening for Autism and Communication Disorders (ESAC): Preliminary field-testing of an autism-specific screening tool for children 12 to 36 months of age [Abstract].* International Meeting for Autism Research, Chicago, IL, United States.

Wetherby, A. M., & Prizant, B. M. (2002). *Communication and Symbolic Behavior Scales Developmental Profile.* Paul H Brookes Publishing. https://imfar.confex.com/imfar/2009/webprogram/Paper4166.html

Wetherby, A. M., Watt, N., Morgan, L., & Shumway, S. (2007). Social communication profiles of children with autism spectrum disorders late in the second year of life. *Journal of Autism and Developmental Disorders, 37*(5), 960–975. https://doi.org/10.1007/s10803-006-0237-4

Wetherby, A. M., Woods, J., Guthrie, W., Delehanty, A., Brown, J. A., Morgan, L., Holland, R. D., Schatschneider, C., & Lord, C. (2018). Changing developmental trajectories of toddlers with autism spectrum disorder: Strategies for bridging research to community practice. *Journal of Speech, Language, and Hearing Research, 61*(11), 2615–2628. https://doi.org/10.1044/2018_JSLHR-L-RSAUT-18-0028

Wetherby, A., Woods, J., Nottke, C., Stronach, S., Dow, D., & McCoy, D. (2004). *SORF: Systematic Observation of Red Flags for autism spectrum disorders in young children.* Florida State University.

Yoder, P. J., & Warren, S. F. (2002). Effects of prelinguistic milieu teaching and parent responsivity education on dyads involving children with intellectual disabilities. *Journal of Speech, Language, and Hearing Research, 45*(6), 1158–1174. https://doi.org/10.1044/1092-4388(2002/094)

Zubler, J. M. (2019). *Early identification of autism.* Medscape. https://www.medscape.com/viewarticle/908580

Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Fein, D., Kasari, C., Pierce, K., Stone, W. L., Yirmiya, N., Estes, A., Hansen, R. L., McPartland, J. C., Natowicz, M. R., Buie, T., Carter, A., Davis, P. A., Granpeesheh, D., Mailloux, Z., Newschaffer, C., Robins, D., & Roley, S. S. (2015). Early identification and interventions for autism spectrum disorder: Executive summary. *Pediatrics, 136*(Supplement 1), S1–S9. https://doi.org/10.1542/peds.2014-3667B

Zwaigenbaum, L., Bauman, M. L., Stone, W. L., Yirmiya, N., Estes, A., Hansen, R. L., McPartland, J. C., Natowicz, M. R., Choueiri, R., Fein, D., Kasari, C., Pierce, K., Buie, T., Carter, A., Davis, P. A., Granpeesheh, D., Mailloux, Z., Newschaffer, C., Robins, D., ... Wetherby, A. (2015). Early identification of autism spectrum disorder: Recommendations for practice and research. *Pediatrics, 136*(Supplement 1), S10–S40. https://doi.org/10.1542/peds.2014-3667C

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Les différentes origines fonctionnelles de l'anomie acquise : illustrations cliniques

The diverse functional origins of acquired anomia: clinical illustrations

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MOTS-CLÉS
SYSTÈME SÉMANTIQUE
LEXIQUE PHONOLOGIQUE DE SORTIE
ANOMIE
ÉVALUATION
RÉÉDUCATION
LANGAGE

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L'anomie compte parmi les manifestations cognitives les plus régulièrement associées au vieillissement normal et pathologique, ainsi que parmi les manifestations cliniques les plus fréquentes de l'aphasie consécutive à un accident vasculaire cérébral. De nombreux travaux de recherche ont été publiés dans la littérature scientifique au sujet de l'anomie, de l'hétérogénéité de sa caractérisation symptomatique et de sa rééducation fonctionnelle. L'objectif du présent tutoriel est d'offrir un éclairage théorique sur l'origine fonctionnelle de l'anomie acquise et de présenter le type d'analyses cliniques (quantitatives et qualitatives) permettant d'en faire l'évaluation, afin d'améliorer son diagnostic et sa prise en charge orthophonique. Trois études de cas sont également présentées à titre d'illustrations.

Abstract

Anomia is one of the cognitive manifestations most commonly associated with normal and pathological aging and is one of the most frequent clinical manifestations of post-stroke aphasia. Many research articles have been published in the literature about anomia, the heterogeneity of its symptomatic characterization and its functional rehabilitation. The objectives of this tutorial are to provide theoretical insights into the functional origin of acquired anomia and to present the type of quantitative and qualitative clinical analyses permitting its assessment to improve speech-language pathologists’ diagnosis and management of anomia. Three prototypical case studies are also presented as illustrations.

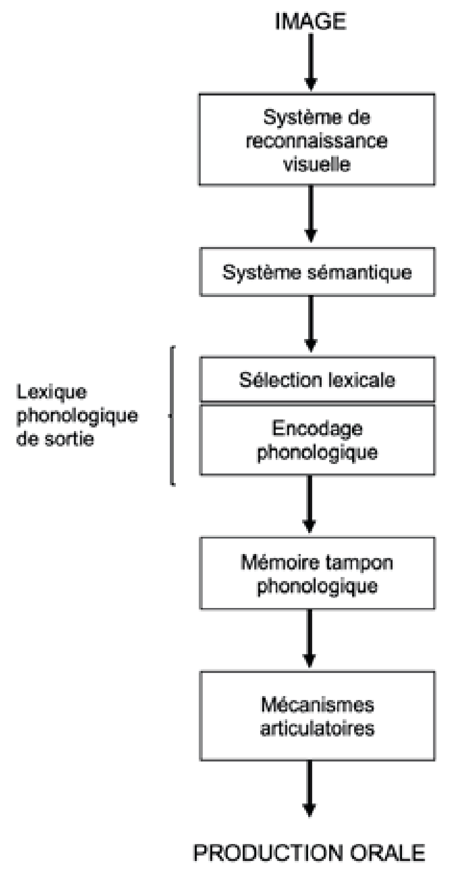
Qu'est-ce que l'anomie acquise?

Les personnes âgées se plaignent souvent de difficultés à retrouver en mémoire le nom des personnes et des objets. Cette difficulté, appelée anomie, figure parmi les manifestations cognitives les plus fréquemment associées au vieillissement normal (Burke et Shafto, 2004) et sa prévalence augmente significativement avec l'avancée en âge (Tsang et Lee, 2003). L'anomie figure parmi les manifestations cliniques les plus fréquentes de l'aphasie résultant d'un accident vasculaire cérébral (AVC; Azhar et al., 2017), des aphasies primaires progressives (Gorno-Tempini et al., 2011) et de la plupart des maladies neurodégénératives (Macoir et al., 2014). Les personnes qui souffrent d'anomie présentent souvent des difficultés à trouver les mots dans les conversations. En outre, leur performance est généralement affectée dans les tests de dénomination d'images utilisés dans les évaluations cliniques. Bien que l'anomie puisse se manifester sur différentes classes grammaticales (p. ex. verbes, noms), seule l'anomie des noms sera abordée dans le présent tutoriel.

Selon les modèles cognitifs de la production orale des mots (Caramazza, 1997; Goldrick et Rapp, 2007), la dénomination d'images requiert l'activation de composantes spécialisées et interconnectées : 1) l'activation du concept correspondant à l'objet représenté dans la mémoire sémantique (niveau conceptuel-sémantique) et 2) l'activation de la forme lexicale correspondant à ce concept dans le lexique phonologique de sortie (niveau lexical-phonologique). Cette seconde étape comprend elle-même deux niveaux : 1) la sélection lexicale, qui consiste à activer le lemme qui encode les informations relatives à la nature du mot et à ses propriétés syntaxiques, et 2) l'encodage phonologique permettant la récupération de la forme sonore du mot (aussi appelée « lexème »), qui spécifie la séquence ordonnée des phonèmes du mot cible (voir la **figure 1**). Ainsi, l'origine fonctionnelle de l'anomie peut être liée à différents processus impliqués dans l'activation des mots.

On distingue généralement l'*anomie sémantique*, qui résulte d'une difficulté à activer les concepts en mémoire sémantique, de l'*anomie lexicale*, qui se manifeste lorsque l'atteinte se situe au niveau lexical (soit au moment de l'accès au lexique, soit aux étapes de sélection lexicale et/ou d'encodage phonologique). Dans de nombreux cas, l'anomie résulte de déficits combinés affectant à la fois la mémoire sémantique et le lexique (*anomie lexicale-sémantique*). Sur le plan clinique, il est primordial d'identifier l'origine fonctionnelle sous-jacente au symptôme de surface qu'est l'anomie afin de bien cibler l'objectif du traitement de rééducation. Dans le présent tutoriel, nous présentons les principes de l'évaluation clinique (quantitative et qualitative) permettant d'identifier l'origine fonctionnelle de l'anomie, puis nous en détaillons les différentes formes possibles en les illustrant par des présentations de cas cliniques.

Figure 1



Description schématique du système cognitif de dénomination orale d'images

Évaluation clinique de l'anomie acquise

Une évaluation basée sur les modèles cognitifs de la production des mots consiste à identifier les composantes et les sous-composantes de traitement altérées (ou au contraire bien préservées) au moyen de tests spécifiques ou de batteries de tests culturellement et linguistiquement adaptés à la population cible. L'évaluation de l'anomie acquise est généralement effectuée au moyen de tâches de dénomination orale (et écrite) d'images, explorant à la fois le système conceptuel-sémantique et le lexique phonologique (et orthographique) de sortie. Des exemples d'instruments adaptés à la population franco-québécoise sont le *Boston Naming Test* (Kaplan et al., 1983; Roberts et Doucet, 2011), les sous-tests de dénomination orale et écrite d'images de la *Batterie d'évaluation cognitive du langage* (BECLA; Macoir et al., 2016), le *Test de dénomination de Québec-60 images* (TDQ-60; Macoir et al., 2018), le *Test de dénomination de Québec-30 images* (TDQ-30; Macoir et al., 2021) ou le sous-test de dénomination du *Protocole Montréal-Toulouse d'examen linguistique de l'aphasie* (MT-86; Nespoulous et al., 1992). Des tâches explorant indépendamment le niveau conceptuel-sémantique sont également requises pour identifier précisément l'origine fonctionnelle de l'anomie. Des exemples d'instruments adaptés à la population franco-québécoise sont le *Questionnaire sémantique de Québec* (QueSQ; Monetta et al., 2020), le sous-test de jugement de similarité sémantique de la BECLA (Macoir et al., 2016) et le *Pyramids and Palm Trees Test* (PPTT; Callahan et al., 2010; Howard et Patterson, 1992). En plus de l'analyse quantitative de la performance, l'identification de l'origine fonctionnelle de l'anomie s'appuie sur : 1) la comparaison des résultats obtenus dans les différentes tâches et modalités, 2) l'analyse qualitative des erreurs produites, 3) l'influence des paramètres psycholinguistiques et 4) la réponse à l'indiçage. Un tableau synthèse de la démarche clinique suggérée pour évaluer l'origine de l'anomie est inclus à la fin de cette section (voir le **tableau 1**).

La comparaison des résultats obtenus dans les différentes tâches et modalités

La comparaison des résultats obtenus aux différentes tâches (dénomination orale et écrite d'images, jugement de similarité sémantique, questionnaire sémantique, etc.) permet une meilleure compréhension de l'origine fonctionnelle de l'anomie. Ainsi, une performance normale à la tâche de dénomination écrite d'images, mais déficitaire à la tâche de dénomination orale, peut orienter le clinicien vers une anomie d'origine lexicale/phonologique sans difficulté sémantique associée. Une performance déficitaire à la tâche de dénomination orale jumelée à une performance normale à la tâche de similarité sémantique sur présentation imagée suggère une anomie d'origine lexicale. Enfin, une performance déficitaire aux tâches de dénomination d'images et de jugement de similarité sémantique oriente plutôt le clinicien vers une anomie d'origine sémantique ou lexicale-sémantique (voir le **tableau 1**).

L'analyse qualitative des erreurs produites

On reconnaît trois grands types d'erreurs en dénomination orale d'images, soit les erreurs d'omission, les paraphasies verbales et les paraphasies non verbales (Pillon, 2014; Whitworth et al., 2014).

Les erreurs d'omission, qui se manifestent sous la forme de non-réponse, résultent de l'altération des représentations sémantiques ou lexicales, ou encore, de difficultés à les activer. Par ailleurs, la production de circonlocutions précises, permettant l'identification non ambiguë de la cible (p. ex. c'est un insecte muni de huit pattes qui tisse des toiles), peut résulter d'un déficit d'accès complet au lexique, ou encore, d'un déficit localisé aux étapes de sélection lexicale et/ou d'encodage phonologique. La production de circonlocutions vagues, consistant le plus souvent en des commentaires peu spécifiques ou en la production d'informations générales (p. ex. c'est un animal; ça vole), résulte généralement de l'altération des représentations sémantiques ou de difficultés à les activer.

Les paraphasies verbales peuvent prendre la forme d'erreurs sémantiques ou formelles. Les paraphasies verbales sémantiques (p. ex. « manteau » au lieu de « chandail ») peuvent résulter d'une atteinte de nature sémantique ou d'un déficit fonctionnellement localisé à l'étape de sélection lexicale. Dans ce dernier cas, l'activation du concept en mémoire sémantique entraine l'activation d'une cohorte de lemmes dans le lexique phonologique de sortie. Cependant, l'atteinte neurologique affecte l'activation du lemme correspondant au concept cible et c'est un lemme sémantiquement associé, activé partiellement dans la cohorte, qui est sélectionné donnant lieu à une erreur sémantique. Les paraphasies formelles (p. ex. « manteau » au lieu de « marteau ») résultent également d'une atteinte de la sélection lexicale et sont explicables par la rétroaction du niveau phonologique vers le niveau de sélection lexicale. Dans un tel cas, l'atteinte neurologique affecte l'activation du lemme correspondant au concept, mais tous les lemmes qui partagent les mêmes phonèmes que le mot cible sont davantage activés par rétroaction du niveau phonologique et un lemme phonologiquement associé est alors sélectionné donnant lieu à une erreur formelle.

Les paraphasies phonémiques et les néologismes sont des paraphasies non verbales qui résultent de difficultés à activer la forme phonologique correspondant au mot cible. Selon certains chercheurs, tous les non-mots produits seraient des néologismes (Bose et Buchanan, 2007). D'autres auteurs réservent ce terme uniquement aux non-mots qui contiennent moins de 50% de la forme phonologique du mot cible (Moss et al., 2004). L'activation insuffisante de certains phonèmes du mot cible entraine la production de paraphasies phonémiques dans le langage spontané et en dénomination, mais pas en lecture et en répétition en raison de la mise en œuvre des processus non lexicaux. L'origine fonctionnelle des néologismes reste controversée. Pour certains auteurs, ils résulteraient d'un déficit complet de l'activation des lexèmes, tandis que pour d'autres ils seraient la conséquence de l'activation de certains phonèmes du mot cible et de ses voisins sémantiques en raison d'un déficit affectant à la fois la sélection lexicale et l'activation de la forme phonologique (Bose et Buchanan, 2007).

Il est également important de noter que les paraphasies phonémiques peuvent aussi être la conséquence d'une atteinte post-lexicale, soit au niveau de la mémoire tampon phonologique ou des mécanismes articulatoires (voir la **figure 1**). Dans un tel cas, elles seront observées dans toutes les modalités de production orale (langage spontané, dénomination, répétition, lecture), pour les mots et les pseudo-mots, et pourront se manifester sous la forme de séquences d'approximations phonémiques (quand le déficit se situe au niveau de la mémoire tampon phonologique) ou résulter de transformations phonétiques (quand le déficit se situe au niveau des mécanismes articulatoires). Ainsi, ce type d'erreurs ne résulte pas de difficulté à activer les représentations lexicales et diffère donc de l'anomie proprement dite.

L'influence des paramètres psycholinguistiques

Le traitement sémantique et la production des mots sont influencés par diverses variables psycholinguistiques, dont la catégorie sémantique, la familiarité des concepts et la fréquence des mots (incluant la fréquence subjective). L'effet de ces variables peut être observé selon qu'elles aient été manipulées ou contrôlées dans le test utilisé. Ainsi, les divers effets relevés lors de la passation des tâches d'évaluation (p. ex. effet de fréquence ou de catégorie sémantique) peuvent orienter la réflexion du clinicien quant à l'origine de l'anomie. La plupart des tests franco-québécois permettant l'évaluation de l'anomie ont été construits en contrôlant (c.-à-d. en assurant un niveau équivalent pour tous les stimuli) et en manipulant (c.-à-d. en ayant des niveaux différents selon les stimuli) diverses variables psycholinguistiques d'intérêt (voir le **tableau 1**).

La catégorie sémantique

La catégorie sémantique est une variable qui influence la performance en dénomination d'images quand la mémoire sémantique est affectée. Dans de nombreuses études, les personnes souffrant d'aphasie post-AVC (Forde et al., 1997), de la maladie d'Alzheimer (Gonnerman et al., 1997) ou de la variante sémantique de l'aphasie primaire progressive (Libon et al., 2013) présentent des déficits « catégories-spécifiques ». Ces déficits sont caractérisés par des différences dans la performance pour les concepts naturels (p. ex. fruits, légumes, animaux) versus manufacturés (p. ex. instruments de musique, outils, vêtements). Plusieurs tests franco-québécois de dénomination orale manipulent cette variable psycholinguistique, comme la BECLA (Macoir et al., 2016), le TDQ-60 (Macoir et al., 2018) et le TDQ-30 (Macoir et al., 2021). Certains outils d'évaluation du système conceptuel-sémantique manipulent également cette variable, comme le sous-test de jugement de similarité sémantique de la BECLA (Macoir et al., 2016) et le QueSQ (Monetta et al., 2020).

La familiarité des concepts

La familiarité des concepts (c.-à-d. le degré selon lequel une personne est en contact ou pense à un concept donné) est une autre variable qui influence le traitement sémantique et la production des mots. Par exemple, Snodgrass et Yuditsky (1996) ont montré que la familiarité des concepts influençait significativement les délais de réponses des personnes en santé dans une tâche de dénomination d'images. Cette variable influence aussi la performance des personnes souffrant de la variante sémantique de l'aphasie primaire progressive (Hirsh et Funnell, 1995). Le degré de familiarité est contrôlé dans quelques tests de dénomination orale d'images, tels le TDQ-60 (Macoir et al., 2018) et le TDQ-30 (Macoir et al., 2021).

La fréquence

Au niveau lexical, l'activation des représentations phonologiques est fortement influencée par la fréquence des mots dans la langue. Ainsi, il a été montré à de multiples reprises que les délais de production des mots en dénomination diminuent au fur et à mesure que la fréquence des mots correspondant aux images présentées augmente (Barry et al., 1997). La fréquence lexicale influence également de manière significative les capacités de production orale des mots des individus ayant une aphasie post-AVC (Kittredge et al., 2008), la maladie d'Alzheimer (Thompson-Schill et al., 1999) ou l'aphasie primaire progressive (Meteyard et Patterson, 2009). Cette variable est manipulée dans le sous-test de dénomination orale de la BECLA (Macoir et al., 2016), tandis qu'elle est contrôlée dans le TDQ-30 (Macoir et al., 2021) et dans le TDQ-60 (Macoir et al., 2018) qui comprennent respectivement des stimuli de fréquence faible et des stimuli de fréquence moyenne ou élevée.

L'âge d'acquisition des mots

Selon cette variable, les mots appris très tôt dans la vie sont produits plus rapidement que ceux appris plus tardivement. Cet effet, fréquemment observé chez les personnes neurologiquement saines, a également été rapporté chez des individus atteints de diverses pathologies (Bell et al., 2000; Hirsh et Funnell, 1995). Selon certains auteurs, l'âge d'acquisition des mots, plus que leur fréquence, est déterminant dans l'accès aux mots des personnes souffrant d'anomie lexicale (Cuetos et al., 2005). Cette variable est contrôlée dans le TDQ-60 (Macoir et al., 2018) et dans le TDQ-30 (Macoir et al., 2021).

La fréquence subjective

La fréquence subjective (c.-à-d. l'estimation du nombre de fois qu'une personne est en contact avec la forme sonore d'un mot), aussi connue sous le terme « familiarité lexicale », est une variable lexicale prédictive de la performance en décision lexicale (c.-à-d. décider si le stimulus présenté est un mot ou non) et en dénomination (Thompson et Desrochers, 2009). Cette variable est contrôlée dans le TDQ-60 (Macoir et al., 2018) et dans le TDQ-30 (Macoir et al., 2021).

La réponse à l'indiçage

Lors de la passation des tâches de dénomination orale d'images, deux types d'indiçages sont fréquemment utilisés pour faciliter l'évocation lexicale : l'indiçage phonologique (aussi appelé « ébauche orale ») et l'indiçage sémantique (aussi appelé « amorçage sémantique »). Un indiçage phonologique est une amorce verbale qui utilise des informations phonologiques pour faciliter l'accès à un mot. Le signal peut inclure une variété d'informations, allant du phonème initial (p. ex. /t/ pour la table) aux premiers phonèmes (p. ex. /tʁ/ pour tracteur), ou encore, à la première syllabe du mot (p. ex. « trac » pour tracteur). L'objectif lorsqu'on fournit un indiçage phonologique est de faciliter la récupération des mots au niveau du lexique phonologique de sortie. L'amorçage sémantique facilite plutôt l'activation sémantique du concept en fournissant des indices (des traits sémantiques) caractéristiques. Ainsi, la réponse du patient à l'indiçage offert contribue également à alimenter la réflexion du clinicien quant à l'origine fonctionnelle de l'anomie. La réponse à l'indiçage permet également de différencier une perte d'information d'une perte de la routine d'accès. Selon Shallice (1988), la réponse à l'indiçage suggère en effet une difficulté

Tableau 1

Démarche clinique d'évaluation de l'origine de l'anomie

Vocabulaire réceptif	Tâches d'évaluation prioritaires	Exemples de tests disponibles	Informations à colliger
1. Évaluation des habiletés à nommer les concepts	Dénomination orale et écrite d'images	TDQ-30 TDQ-60 BECLA BNT	1) Résultats bruts obtenus aux tâches 2) Type(s) d'erreur(s) majoritaire(s) : non-réponses, circonlocutions, paraphasies verbales sémantiques ou formelles, paraphasies phonémiques et néologismes 3) Influence des paramètres psycholinguistiques (variables sémantiques : appartenance catégorielle sémantique et familiarité; variable lexicale : fréquence; autre variable : complexité visuelle) 4) Réponse à l'indiçage : indiçage phonologique et indiçage sémantique
2. Évaluation du système conceptuel sémantique (tâches verbales et non verbales)	Appariement sémantique d'images	PPTT/BECLA	1) Résultats bruts obtenus aux tâches 2) Influence des paramètres psycholinguistiques : appartenance catégorielle sémantique et nature des traits sémantiques
	Appariement sémantique de mots écrits	BECLA	
	Appariement mots entendus/images	MT-86/BECLA	
	Questionnaire sémantique	QueSQ	

Note. MT-86 = Protocole Montréal-Toulouse d'examen linguistique de l'aphasie (Nespoulous et al., 1992); TDQ-30 = Test de dénomination de Québec-30 images (Macoir et al., 2021); TDQ-60 = Test de dénomination de Québec-60 images (Macoir et al., 2018); BECLA = Batterie d'évaluation cognitive du langage (Macoir et al., 2016); PPTT = Pyramids and Palm Trees Test (Callahan et al., 2010; Howard et Patterson, 1992); QueSQ = Questionnaire d'évaluation sémantique de Québec (Monetta et al., 2020); BNT = Boston Naming Test (Kaplan et al., 1983; Roberts et Doucet, 2011).

d’accès aux représentations sémantiques et/ou lexicales puisqu’une forme dégradée ou perdue ne peut pas être activée.

Déterminer l’origine fonctionnelle de l’anomie

Dans cette section, nous détaillons davantage les différentes formes possibles d’anomie (c.-à-d. l’anomie sémantique, l’anomie lexicale et l’anomie lexicale-sémantique) et les illustrons par des présentations de cas cliniques prototypiques[1]. Un tableau synthèse des caractéristiques observées lors de l’évaluation, selon l’origine fonctionnelle de l’anomie, est présenté à la fin de cette section (voir le **tableau 2**).

Anomie sémantique

L’anomie sémantique se manifeste typiquement par une performance sous les normes aux tâches évaluant le niveau conceptuel-sémantique (p. ex. tâche d’appariement sémantique d’images/mots écrits; tâche d’appariement de mots entendus/images). Cette atteinte sémantique se répercute par « effet domino » sur les capacités de production orale et écrite de mots et les résultats en dénomination d’images sont donc également affectés. L’analyse qualitative des erreurs en dénomination révèle la production de paraphasies verbales sémantiques, quoique les erreurs d’omission de types non-réponses ou circonlocutions vagues peuvent également être observées (voir le **tableau 3**). Des effets de catégorie sémantique et de familiarité des concepts peuvent également être relevés dans les tâches où ces paramètres sont manipulés. Dans les tâches de dénomination, lorsque les représentations sémantiques correspondantes ne sont pas totalement dégradées, l’indiçage sémantique peut être bénéfique et l’indiçage phonologique peut également faciliter la production du mot cible dans certains cas.

Le cas de CL, une illustration clinique de l’anomie sémantique

CL est un homme âgé de 62 ans ayant reçu un diagnostic de la variante sémantique de l’aphasie primaire progressive (Gorno-Tempini et al., 2011). Le langage de CL est principalement affecté par une atteinte modérée de la mémoire sémantique. Des paraphasies sémantiques sont présentes dans le langage spontané, ainsi que dans une tâche de dénomination orale d’images, soit le TDQ-60 (Macoir et al., 2018), et dans une tâche de dénomination écrite d’images, soit la BECLA (Macoir et al., 2016). Il présente une anomie de degré modéré et les résultats obtenus en modalités orale et écrite sont similaires. L’indiçage phonologique et sémantique s’avère inefficace en dénomination d’images. CL présente également des difficultés de compréhension des concepts, que ce soit dans les tâches verbales du QueSQ (Monetta et al., 2020) ou dans les tâches non verbales du PPTT (Callahan et al., 2010; Howard et Patterson, 1992).

Le cas de CL est un cas typique d’anomie d’origine sémantique. Bien qu’il soit impossible de démontrer directement la préservation des lexiques de sortie, les résultats obtenus dans les tâches de production de mots sont entièrement explicables par l’atteinte sémantique relevée (c.-à-d. une anomie modérée et une similarité des résultats obtenus dans les deux modalités de sortie). Par ailleurs, aucun indice additionnel n’oriente vers une atteinte lexicale ajoutée (p. ex. il n’y a pas d’effet de fréquence); l’hypothèse d’une anomie lexicale-sémantique n’est donc pas justifiée.

Dans le cas d’une anomie sémantique, comme chez CL, la rééducation devrait viser le réapprentissage ou la réactivation des connaissances sémantiques relatives aux concepts cibles en mémoire sémantique. Selon une telle approche, la production d’un mot sera facilitée par des indices portant sur la catégorie sémantique à laquelle il appartient, ainsi que sur ses caractéristiques perceptuelles ou fonctionnelles/encyclopédiques (p. ex. sur l’utilité de l’objet, l’endroit où on le trouve, la catégorie sémantique, la couleur et la forme de l’objet, etc.). Un effet de généralisation entre les concepts est attendu à la suite d’un tel traitement puisqu’en théorie les mots non-traités mais sémantiquement reliés aux mots cibles traités devraient bénéficier de l’effet du traitement (Whitworth et al., 2014). Notons que plusieurs traitements sémantiques ont été montrés efficaces pour la rééducation de l’anomie d’origine sémantique, tel le traitement *Semantic Feature Analysis* (Boyle et Coelho, 1995). Basé sur la conception d’un réseau sémantique constitué de représentations interreliées entre elles par des traits communs et où le sens de chacun des concepts est défini par l’ensemble de ses interconnexions, le traitement *Semantic Feature Analysis* facilite la récupération des mots en favorisant le réapprentissage ou l’apprentissage d’une stratégie d’activation des traits sémantiques liés au concept cible (Boyle, 2004; Coelho et al., 2000; Nickels, 2002). Plusieurs versions et adaptations de ce traitement ont vu le jour ces dernières années. À titre d’exemple, dans une étude récente, des chercheurs ont utilisé efficacement une version auto-administrée du traitement *Semantic Feature Analysis* (trois séances d’entrainement avec l’orthophoniste et seize séances effectuées de façon autonome/auto administrées) pour traiter l’anomie d’origine sémantique de deux participants ayant reçu un diagnostic de la variante sémantique de l’aphasie primaire progressive (Lavoie et al., 2020).

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[1] Les trois cas cliniques sont fictifs, mais inspirés de cas réels.

Anomie lexicale

L'anomie lexicale se manifeste par une performance dans les normes aux tâches évaluant le niveau conceptuel-sémantique. Par ailleurs, une anomie est relevée en dénomination, mais peut parfois être moins observable en langage spontané. On observe aussi généralement des performances distinctes en dénomination orale et écrite. À l'analyse qualitative des erreurs en dénomination, différents profils peuvent émerger. Lorsque le déficit résulte d'un blocage complet de l'accès au lexique, des erreurs d'omission de type non-réponses, ou encore, des circonlocutions précises sont généralement observées. Dans le cas où le déficit se situe à l'étape de la sélection lexicale (c.-à-d. les lemmes), une majorité de paraphasies verbales sémantiques et formelles, ou encore, de circonlocutions précises est typiquement notée. Enfin, dans le cas où le déficit se situe à l'étape de la récupération de la forme phonologique (c.-à-d. les lexèmes), deux profils d'erreurs sont typiquement observés, soit la production de circonlocutions précises ou l'absence de réponse (voir le profil A dans le **tableau 3**) et la production de paraphasies phonémiques (voir le profil B dans le **tableau 3**). L'effet de la fréquence lexicale est typique de cette forme d'anomie et l'indiçage phonologique est souvent efficace.

Le cas de BM, une illustration clinique de l'anomie lexicale

BM est une femme âgée de 50 ans vivant avec une aphasie chronique consécutive à un AVC. Le langage de BM est caractérisé par une préservation de la mémoire sémantique, comme en témoignent les résultats obtenus au PPTT (Callahan et al., 2010; Howard et Patterson, 1992) et au QueSQ (Monetta et al., 2020). L'anomie, de degré modéré, se manifeste à la fois en contexte de conversation et dans des tâches structurées. En langage spontané, une majorité de blocages, de délais et d'hésitations est notée. Dans des tâches de dénomination orale, soit le TDQ-60 (Macoir et al., 2018), et écrite, soit la BECLA (Macoir et al., 2016), une majorité de non-réponses et de circonlocutions précises est notée. La performance en modalité orale est supérieure à celle obtenue en modalité écrite pour les mêmes stimuli. BM arrive plus aisément à dénommer les concepts fréquents et l'ébauche orale facilite significativement l'évocation du mot cible.

Le cas de BM est un cas typique d'anomie d'origine lexicale. Les résultats obtenus dans les tâches évaluant la mémoire sémantique sont dans les normes, alors qu'une anomie est notée en langage spontané et dans des tâches de dénomination. Cette anomie est par ailleurs un peu plus importante en modalité écrite. L'effet de fréquence et l'effet positif de l'indiçage phonologique sont en concordance avec le profil clinique. Le profil d'erreurs oriente davantage vers une atteinte affectant l'étape de la récupération de la forme phonologique (c.-à-d. les lexèmes). Une évaluation plus approfondie, par exemple au moyen de tâches évaluant l'accès aux propriétés syntaxiques des mots, permettrait de statuer sur cet aspect.

Dans le cas de BM, la rééducation de l'anomie à l'oral devrait cibler le réapprentissage ou la réactivation de la forme lexicale correspondant au concept dans le lexique de sortie (niveau lexical-phonologique). L'efficacité de plusieurs traitements phonologiques a été largement montrée dans les écrits scientifiques (de Partz, 2016; Madden et al., 2017). Classiquement, les traitements visent la restauration des items dégradés au niveau du lexique phonologique/orthographique de sortie (Howard et al., 1985). L'effet attendu de ces traitements est dit « item-spécifique » puisqu'en théorie seuls les mots traités devraient bénéficier de l'effet du traitement (Franklin et al., 2002). Ainsi, la sélection de cibles thérapeutiques fonctionnelles et significatives pour la personne revêt toute son importance. La plupart des traitements phonologiques impliquent que le patient produise oralement ou répète le mot cible à partir d'indices qui lui sont fournis. À titre d'exemple, un groupe de chercheurs (Miceli et al., 1996) ont présenté une étude de cas cliniques portant sur deux participants ayant une anomie d'origine purement lexicale (les participants n'avaient aucun déficit sémantique). Les chercheurs ont alors proposé un traitement phonologique consistant en la présentation d'images que les participants n'arrivaient pas à nommer. Dans un premier temps, les participants devaient lire à voix haute le mot correspondant à l'image et, dans un deuxième temps, le répéter après l'expérimentateur. Les deux participants se sont significativement améliorés pour les items traités et un maintien des acquis a été observé 17 mois après la fin du traitement. D'autres types de traitements phonologiques visent le développement de stratégies. L'approche par analyse de composantes phonologiques (Leonard et al., 2008) est un excellent exemple. Dans l'analyse de composantes phonologiques, les participants sont invités à identifier cinq composantes phonologiques du mot cible (il rime avec quel mot; sa longueur syllabique; son 1er phonème; un autre mot qui débute par le même son; le dernier phonème) lorsqu'ils ne peuvent le nommer. Quelques études (Leonard et al., 2008, 2015; Marcotte et al., 2018) ont montré l'efficacité de ce type de traitement visant le renforcement de l'activation des représentations dans le lexique phonologique de sortie.

Anomie lexicale-sémantique

L'anomie lexicale-sémantique se manifeste typiquement par une performance sous les normes aux tâches évaluant le niveau conceptuel-sémantique (p. ex. tâche d'appariement sémantique d'images/mots écrits; tâche d'appariement des mots entendus/images). Par ailleurs, les résultats en dénomination d'images sont altérés dans une plus grande mesure que ce que l'atteinte sémantique permet d'anticiper. Dans un tel cas, les performances en dénomination orale et écrite peuvent différer puisque les lexiques phonologique et orthographique sont deux composantes distinctes. L'analyse qualitative des erreurs en dénomination, l'effet des paramètres psycholinguistiques et l'impact de l'indiçage sont variables d'une personne à l'autre, selon la contribution proportionnelle des composantes à la source de l'anomie.

Le cas de LN, une illustration clinique de l'anomie lexicale-sémantique

LN est un homme âgé de 64 ans vivant avec une aphasie chronique consécutive à un AVC. Le langage de LN est affecté par une atteinte légère de la mémoire sémantique, comme le suggèrent les résultats obtenus au PPTT (Callahan et al., 2010; Howard et Patterson, 1992) et au QueSQ (Monetta et al., 2020). L'anomie, de degré modérée-sévère, se manifeste à la fois en contexte de conversation et dans des tâches structurées. En langage spontané, une majorité de blocages, de délais et d'hésitations est notée. Dans des tâches de dénomination orale, soit le TDQ-60 (Macoir et al., 2018), et écrite, soit la BECLA (Macoir et al., 2016), on observe essentiellement des non-réponses. Dans ces tests, la performance en modalité écrite est légèrement supérieure à celle obtenue en modalité orale pour les mêmes stimuli. LN parvient plus aisément à nommer les concepts familiers et fréquents et l'ébauche orale facilite beaucoup l'évocation du mot cible.

Tableau 2

Synthèse des caractéristiques observées lors de l'évaluation selon l'origine fonctionnelle de l'anomie

	Anomie sémantique	Anomie lexicale	Anomie lexicale-sémantique
Performance aux tâches de dénomination orale et écrite d'images	• Sous les normes; • Identique en modalité orale et en modalité écrite; • Types d'erreurs : paraphasies verbales sémantiques; circonlocutions vagues; non-réponses.	• Sous les normes; • Pouvant différer en modalité orale et écrite; • Types d'erreurs : → Lors de déficit à l'étape de sélection lexicale : paraphasies verbales sémantiques et formelles; circonlocutions précises. → Lors de déficit à l'étape d'encodage phonologique : circonlocutions précises/ non réponses; paraphasies phonémiques.	• Sous les normes; • Pouvant différer en modalité orale et écrite; • Types d'erreurs : variables et proportionnels à la contribution des composantes à la source de l'anomie.
Performance aux tâches évaluant le systéme sémantique	Sous les normes.	Dans les normes.	Sous les normes.
Effets des variables	Catégorie sémantique et familiarité.	Fréquence lexicale.	Catégorie sémantique, familiarité et la fréquence (effet variable selon la contribution des composantes à la source de l'anomie).
Effet de l'indiçage sémantique et phonologique	• Indiçage sémantique efficace, sauf lorsque la représentation sémantique est complètement dégradée; • Indiçage phonologique pouvant être efficace.	• Indiçage sémantique inefficace; • Indiçage phonologique souvent efficace.	• Efficacité variable de l'indiçage, selon la contribution des composantes à la source de l'anomie

Tableau 3

Erreurs observées lors de la passation d'un test de dénomination orale d'images

Types d'erreurs	Exemples	Présence dans les différentes origines possibles de l'anomie				
		Anomie sémantique	Anomie lexicale par blocage complet de l'accès au lexique	Anomie lexicale – accès aux lemmes	Anomie lexicale – accès aux lexèmes	
					Profil A	Profil B
Paraphasie verbale sémantique	Clou → Vis	Oui		Oui		
Circonlocution vague	Mouche → « C'est une bibitte, ça vole »	Oui				
Circonlocution précise	Marteau → « Outil qui sert à cogner des clous »		Oui	Oui	Oui	
Paraphasie verbale formelle	Mouche → Bouche			Oui		
Paraphasie phonémique	Vache → Vonche					Oui
Absence de réponse	Moto →	Oui	Oui		Oui	

Le cas de LN est un cas typique d'anomie d'origine lexicale-sémantique. Les résultats obtenus dans les tâches de production de mots ne peuvent entièrement être expliqués par l'atteinte sémantique relevée (c.-à-d. une atteinte sémantique légère dans un contexte d'anomie modérée-sévère et une anomie plus sévère en modalité orale qu'écrite). Par ailleurs, un effet de fréquence s'ajoute à celui de familiarité et l'indiçage phonologique apporte une aide considérable à LN. Dans ce cas, l'hypothèse d'une anomie lexicale-sémantique doit être privilégiée.

Dans le cas de LN, il importe que la rééducation de l'anomie à l'oral cible à la fois le réapprentissage ou la réactivation des connaissances sémantiques relatives aux concepts cibles en mémoire sémantique et le réapprentissage ou la réactivation des formes lexicales correspondantes dans le lexique de sortie (niveau lexical-phonologique). Un traitement efficace devrait alors combiner des indices sémantiques et phonologiques (Marshall et al., 1990; Raymer et Rothi, 2001). Par ailleurs, un groupe de chercheurs a récemment effectué une revue de littérature des articles ayant étudié la rééducation des anomies lexicales-sémantiques (Casarin et al., 2014). Bien qu'un grand nombre de combinaisons de différentes thérapies lexicales et sémantiques semblent, effectivement, entrainer une amélioration de l'anomie lexicale-sémantique chez les participants avec une aphasie post-AVC, les auteurs concluent que plus d'études sont nécessaires pour compléter les données probantes sur le sujet.

Conclusion générale

En conclusion, l'identification de l'origine fonctionnelle de l'anomie (c.-à-d. lexicale, sémantique ou lexicale-sémantique) permet de bien déterminer la cible de l'intervention orthophonique et de proposer à la personne souffrant d'anomie un traitement approprié et spécifique. Les traitements cognitifs de l'anomie, visant le réapprentissage ou la réactivation de mots/concepts pour lesquels la personne présente des difficultés, ont fait l'objet de plusieurs études dans la littérature scientifique (de Partz, 2016; Whitworth et al., 2014). Ne pas considérer l'origine fonctionnelle de l'anomie pourrait entrainer la mise en place d'une thérapie orthophonique non adaptée, qui pourrait s'avérer inefficace sans que l'orthophoniste ne puisse en expliquer les raisons. Ainsi, lorsque vient le temps de choisir le type de traitement qui sera offert à une personne, il est primordial de considérer l'origine de son anomie afin de déterminer l'approche thérapeutique la mieux adaptée, et ainsi, maximiser les gains potentiels. De surcroît, cette démarche de réflexion clinique est essentielle à l'établissement de la mesure de l'efficacité du traitement. En effet, alors qu'une généralisation des effets sur des mots non travaillés en thérapie est attendue dans le cas d'une anomie sémantique, des effets item-spécifiques sont plutôt anticipés lorsque l'anomie est d'origine lexicale.

Références

Azhar, A., Maqbool, S., Awais Butt, G., Iftikhar, S. et Iftikhar, G. (2017). Frequency of aphasia and its symptoms in stroke patients. *Journal of Speech Pathology & Therapy, 2*(1). http://doi.org/10.4172/2472-5005.1000121

Barry, C., Morrison, C. M. et Ellis, A. W. (1997). Naming the Snodgrass and Vanderwart Pictures: Effects of age of acquisition, frequency, and name agreement. *The Quarterly Journal of Experimental Psychology Section A, 50*(3), 560–585. http://doi.org/10.1080/783663595

Bell, B. D., Davies, K. G., Hermann, B. P. et Walters, G. (2000). Confrontation naming after anterior temporal lobectomy is related to age of acquisition of the object names. *Neuropsychologia, 38*(1), 83–92. http://doi.org/10.1016/s0028-3932(99)00047-0

Bose, A. et Buchanan, L. (2007). A cognitive and psycholinguistic investigation of neologisms. *Aphasiology, 21*(6–8), 726–738. http://doi.org/10.1080/02687030701192315

Boyle, M. (2004). Semantic feature analysis treatment for anomia in two fluent aphasia syndromes. *American Journal of Speech-Language Pathology, 13*(3), 236–249. http://doi.org/10.1044/1058-0360(2004/025)

Boyle, M. et Coelho, C. A. (1995). Application of semantic feature analysis as a treatment for aphasic dysnomia. *American Journal of Speech-Language Pathology, 4*(4), 94–98. http://doi.org/10.1044/1058-0360.0404.94

Burke, D. M. et Shafto, M. A. (2004). Aging and language production. *Current Directions in Psychological Science, 13*(1), 21–24. http://doi.org/10.1111/j.0963-7214.2004.01301006.x

Callahan, B. L., Macoir, J., Hudon, C., Bier, N., Chouinard, N., Cossette-Harvey, M., Daigle, N., Fradette, C., Gagnon, L. et Potvin, O. (2010). Normative data for the Pyramids and Palm Trees Test in the Quebec-French population. *Archives of Clinical Neuropsychology, 25*(3), 212–217. http://doi.org/10.1093/arclin/acq013

Caramazza, A. (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14*(1), 177–208. http://doi.org/10.1080/026432997381664

Casarin, F. S., Branco, L., Pereira, N., Kochhann, R., Gindri, G. et Fonseca, R. P. (2014). Rehabilitation of lexical and semantic communicative impairments: An overview of available approaches. *Dementia & Neuropsychologia, 8*(3), 266–277. http://doi.org/10.1590/S1980-57642014DN83000011

Coelho, C. A., McHugh, R. E. et Boyle, M. (2000). Semantic feature analysis as a treatment for aphasic dysnomia: A replication. *Aphasiology, 14*(2), 133–142. http://doi.org/10.1080/026870300401513

Cuetos, F., Monsalve, A. et Pérez, A. (2005). Determinants of lexical access in pure anomia. *Journal of Neurolinguistics, 18*(5), 383–399. http://doi.org/10.1016/J.JNEUROLING.2005.02.001

de Partz, M.-P. (2016). Traitements des troubles de la production orale des mots : composantes sémantique et lexicale. Dans X. Seron et M. Van der Linden (dir.), *Traité de neuropsychologie clinique de l'adulte. Revalidation.* (2e éd., vol. 2, p. 161–188). De Boeck Supérieur.

Forde, E. M. E., Francis, D., Riddoch, M. J., Rumiati, R. I. et Humphreys, G. W. (1997). On the links between visual knowledge and naming: A single case study of a patient with a category-specific impairment for living things. *Cognitive Neuropsychology, 14*(3), 403–458. http://doi.org/10.1080/026432997381538

Franklin, S., Buerk, F. et Howard, D. (2002). Generalised improvement in speech production for a subject with reproduction conduction aphasia. *Aphasiology, 16*(10–11), 1087–1114. http://doi.org/10.1080/02687030244000491

Goldrick, M. et Rapp, B. (2007). Lexical and post-lexical phonological representations in spoken production. *Cognition, 102*(2), 219–260. http://doi.org/10.1016/j.cognition.2005.12.010

Gonnerman, L. M., Andersen, E. S., Devlin, J. T., Kempler, D. et Seidenberg, M. S. (1997). Double dissociation of semantic categories in Alzheimer's disease. *Brain and Language, 57*(2), 254–279. http://doi.org/10.1006/brln.1997.1752

Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., Ogar, J. M., Rohrer, J. D., Black, S., Boeve, B. F., Manes, F., Dronkers, N. F., Vandenberghe, R., Rascovsky, K., Patterson, K., Miller, B. L. Knopman, D. S., Hodges, J. R., Mesulam, M. M. et Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology, 76*(11), 1006–1014. http://doi.org/10.1212/WNL.0b013e31821103e6

Hirsh, K. W. et Funnell, E. (1995). Those old, familiar things: Age of acquisition, familiarity and lexical access in progressive aphasia. *Journal of Neurolinguistics, 9*(1), 23–32. http://doi.org/10.1016/0911-6044(95)00003-8

Howard, D. et Patterson, K. (1992). *The Pyramids and Palm Trees Test: A test of semantic access from words and pictures.* Thames Valley Test Company.

Howard, D., Patterson, K., Franklin, S., Orchard-Lisle, V. et Morton, J. (1985). Treatment of word retrieval deficits in aphasia: A comparison of two therapy methods. *Brain, 108*(4), 817–829. http://doi.org/10.1093/brain/108.4.817

Kaplan, E., Goodglass, H. et Weintraub, S. (1983). *Boston Naming Test* (2e éd.). Lea & Febiger.

Kittredge, A. K., Dell, G. S., Verkuilen, J. et Schwartz, M. F. (2008). Where is the effect of frequency in word production? Insights from aphasic picture-naming errors. *Cognitive Neuropsychology, 25*(4), 463–492. http://doi.org/10.1080/02643290701674851

Lavoie, M., Bier, N., Laforce, R. Jr. et Macoir, J. (2020). Improvement in functional vocabulary and generalization to conversation following a self-administered treatment using a smart tablet in primary progressive aphasia. *Neuropsychological Rehabilitation, 30*(7), 1224-1254. http://doi.org/10.1080/09602011.2019.1570943

Leonard, C., Laird, L., Burianová, H., Graham, S., Grady, C., Simic. T. et Rochon, E. (2015). Behavioural and neural changes after a "choice" therapy for naming deficits in aphasia: Preliminary findings. *Aphasiology, 29*(4), 506–525. https://doi.org/10.1080/02687038.2014.971099

Leonard, C., Rochon, E. et Laird, L. (2008). Treating naming impairments in aphasia: Findings from a phonological components analysis treatment. *Aphasiology, 22*(9), 923–947. https://doi.org/10.1080/02687030701831474

Libon, D. J., Rascovsky, K., Powers, J., Irwin, D. J., Boller, A., Weinberg, D., McMillan, C. T. et Grossman, M. (2013). Comparative semantic profiles in semantic dementia and Alzheimer's disease. *Brain, 136*(8), 2497–2509. https://doi.org/10.1093/brain/awt165

Macoir, J., Beaudoin, C., Bluteau, J., Potvin, O. et Wilson, M. A. (2018). TDQ-60 – A color picture-naming test for adults and elderly people: Validation and normalization data. *Aging, Neuropsychology, and Cognition, 25*(5), 753–766. https://doi.org/10.1080/13825585.2017.1372355

Macoir, J., Chagnon, A., Hudon, C., Lavoie M. et Wilson, M. A. (2021). TDQ-30 – A new color picture-naming test for the diagnostic of mild anomia: Validation and normative data in Quebec French adults and elderly. *Archives of Clinical Neuropsychology, 36*(2), 267 –280. https://doi.org/10.1093/arclin/acz048

Macoir, J., Gauthier, C., Jean, C. et Potvin, O. (2016). BECLA, a new assessment battery for acquired deficits of language: Normative data from Quebec-French healthy younger and older adults. *Journal of the Neurological Sciences, 361*, 220–228. https://doi.org/10.1016/j.jns.2016.01.004

Macoir, J., Laforce, R. Jr., Monetta, L. et Wilson, M. (2014). Les troubles du langage dans les principales formes de démence et dans les aphasies primaires progressives : mise à jour à la lumière des nouveaux critères diagnostiques. *Gériatrie et Psychologie Neuropsychiatrie du Vieillissement, 12*(2), 199–208. https://doi.org/10.1684/pnv.2014.0466

Madden, E. B., Robinson, R. M. et Kendall, D. L. (2017). Phonological treatment approaches for spoken word production in aphasia. *Seminars in Speech and Language, 38*(1), 62–74. https://doi.org/10.1055/s-0036-1597258

Marcotte, K., Laird, L., Bitan, T., Meltzer, J. A., Graham, S. J., Leonard, C. et Rochon, E. (2018). Therapy-induced neuroplasticity in chronic aphasia after phonological component analysis: A matter of intensity. *Frontiers in Neurology, 9*, Article 225. https://doi.org/10.3389/fneur.2018.00225

Marshall, J., Pound, C., White-thomson, M. et Pring, T. (1990). The use of picture/word matching tasks to assist word retrieval in aphasic patients. *Aphasiology, 4*(2), 167–184. https://doi.org/10.1080/02687039008249068

Meteyard, L. et Patterson, K. (2009). The relation between content and structure in language production: An analysis of speech errors in semantic dementia. *Brain and Language, 110*(3), 121–134. https://doi.org/10.1016/j.bandl.2009.03.007

Miceli, G., Amitrano, A., Capasso, R. et Caramazza, A. (1996). The treatment of anomia resulting from output lexical damage: Analysis of two cases. *Brain and Language, 52*(1), 150–174. https://doi.org/10.1006/brln.1996.0008

Monetta, L., Légaré, A., Macoir, J. et Wilson, M. A. (2020). Questionnaire Sémantique de Québec (QueSQ). Développement, validation et normalisation. *La revue canadienne du vieillissement, 39*(1), 98–106. https://doi.org/10.1017/S0714980819000333

Moss, M. S., Nickels, L. A. et Sheard, C. (2004) Disentangling the web: Neologistic perseverative errors in jargon aphasia. *Neurocase, 10*(6), 452–461. https://doi.org/10.1080/13554790490894057

Nespoulous, J.-L., Lecours, A.-R., Lafond, D., Lemay, M.-A., Puel, M., Joanette, Y., Cot, F. et Rascol, A. (1992). *Protocole Montréal-Toulouse d'examen linguistique de l'aphasie: MT-86.* Ortho Edition.

Nickels, L. (2002). Therapy for naming disorders: Revisiting, revising, and reviewing. *Aphasiology, 16*(10–11), 935–979. https://doi.org/10.1080/02687030244000563

Pillon, A. (2014). L'évaluation des troubles de la production et de la compréhension des phrases. Dans X. Seron et M. Van der Linden (dir.), *Traité de neuropsychologie clinique de l'adulte. Évaluation*. (2e éd., vol. 1, p. 321–337). De Boeck Supérieur.

Raymer, A. M. et Rothi, L. J. G. (2001). Cognitive approaches to impairments of word comprehension and production. Dans R. Chapey (dir.), *Language intervention strategies in aphasia and related neurogenic communication disorders* (4e éd.). 524–550. Lippincott Williams & Wilkins.

Roberts, P. M. et Doucet, N. (2011). Performance of French-speaking Quebec adults on the Boston Naming Test. *Canadian Journal of Speech-Language Pathology and Audiology, 35*(3), 254–267.

Shallice, T. (1988). *From neuropsychology to mental structure.* Cambridge University Press.

Snodgrass, J. G. et Yuditsky, T. (1996). Naming times for the Snodgrass and Vanderwart pictures. *Behavior Research Methods, Instruments & Computers, 28*(4), 516–536. https://doi.org/10.3758/BF03200540

Thompson, G. L. et Desrochers, A. (2009). Corroborating biased indicators: Global and local agreement among objective and subjective estimates of printed word frequency. *Behavior Research Methods, 41*(2), 452–471. http://doi.org/10.3758/BRM.41.2.452

Thompson-Schill, S. L., Gabrieli, J. D. E. et Fleischman, D. A. (1999). Effects of structural similarity and name frequency on picture naming in Alzheimer's disease. *Journal of the International Neuropsychological Society, 5*(7), 659–667. https://doi.org/10.1017/S1355617799577084

Tsang, H.-L. et Lee, T. M. C. (2003). The effect of ageing on confrontational naming ability. *Archives of Clinical Neuropsychology, 18*(1), 81–89. https://doi.org/10.1016/S0887-6177(01)00184-6

Whitworth, A., Webster, J. et Howard, D. (2014). *A cognitive neuropsychological approach to assessment and intervention in aphasia. A clinician's guide* (2e éd.). Psychology Press.

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Speech-on-Speech Masking: Effect of Maskers with Different Degrees of Linguistic Information

Le masquage par la parole : l'effet de bruits masquants contenant différents degrés d'information linguistique

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Abstract

The current study measured speech recognition and subjective listening effort scores while systematically varying the amount of linguistic information in maskers. Linguistic information in the maskers was varied by (a) increasing the number of speakers in the speech babble maskers and (b) time-reversing them. In Experiment 1, we measured speech recognition performance (signal-to-noise ratios required for 50% accuracy of sentences) for 16 participants. The speech (sentences) recognition scores were obtained in 15 background conditions: speech babble maskers with 2 to 8 speakers (7 conditions), time-reversed babble maskers (7 conditions), and a speech-spectrum noise. For Experiment 2, another 15 participants rated the effort (7-point rating scale) required to understand sentences in the same maskers as Experiment 1. This was done at a signal-to-noise ratio of 0 dB. Results showed that fewer speakers in the babble maskers (a) caused the greatest masking effects and (b) required the greatest listening effort ratings. Speech babble maskers resulted in significantly higher masking effects than reverse babble maskers only for the 2- and 3-speaker babble conditions. However, the listening effort scores were substantially higher for the speech babble maskers than reverse babble maskers in most of the conditions. Results suggest that both magnitudes of masking and the listening effort scores are related to the linguistic information in the masker.

Abrégé

Dans la présente étude, les scores de reconnaissance de stimuli verbaux et d'effort à l'écoute ont été mesurés en variant systématiquement la quantité d'information linguistique contenue dans des bruits masquants. L'information contenue dans les bruits masquants a été modifiée en (a) augmentant le nombre d'interlocuteurs et (b) en inversant ces bruits. Dans l'expérience 1, les scores de reconnaissance de la parole (rapport signal-sur-bruit permettant de comprendre 50% des phrases) de 16 participants ont été mesurés. Ceux-ci ont été obtenus dans 15 environnements bruyants : 7 bruits de verbiage qui incluaient de 2 à 8 interlocuteurs, ces 7 mêmes bruits de verbiage inversés, de même qu'un bruit à spectre vocal. Dans l'expérience 2, 15 autres participants ont noté (sur une échelle de 7 points) l'effort qu'ils ont eu à déployer pour comprendre des phrases dans les mêmes 15 environnements bruyants. Pour cette deuxième expérience, le rapport signal-sur-bruit était de 0 dB. Les résultats ont montré qu'un bruit de verbiage qui inclut moins d'interlocuteurs (a) cause un effet masquant plus important et (b) génère des scores d'effort à l'écoute plus élevés. Les bruits de verbiage ont conduit à un effet masquant plus important que les bruits de verbiage inversés, et ce, seulement lorsqu'ils contenaient de 2 à 3 interlocuteurs. Toutefois, les scores d'effort à l'écoute étaient considérablement plus élevés pour les bruits de verbiage que pour les bruits de verbiage inversés, et ce, dans la majorité des environnements bruyants. Les résultats suggèrent que les scores de reconnaissance de stimuli verbaux et d'effort à l'écoute sont associés à la quantité d'information linguistique contenue dans un bruit masquant.

Speech perception is affected in different ways by different types of maskers depending on their spectral, temporal, linguistic, and/or energetic characteristics. Speech recognition is reportedly better in temporally modulated noise compared to steady-state noise due to "dip-listening" or "glimpsing" (Festen & Plomp, 1990; Jin & Nelson, 2006; Summers & Molis, 2004). Speech maskers are dynamic signals and provide multiple opportunities for listeners to glimpse (i.e., gaps between words and sentences or the presence of weak speech segments such as /f/ and /θ/, for example) the target speech signal. Yet, speech recognition is more challenging in the presence of speech backgrounds compared to non-speech backgrounds (Bronkhorst, 2000; Carhart et al., 1975; Hoen et al., 2007; Lu et al., 2016) because speech maskers cause perceptual confusions with the target speech due to their linguistic similarities. This excessive masking of speech by competing speech(es) is termed *informational masking* (Brungart, 2001; Brungart et al., 2001; Kidd et al., 2008). As speech maskers are highly variable in their linguistic content, the type and amount of linguistic confusions that these maskers create are also highly variable and random.

In a masking scenario, total masking is a sum of at least two major types of masking (Kidd & Colburn, 2017): energetic masking and informational masking. Energetic masking is associated with the physical attributes of the target and maskers. Informational masking, on the other hand, is caused by the uncertainty or confusability between the target and the masker (Hafter & Schlauch, 1989; Leek et al., 1991; Neff & Green, 1987). In speech-on-speech masking, informational masking is calculated as the difference in the magnitude of masking under a speech masker—often speech babbles with varying numbers of speakers—and a non-speech masker with identical spectral content (i.e., speech-spectrum noise [SSN] or modulated noise; Balakrishnan & Freyman, 2008; Bronkhorst, 2000; Brungart et al., 2013; Freyman et al., 2004). The reduction in speech recognition under speech maskers, compared to non-speech maskers, despite similar spectral characteristics of maskers, is often attributed to confusion with the linguistic information present in the speech maskers (Mattys et al., 2009; Rhebergen et al., 2005; Simpson & Cooke, 2005). These linguistic confusions are due to the acoustic phonetic information (Hoen et al., 2007) and/or the lexical semantic information (Brungart & Simpson, 2004) present in the target speech and babble masker.

The amount of informational masking in speech-on-speech masking depends on the amount of intelligible linguistic information in the masker (Simpson & Cooke, 2005). The intelligibility and linguistic information of the speech masker (speech babble) are inversely related to the number of simultaneous speakers in the babble (Rosen et al., 2013; Simpson & Cooke, 2005). Thus, the linguistic information in a babble masker is greatest when there are fewer simultaneous (usually less than four) speakers. Previous studies have confirmed this inverse relationship between the number of talkers in the babble and the magnitude of informational masking (i.e., Lu & Cooke, 2008; Simpson & Cooke, 2005).

Maskers which approximate the features of a babble can also cause greater masking effects than noise maskers. For example, a time-reversed babble masker lacks any lexical semantic information but still causes greater masking effects than an SSN. This is because the time-reversed babble has spectral and temporal features similar to that of the speech babble (Arai, 2010; Rhebergen et al., 2005). The excessive masking observed for the reverse babble maskers is thought to be because of (a) greater linguistic confusion and uncertainty due to the presence of acoustic phonetic information and (b) increased forward masking effects due to their unusual temporal envelope (Rhebergen et al., 2005). A time-reversed babble masker also provides excellent control in order to study the effects of intelligibility on informational masking.

Most of the work on informational masking has involved speech recognition tasks. Listening effort, a metric describing the difficulty and effort involved in comprehending speech, can also be used to measure informational masking (Rennies et al., 2019). Typically, a listener expends little energy to understand speech in a quiet environment. However, the addition of a competing signal places extra demands on the cognitive resources of a listener. Such a cognitive effort expended by a listener when parsing a target from a competing message is referred to as *listening effort* (Howard et al., 2010; Peelle, 2017; Pichora-Fuller et al., 2016). The Ease of Language Understanding model (Rönnberg et al., 2013) and the Framework for Understanding Effortful Listening model (Pichora-Fuller et al., 2016) describe, in detail, the interactions among speech comprehension, cognitive resources, and background noise. According to these models, a competing signal introduces a mismatch between the incoming signal—perhaps, due to distortion—and the long-term phonological/lexical representations at the level of the phonological loop, part of the working memory construct (see Baddeley, 2003, for a detailed review on the different components of working memory). Such distortions necessitate the allocation of additional cognitive resources for parsing the target speech from the background speech. Speech babble maskers with fewer talkers, and more linguistic information, result in a higher cognitive processing load compared to that of non-speech maskers (Koelewijn et al., 2012) and hence more listening effort is required for speech recognition.

Considerable differences in listening effort scores are reported in spite of similar recognition scores (Brungart et al., 2013). Increased listening effort can have negative consequences on sustained speech comprehension, perhaps due to listener fatigue (Gosselin & Gagné, 2010; Peelle, 2017). Therefore, listening effort has equal importance to speech recognition performance as a metric. Previous studies have mostly used speech recognition scores alone to estimate the effects of informational masking.

In our study, we intend to supplement the outcomes of speech recognition tasks with listening effort scores. We aim to systematically vary the amount of information in the masker and observe the effects of informational masking on two different, but related, metrics of speech perception: recognition and subjective listening effort rating (Rudner et al., 2012). The information in the maskers was altered by varying the number of speakers in the babbles and by time-reversing them. Comparing the performance among the babble maskers—with a varying number of talkers—helps in quantifying the change in lexical-semantic information of the masker. The time-reversed versions of these babble maskers help quantify the change in acoustic-phonetic information. These maskers can also help estimate the real-world difficulties faced by listeners. While the time-reversed babble maskers can simulate a non-native babble (sounds "speech-like" but does not have semantic information), the regular speech babble masker simulates the typical cocktail party scenario. We hypothesize that both increasing numbers of speakers in the babble maskers and their time-reversal will reduce the overall linguistic information contained in the masker. This results in lesser amounts of informational masking and, therefore, causes the tasks (speech recognition as well as listening effort rating) to become progressively easier.

Experiment 1: Speech Recognition Performance

Method

Participants

Sixteen participants (6 women, 10 men) aged 18 to 27 years (*M* = 24.1 years) volunteered for Experiment 1. All participants were native speakers of the Kannada language and had at least 12 years of formal education. Each participant had pure-tone air conduction hearing thresholds of 15 dB HL or better at octave frequencies between 250 and 8000 Hz. None of the participants had any history or complaints of otological or neurological problems. All participants signed informed consents before starting the testing. The Ethics Committee of the All India Institute of Speech and Hearing, Mysuru, reviewed and approved the research according to their bio-behavioural guidelines (Ref No: Ph.D/AUD-2/2016-17).

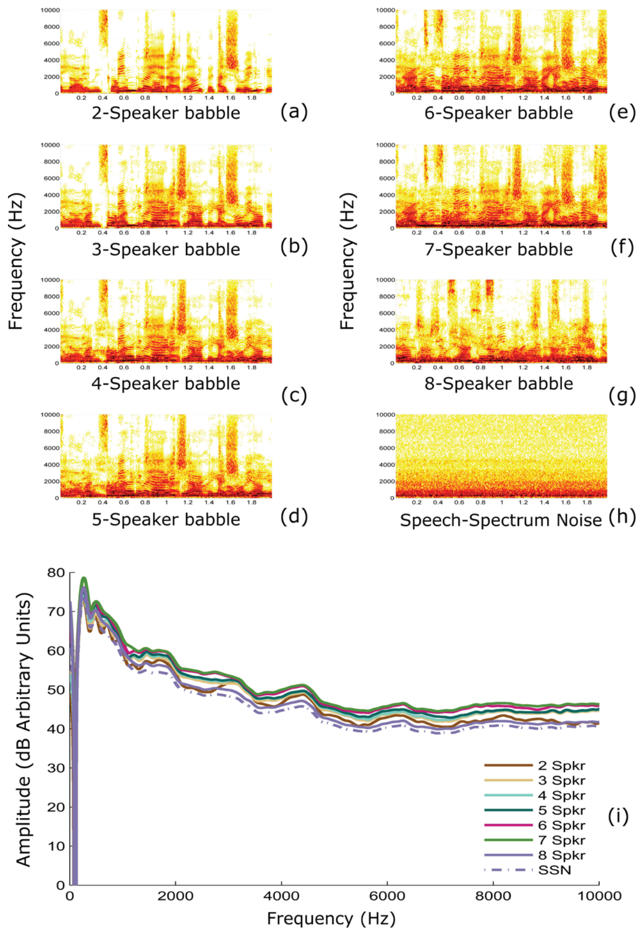
Stimuli

Target stimuli consisted of 15 phonemically balanced lists from the Kannada sentence identification test (Geetha et al., 2014). Each list included 10 low-predictability sentences spoken by a native female speaker of the Kannada language. Each sentence contained four keywords. All lists were matched for difficulty level. This meant that the signal-to-noise ratio (SNR) required for 50% accuracy (in the presence of SSN) was observed to be comparable (-5 dB) for all the lists (see Geetha et al., 2014, for further details regarding the generation and validity of the sentence lists). All lists were digitally stored in a computer with a 16-bit resolution and a sampling rate of 44100 Hz.

Three types of maskers were created for the study: speech babble maskers (SB), reversed babble maskers (RB), and a steady-state SSN. Eight female native speakers of Kannada read random sections in Kannada newspapers for 3.5 minutes. Speakers were instructed to read the passages in their regular speech rates, stress, and intonation patterns. The spoken samples were recorded using a Behringer B-2 Pro dual-diaphragm condenser microphone (Behringer, Germany) kept 5 cm from the speakers' mouth. The recordings were done using the Adobe Audition 3.0 software installed in a Lenovo-Z50 personal computer and connected to a Motu Microbook II external sound card interface. Spoken samples were recorded at a sampling frequency of 44100 Hz. Each individual recording was pruned for silent gaps of greater than 100ms. The pruned recordings were then amplitude (Root Mean Square) normalized. Two randomly chosen tracks were first mixed to obtain the 2-speaker babble. The 3-, 4-, 5-, 6-, 7-, and 8-speaker babble maskers were then created by successively adding randomly selected individual tracks to the previously mixed signal.

The RB maskers and the SSN were created from the previously generated SB maskers. Each of the seven SB maskers was temporally reversed to obtain the seven corresponding RB maskers. Finally, the SSN was created from the 8-speaker babble using a custom Matlab script (Gnanateja, 2016). The SSN had the same long-term average spectrum as the 8-speaker babble masker. Thus, there were 15 maskers for the experiments—seven speech babble maskers, seven reversed babble maskers, and the SSN masker. **Figure 1** depicts the spectra and the spectrograms of the different maskers used in the current study. **Figure 1** shows similar spectral compositions for all maskers.

Figure 1



Panels (a) through (g) represent the spectrograms of the 2-speaker to 8-speaker speech babble maskers for a 2-second section. The reverse babble maskers are not represented separately as they have identical spectrograms as the speech babble maskers, albeit reversed in time. With an increase in the number of speakers from panel (a) to (g), the salience of the spectral and formant information progressively decreases. Panel (h) represents the spectrogram of the speech-spectrum noise masker. Panel (i) shows the average long-term speech spectra of all the masker conditions considered for the study. Spkr = Speaker, SSN = Speech-Spectrum Noise.

Procedure

The experiments were carried out in a sound-treated room with ambient noise levels acceptable according to standards (American National Standard Institute, 2003). All target stimuli (sentences) were presented binaurally at 70 dB SPL. Stimuli were presented using a Lenovo-Z50 personal computer connected to Sennheiser HD 380 pro (Wedemark, Germany) headphones. The SNR required for achieving 50% correct identification (referred to as SNR-50 henceforth) of the speech stimuli was obtained for each participant, across all the 15 maskers. A separate sentence list was used to calculate SNR-50 for each of the 15 noise conditions. Each sentence had four keywords, resulting in 40 keywords per list. The SNR in each list was reduced from +10 to -8 dB across the 10 sentences in 2 dB steps. The SNR was manipulated by increasing the masker levels in 2 dB steps from 60 dB SPL to 78 dB SPL while keeping the target (sentence) level constant at 70 dB SPL. The masker began 0.5 s before the onset of each sentence and remained 0.5 s after the offset of the sentence. The mixing of the maskers with the sentences was done using custom Matlab scripts (Gnanateja, 2012). The mixing was done such that each target sentence was mixed with a random section within the masker. Also, a particular list was pre-selected to be mixed with a particular masker, thus yielding 15 lists, each mixed with a different masker. Further, the selection order of these 15 lists, as well as the order of presentation of the 10 sentences within each of these lists, was pseudo-randomized to minimize order effects.

We instructed participants to repeat the whole target sentence verbatim and to guess the possible words when the SNR of the presented speech was difficult. The total number of correctly identified keywords was noted for each list. The SNR-50 was calculated for each list using the Spearman-Karber equation (Finney, 1952; Tillman & Olsen, 1973),

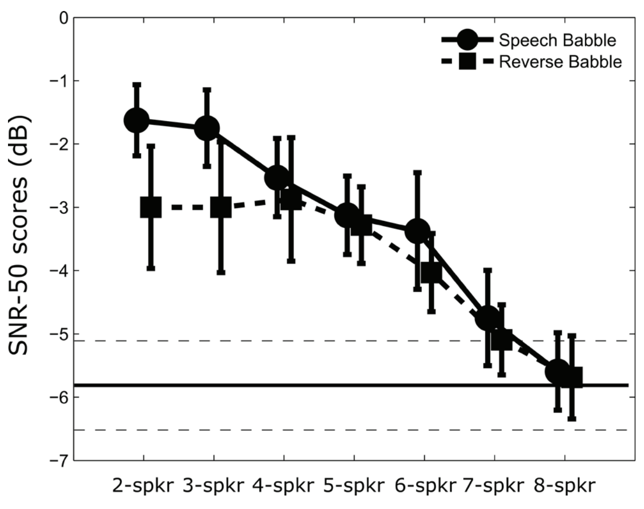
$$\text{SNR-50} = i + 1/2(d) - [(d)(\#\text{correct}) / (W)]$$

where *i* is the initial presentation level (+10 dB), *d* is the decrement step size (2 dB), *W* is keywords per decrement (4 in this case), and *#correct* is the total number of correct keywords repeated by the participants. This formula is designed to obtain the statistical 50% point in various biological and medical experiments and was hence suggested as a method to measure spondee thresholds (Tillman & Olsen, 1973). Because there were 15 masked conditions, the Spearman-Karber equation helped in calculating the speech recognition thresholds (i.e., the SNR-50 scores) quickly.

Results

We used JASP (Version 0.7.5.6; JASP Team, 2016) to carry out all statistical analyses. **Figure 2** shows the means and standard deviations of the SNR-50 scores for the different masker conditions. The figure shows a general tendency for the SNR-50 scores to improve when the number of speakers in the masker was increased for both the SB and RB masker conditions. A two-way 2 (Masker Type: SB & RB) X 7 (Number of Speakers in the Babble: 2 to 8) repeated-measures Analysis of Variance (RM-ANOVA) was performed on the data. The RM-ANOVA (corrected for violations of sphericity assumptions using Greenhouse-Geisser correction wherever necessary) revealed significant main effects of the masker types, $F(1, 15) = 35.60$, $p < .001$, $\eta_p^2 = .70$, and number of speakers, $F(4.16, 62.40) = 77.12$, $p < .001$, $\eta_p^2 = .88$, and a significant interaction between the masker types and the number of speakers, $F(3.77, 56.60) = 3.41$, $p < .001$, $\eta_p^2 = .27$. Further, to test for effects of the number of speakers on SNR-50 within the two maskers (SBs and RBs), a one-way RM-ANOVA was performed among the 2- to 8-speaker babble conditions. Additionally, the SSN condition was included in the ANOVA models. Therefore, each one-way RM-ANOVA compared scores across eight conditions (seven babble conditions plus the SSN condition).

Figure 2



Means and standard deviations of the SNR-50 (signal-to-noise) scores across the different masker conditions (number of speakers in the babble). The circles represent the SNR-50 scores for the speech babble maskers, the squares for the reverse babble maskers. The solid line at the bottom indicates the mean SNR-50 scores for the speech-spectrum noise masker, and the dashed lines show the standard deviations for the same. Spkr = Speaker.

The one-way RM-ANOVA revealed a significant main effect of the number of speakers for both the SB, $F(3.98, 59.83) = 122.0$, $p < .001$, $\eta_p^2 = .89$, and RB masker conditions, $F(4.01, 60.07) = 50.67$, $p < .001$, $\eta_p^2 = .77$. **Table 1** shows the follow-up posthoc pairwise comparisons (adjusted for multiple comparisons using Bonferroni's correction). SNR-50 scores in the presence of 2- and 3-speaker SB maskers were significantly poorer compared to all other conditions. There were no significant differences in the SNR-50 scores among the 4- through 6-speaker SB masker conditions. The 7- and 8-speaker SB maskers resulted in significantly better SNR-50 scores than the other SB maskers. However, there were no statistically significant differences in SNR-50 scores between the 7- and 8-speaker SB masker conditions and SSN masker condition. For the RB maskers, the 2- through 6-speaker conditions resulted in similar masking effects. SNR-50 scores in the 7- and 8-speaker masker conditions were significantly better than in the 2- to 6-speaker RB conditions. Additionally, there were no statistically significant differences in the SNR-50 scores between the 7- and 8-speaker babble conditions and the SSN.

We also compared the corresponding individual speaker condition pairs across the SB and RB maskers. Paired samples *t* tests revealed SNR-50 scores for 2-speaker, $t(14) = 5.21$, $p < .001$, and 3-speaker, $t(14) = 5.09$, $p < .001$, RB masker conditions to be significantly better than the corresponding SB masker conditions. Apart from these, all other paired comparisons revealed no significant differences.

Overall, Experiment 1 showed that the masking effect was highest when the number of speakers in the babble masker was less than four. The SB maskers caused significantly greater masking effects than the RB maskers for the 2- and 3-speaker conditions. The SNR-50 scores were comparable for both babble masker types when the numbers of speakers in the babble were between four and eight. The SSN caused significantly lesser masking effects than the babble maskers, except the 7- and 8-speaker conditions.

Experiment 2: Listening Effort Rating

Results of Experiment 1 showed that speech recognition performance was modulated by the type of masker and the number of speakers in the masker. SNR-50 scores differed significantly between the low (2- or 3-speaker) and high (7- or 8-speaker) number of speaker conditions. Also, performances under the RB maskers did not show significant differences until the 6-speaker condition. There were also no significant differences between the SB and RB masker conditions from the 4-speaker condition and above. However, despite comparable performances on the speech recognition task, it is possible that the effort expended to achieve similar performances could be different (Brungart et al., 2013). Listening effort can be a particularly useful metric, especially when recognition performances reach saturation levels (Gagné et al., 2017; Rennies et al., 2014). Furthermore, listening effort rating scores are indicated to be more influenced by working memory compared to speech recognition performance (Rudner et al., 2012). This points towards subjective ratings and speech recognition having different but complementary psychophysiological mechanisms.

Table 1

Test Statistic Value, Statistical Significance, and Effect Size of the Posthoc Pair-Wise Comparisons for the SNR-50 Scores Across the Masker Conditions

Comparisons		Speech babble			Reverse babble		
		t	*p*	Cohen's *d*	*t*	*p*	Cohen's *d*
2 speaker	3 speaker	0.75	1.000	0.19	0.00	1.000	0.00
	4 speaker	4.42	.014	1.10	-0.43	1.000	-0.11
	5 speaker	8.78	< .001	2.20	1.15	1.000	0.29
	6 speaker	7.83	< .001	1.96	5.57	.002	1.39
	7 speaker	15.92	< .001	3.98	8.21	< .001	2.05
	8 speaker	19.71	< .001	4.93	8.79	< .001	2.20
	SSN	18.04	< .001	4.51	9.76	< .001	2.44
3 speaker	4 speaker	6.48	< .001	1.62	-0.36	1.000	-0.09
	5 speaker	8.20	< .001	2.05	1.09	1.000	0.27
	6 speaker	6.24	< .001	1.56	3.64	.087	0.91
	7 speaker	14.01	< .001	3.50	8.08	< .001	2.02
	8 speaker	20.01	< .001	5.00	9.21	< .001	2.30
	SSN	17.50	< .001	4.37	8.91	< .001	2.23
4 speaker	5 speaker	3.72	.057	0.93	1.40	1.000	0.35
	6 speaker	3.45	.100	0.86	4.65	.011	1.16
	7 speaker	9.93	< .001	2.48	9.54	< .001	2.39
	8 speaker	15.44	< .001	3.86	9.30	< .001	2.33
	SSN	15.00	< .001	3.75	10.75	< .001	2.69
5 speaker	6 speaker	1.46	1.000	0.37	3.77	.067	0.94
	7 speaker	7.68	< .001	1.92	11.07	< .001	2.77
	8 speaker	15.32	< .001	3.82	12.35	< .001	3.09
	SSN	13.55	< .001	3.39	12.26	< .001	3.06
6 speaker	7 speaker	4.99	.005	1.25	5.51	.002	1.38
	8 speaker	9.36	< .001	2.34	6.66	< .001	1.66
	SSN	10.50	< .001	2.63	6.90	< .001	1.73
7 speaker	8 speaker	3.18	.173	0.80	4.84	.008	1.21
	SSN	3.60	.074	0.90	5.26	.003	1.32
8 speaker	SSN	2.78	.391	0.70	1.17	1.000	0.29

Note. Significance value adjusted for multiple comparisons using Bonferroni's correction. The comparisons are made across the maskers with different number of speakers. SNR = signal-to-noise; SSN = speech-spectrum noise.

Therefore, we hypothesized that during the sentence recognition task of Experiment 1, different maskers could require different listening effort scores even when the SNR-50 scores are comparable. To test this hypothesis, and to supplement the results of Experiment 1, we measured the subjective efforts involved in listening to sentences under each of the masker conditions as used in Experiment 1. This was done by measuring the subjectively rated listening effort using the same sentences and maskers used in Experiment 1. Thus, the results can be easily interpreted in line with these results of Experiment 1. Furthermore, we also ensured that there was complete intelligibility of all the sentences used for the listening effort task. Subjective ratings are a valid and sensitive approach to observe the difficulties and effort involved in a listening task (Johnson et al., 2015; Letowski & Scharine, 2017). This is also ecologically valid, as listening difficulty contributes to long-term comprehension and operator fatigue faced under different masker conditions.

Method

Participants

Fifteen participants aged 20 to 29 years (*M* = 24 years), all of whom were not a part of Experiment 1, volunteered for Experiment 2. A different set of participants was chosen to avoid habituation or familiarity effects. Familiarity effects were expected in the second experiment because we used the same target sentences as were used in Experiment 1. Inclusion criteria were identical to those used in Experiment 1. All participants signed informed consent forms according to the bio-behavioural guidelines of the All India Institute of Speech and Hearing, Mysore.

Stimuli

The same 15 lists used in Experiment 1 were chosen for this experiment as well. Three target sentences, randomly chosen from each list, were selected for each of the masker conditions to ensure that the participants had enough samples to judge the listening effort. Participants listened to the sentences mixed in SB maskers (2- to 8-speakers), RB maskers (2- to 8-speakers), and SSN at 0 dB SNRs. The choice of the 0 dB SNR, instead of SNR-50, was based on the results from the first experiment and a pilot study where we observed that at 0 dB SNR, all the participants had 100% correct identification of sentences across all the masker conditions. The SNR corresponding to SNR-50 was not chosen because the audibility and intelligibility of the target sentences are compromised (only 50%). The SNR of 0 dB ensured complete audibility of the target sentences across all masker conditions, and the only variable that was varied was the information in the maskers. The sentences were presented in a pseudo-random order at the same intensity (70 dB SPL) as in the previous experiment.

Procedure

In a sound-proofed room, all participants were asked to listen to the sentences in the presence of the different maskers and rate the effort involved in understanding the target sentences. Experiment 2 was done on all participants on a different day. All participants were first given three to five practice sentences to gain familiarity with the task and rating scales. The sentences used for the practice trials were different from the ones used in the actual experiment. The rating was similar to the 7-point scale used by Krueger et al. (2017). Each of the seven categories was also assigned a number as in the Krueger et al. study. A *no effort* rating was given 1, *very little effort* was given 3, *little effort* was given 5, *moderate effort* was given 7, *considerable effort* was given 9, *significant effort* was given 11, and *extreme effort* was given 13. These numbers were not visible to the listeners and were used only for analysis.

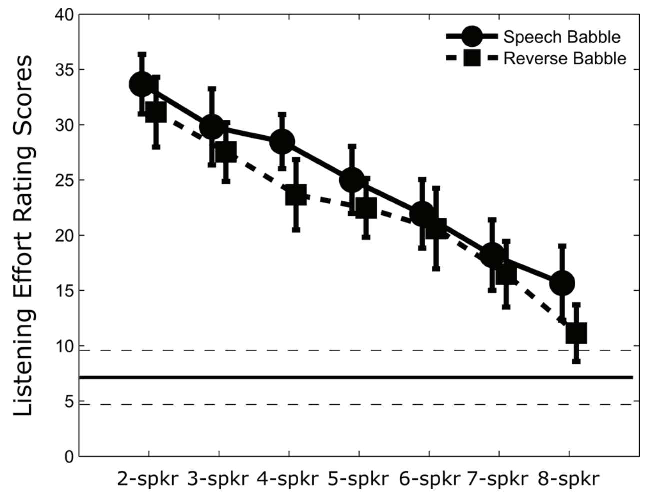
Once familiar with the procedure, each of the 45 sentence tokens was presented in a pseudo-random order, and the participants were asked to rate the effort required to perceive the target sentences. However, they were not required to repeat the sentences as it was already ensured that all stimuli had 100% identification at the SNR chosen. Once all stimuli were rated, the scores of the three sentences of each masker condition were added up to get a single *effort score* for each of the masker conditions.

Results

The statistical analyses were similar to those reported in Experiment 1. **Figure 3** shows the means and standard deviations of the listening effort rating scores across the different masker conditions. The rating scores, similar to the speech recognition scores of Experiment 1, showed a clear trend of decreasing listening effort with increasing number of speakers for both SB and RB conditions. The SSN required less effort than the two types of babble maskers. A two-way 2 (Masker Type: SB and RB) X 7 (Number of Speakers) RM-ANOVA was performed. The RM-ANOVA showed a significant main effect of both masker type, $F(1, 14) = 43.70$, $p < .001$, $\eta_p^2 = .76$, and number of speakers, $F(2.03, 28.51) = 168.26$, $p < .001$, $\eta_p^2 = .92$, on listening effort as well as a significant interaction between the two, $F(6, 84) = 3.59$, $p = .003$, $\eta_p^2 = .20$.

Further, separate one-way RM-ANOVAs were carried out on the seven speaker conditions within both SB and RB masker types. The SSN condition was also included in the ANOVA models. One-way RM-ANOVAs (corrected for violations of sphericity assumptions, wherever necessary) revealed significant main effects of the number of speakers for both the SB maskers, $F(2.64, 37.05) = 183.30$, $p < .001$, $\eta_p^2 = .93$, and RB maskers, $F(3.26, 45.64) = 153.20$, $p < .001$, $\eta_p^2 = .92$. Additional pairwise comparisons (adjusted for multiple comparisons using Bonferroni's correction) for each masker condition (SB or RB), showed that the babble maskers with fewer speakers required significantly greater effort than babble maskers with more speakers. All comparisons were significant ($p < .05$) except for those between the 3- and 4-speaker SB masker conditions. Similarly, in the RB masker conditions, significantly greater efforts were required for maskers with fewer speakers than for those with more speakers. This was true for most comparisons except for those between 4- vs. 5-speaker ($p = 1$), 5- vs. 6-speaker ($p = .216$), and 4- vs. 6-speaker ($p = .311$) conditions. **Table 2** summarizes the pairwise comparisons for both SB and RB maskers, including the SSN.

Figure 3



Means and standard deviations of the listening effort rating scores across the different masker conditions (number of speakers in the babble). The circles represent the effort scores for the speech babble maskers, the squares for the reverse babble maskers. The solid line at the bottom indicates the mean listening effort rating scores for the speech-spectrum noise masker, and the dashed lines show the standard deviations for the same. Spkr = Speaker.

We also compared the listening effort ratings between the corresponding number-of-speaker conditions between the SB and RB maskers. Paired samples *t* tests for the corresponding speaker conditions revealed significant differences (SB maskers required greater effort than RB maskers) between the listening effort when listening to the SB and RB maskers for all conditions ($p < .05$) except the comparisons for the 6-speaker ($p = .136$) and 7-speaker ($p = .072$) conditions.

Overall, the results from Experiment 2 suggest that the listening effort rating was influenced by the amount of linguistic information prevalent in the masker. Greater efforts were needed when there were fewer speakers in the masker. This was true for both SB and RB maskers. Most often, SB maskers required greater listening effort than RB maskers. The SSN masker was rated as requiring the least effort.

Discussion

The present study reports two experiments that measure the effect of linguistic content in a masker on the (a) sentence recognition accuracy and (b) listening effort involved in the perception of those sentences. The amount of linguistic information in a masker was varied by increasing the number of speakers in the masker (from two to eight) as well as by time reversal. A steady-state SSN masker, with nearly identical spectral information as that of the 8-speaker SB masker, was also considered as the control (energetic) masker condition.

Speech Recognition Performance Under Different Maskers

In Experiment 1, SNR-50 scores improved as a function of the number of speakers in the masker for both SB and RB maskers. SNR-50 scores became similar to that of the SSN when the number of speakers in the babble maskers reached eight. Other investigators have also reported improvements in speech recognition scores when the number of speakers in the babble increase (Boulenger et al., 2010; Hoen et al., 2007; Van Engen & Bradlow, 2007). When there are fewer speakers in the masker, the masker contains more recognizable linguistic information (phoneme identity and lexical items). This results in greater competition for attention between the target speech and babble masker. Because of the higher competition for the "limited" amount of attention resources, the SNR-50 scores are likely to be affected. Increasing the number of speakers results in an acoustically dense background, thus reducing the access to the linguistic information from the background (particularly the lexical-semantic information).

Results also showed that SB maskers with two and three speakers caused significantly higher masking (approximately 1.5 dB of SNR loss) compared to the corresponding RB maskers. The poorer performance in the SB masker condition is likely due to the additional presence of lexical-semantic information, despite similar spectral information (see **Figure 1**). Freyman et al. (2001) also reported significantly lesser masking effects by the time-reversed babble. In a prose recall task, Bell et al. (2008) further suggested that the amount of disruption depended on the semantic properties contained in the irrelevant

Table 2

Test Statistic Value, Statistical Significance, and Effect Size of the Posthoc Pair-Wise Comparisons for the Listening Effort Rating Scores Across the Different Masker Conditions

Comparisons		Speech babble			Reverse babble		
		t	*p*	Cohen's *d*	*t*	*p*	Cohen's *d*
2 speaker	3 speaker	6.12	< .001	1.58	5.08	.005	1.31
	4 speaker	7.45	< .001	1.92	10.43	< .001	2.69
	5 speaker	9.13	< .001	2.36	8.77	< .001	2.26
	6 speaker	11.82	< .001	3.05	9.19	< .001	2.37
	7 speaker	13.70	< .001	3.54	12.08	< .001	3.12
	8 speaker	14.77	< .001	3.81	19.72	< .001	5.09
	SSN	22.51	< .001	5.81	20.22	< .001	5.22
3 speaker	4 speaker	1.54	1.000	0.40	8.47	< .001	2.19
	5 speaker	4.58	.015	1.18	6.14	< .001	1.59
	6 speaker	6.87	< .001	1.77	5.93	.001	1.53
	7 speaker	10.16	< .001	2.62	9.74	< .001	2.52
	8 speaker	10.09	< .001	2.61	17.08	< .001	4.41
	SSN	17.00	< .001	4.39	20.82	< .001	5.38
4 speaker	5 speaker	7.60	< .001	1.96	1.66	1.000	0.43
	6 speaker	13.16	< .001	3.34	2.92	.311	0.76
	7 speaker	15.27	< .001	3.94	6.76	< .001	1.75
	8 speaker	17.05	< .001	4.40	12.98	< .001	3.35
	SSN	22.01	< .001	5.68	15.88	< .001	4.10
5 speaker	6 speaker	9.28	< .001	2.40	3.11	.216	0.80
	7 speaker	11.74	< .001	3.03	9.72	< .001	2.51
	8 speaker	16.24	< .001	4.19	15.71	< .001	4.06
	SSN	18.14	< .001	4.68	15.51	< .001	4.00
6 speaker	7 speaker	7.90	< .001	2.04	6.00	.001	1.55
	8 speaker	14.55	< .001	3.76	10.99	< .001	2.84
	SSN	15.54	< .001	4.01	11.59	< .001	2.99
7 speaker	8 speaker	4.01	.046	1.04	8.79	< .001	2.27
	SSN	12.13	< .001	3.13	10.52	< .001	2.72
8 speaker	SSN	8.84	< .001	2.282	5.68	.002	1.47

Note. Significance value adjusted for multiple comparisons using Bonferroni's correction. The comparisons are made across the maskers with different number of speakers. SSN = speech-spectrum noise.

speech. The SB maskers cause informational masking at both phonetic as well as lexical levels, whereas the RB maskers only cause informational masking via their phonetic information (Rhebergen et al., 2005). Hence, the lexical-semantic information of the SB maskers (2- and 3-speaker conditions) causes the additional 1.5 dB of masking.

Interestingly, in our study, speech recognition scores were quite similar across the two babble maskers when the number of speakers in the babble was four and above. This effect appears to be similar for both SB and RB maskers. Hence both the SB and RB maskers result in similar masking effects above the 4-speaker condition. Further, any residual effects of the lexical-semantic information available in the SB maskers seem to be offset by the unusual nature of the RB masker along with their excessive forward masking effects. However, it should be noted that the effort involved in performing the tasks under the 4- to 8-speaker conditions are not necessarily similar.

Another interesting finding from the study is that the speech recognition performances with 7- and 8-speaker conditions, for both RB and SB maskers, were like that of the SSN condition (see Figure 2). This indicates that as the number of speakers in the masker approaches eight, the salience of both semantic and phonetic information in the acoustically dense babbles reduce. Hence, there is minimal additional masking present, and the nature of the masking effect observed is predominantly energetic. However, other studies do show that with eight speakers or even slightly higher numbers of speakers in the babble, the performance does not reach the level of noise masker. Simpson and Cooke (2005) showed that consonant identification does not reach the levels of noise (only energetic masking) until the babble had at least 16 speakers. Although we did observe that the listening effort was significantly lower for the SSN maskers compared to the 8-speaker conditions of both SB and RB maskers, this finding needs to be studied in further detail.

Listening Effort Rating Under Different Maskers

Experiment 2 examined the effort required to listen to sentences presented in the 15 masker backgrounds. Similar to the results of Experiment 1, the maskers with fewer speakers required greater listening effort. Also, listening in the presence of SB maskers was significantly more effortful than the RB masker. The results of Experiment 2, therefore, supplement the results of Experiment 1.

A competing/irrelevant signal causes listeners to employ extra effort in perceiving the target signals (Baddeley, 2000; Ellermeier et al., 2015; Ellermeier & Zimmer, 2014; Li et al., 2004; Neath, 2000; Schneider et al., 2007). Our results showed that when the audibility and intelligibility of the target sentences were accounted for, the listening effort was significantly greater for the maskers with fewer speakers than in speaker conditions with a higher number of speakers. This indicates that the listening effort is positively related to the overall linguistic information present in the maskers.

Similar to the results of Experiment 1, Experiment 2 showed that the 2- and 3-speaker SB conditions were the most difficult with the 2-speaker SB being rated as the most effortful condition to perceive. Also, SB maskers required significantly greater listening effort than RB maskers. As explained earlier, the 2- and 3-speaker SB maskers contain robust lexical-semantic information. These meaningful, yet irrelevant, sentences often distort the target at the level of the phonological store of the working memory system. Our previous study (see Basavanahalli Jagadeesh & Kumar, 2019) further reinforces these assumptions. Therefore, significantly greater effort needs to be expended in parsing the target sentence from the background. Additionally, studies have shown that an irrelevant and dynamic background, like speech, with clear audibility and meaning, causes a switch in attention away from the target sound (Neath, 2000). Greater effort, therefore, will also be required to bring the focus back to the target signal.

In Experiment 2, there were significant differences in the listening effort rating scores between the 7- and 8-speaker conditions as well as the SSN. This indicates that even though the SNR-50 scores were similar across the SSNs and the 7- and 8-speaker conditions, the effort required in successfully performing the tasks varied significantly. This points towards the complementary nature of the two metrics. It also appears that the SNR-50 reveals the gross differences between the different masker conditions, while the listening effort reveals the subtler differences between the maskers. Variations in listening effort despite comparable performances in the speech perception tasks have already been demonstrated (Sarampalis et al., 2009). Two possible assumptions could explain this result. It is likely that the 7- and 8-speaker conditions still contain small but noticeable amounts of linguistic information in them. While this may not be enough to cause reductions in speech perception performance, it is still more effortful (or possibly annoying) to parse the targets from the background.

Further, the presence of slightly more evident modulations in the babble maskers (compared to noise) could cause greater modulation masking than the noise maskers. *Modulation masking* refers to the masking that occurs due to the inherent modulations present in the maskers (Stone & Canavan, 2016; Stone et al., 2012; Stone & Moore, 2002). In contrast to the concept of *dip-listening* where the presence of modulations in the masker leads to better speech perception, modulation masking results in a reduction in speech recognition performance because of the modulations present in the noises. The presence of spurious modulations in the noise can cause greater masking effects than a steady noise. We hypothesize that since these spurious modulations are more robust in the 8-speaker maskers than the SSN, it is likely to cause greater masking effects.

Other Factors That Contribute to Informational Masking

Multiple factors, other than the linguistics of the target and masker, also contribute to speech-on-speech masking. These include onset-related cues, spatial separation, the perceptual similarity between the target and maskers (gender and/or fundamental frequency), intensity of the two competing speech signals, and attention (Bregman, 2009). When the target and masker have significant overlap with respect to these factors, the masking effect will be more substantial.

However, we believe that we have accounted for most of these factors in our choice of stimuli and methodology. We accounted for any effects of spatial cues by presenting both the target and masker diotically. Gender and fundamental frequency related cues were accounted for, to a certain degree, as both the stimuli and the maskers were spoken by young adult women. Dialectal or accent-related variations were also largely controlled since such differences are shown to aid in more effective parsing of the target stimulus (Freyman et al., 2001). Stimulus (target) onset cues were also largely controlled by ensuring that the onset of the target was 0.5 s after the onset of the masker. The maskers themselves were selected from different random sections of the different babble maskers for each sentence, further reducing any possible onset related cues. We have also discussed the potential role of attention while explaining the confusions expected while parsing target and stimulus in a low-speaker babble condition.

A complex element associated with speech-on-speech masking, however, is the possibility of dip listening. Dip listening refers to the glimpsing of target signals during the momentary drops in the maskers' levels (Miller & Licklider, 1950). When the masker contains only two speakers (2SB or 2RB), the occurrences of dips in the maskers are more. This should, theoretically, lead to greater chances for the target stimuli to be heard and processed. Yet, the 2SB masker condition suffered the greatest deteriorations, both with respect to speech perception and listening effort. Rennies et al. (2019) further supposed that, despite the extra information available during these glimpses, it takes significantly greater effort to reassemble the target from the glimpses into a stream of coherent speech.

Another perspective of the same glimpsing phenomenon, however, could be related to the presence of glimpses in the target sentences themselves. Dips in the target sentences can lead to a clearer perception of the babble maskers. The perception of the babble, in turn, leads to greater masking effects. Additionally, as soon as the babble masker's speech is detected, the central executive of the working memory system is likely to immediately shift attention to the babble in an attempt to make sense of the information in the babble. Again, if the masker has significant lexical-semantic information, the attention is likely to be sustained longer on the babble maskers than when the babble maskers have no semantic information (Vachon et al., 2017). This counteracting effect of dips in the babble maskers and the target sentences do not appear to cancel each other. Evidently, the possible benefits of dip-listening are more than offset by the significant informational masking that is created in such a linguistically confusing listening scenario.

The glimpsing phenomenon is also pertinent in the conditions where the number of speakers in the maskers is high. The higher number of speakers in the babble maskers tend to fill in the dips, causing greater energetic masking (Freyman et al., 2004). However, it appears that increased energetic masking does not compensate for the loss of linguistic information in the masker. Brungart (2001) also argued that, overall, the informational masking tends to dominate the energetic masking in the overall masking effect. While we acknowledge the contribution of the other factors to the speech-on-speech masking scenario, it seems that the contribution of the informational component to the overall masking is significantly greater than the energetic component.

Conclusion

The results of our study show that the amount of informational masking was related to the robustness of the linguistic information present in the maskers. Varying the linguistic information in the maskers manifested as an increase in the listening effort as well as a reduction in performance in the sentence recognition task. Greatest masking effects and listening efforts were observed for babble maskers with fewer speakers while the SSN elicited the least masking effects and listening effort scores. We also recognize that factors other than just the linguistic information contribute to the overall masking. Furthermore, the use of ecologically valid maskers such as the speech babble and the time-reversed babble could give a realistic idea of the problems faced by listeners with compromised auditory functions (e.g., ageing and/or hearing loss) in identifying speech in the background of speech. However, the interpretation of any speech perception task could depend on the type of target stimuli used. Hence, future research directed towards understanding informational masking effects for different types of stimuli is essential and necessary. Furthermore, we recommend the use of the babble maskers (both forward and reversed) in clinical settings along with the noise maskers to better simulate the problems faced by listeners, particularly the elderly and hearing impaired, in their daily lives.

References

American National Standard Institute. (2003). *Maximum permissible ambient noise levels for audiometric test rooms* (Rev. ed). (ANSI S3.1-1999).

Arai, T. (2010). Masking speech with its time-reversed signal. *Acoustical Science and Technology, 31*(2), 188–190. https://doi.org/10.1250/ast.31.188

Baddeley, A. D. (2000). The phonological loop and the irrelevant speech effect: Some comments on Neath (2000). *Psychonomic Bulletin and Review, 7*(3), 544–549. https://doi.org/10.3758/BF03214369

Baddeley, A. D. (2003). Working memory and language: An overview. *Journal of Communication Disorders, 36*(3), 189–208. https://doi.org/10.1016/S0021-9924(03)00019-4

Balakrishnan, U., & Freyman, R. L. (2008). Speech detection in spatial and nonspatial speech maskers. *The Journal of the Acoustical Society of America, 123*(5), 2680–2691. https://doi.org/10.1121/1.2902176

Basavanahalli Jagadeesh, A., & Kumar, A. U. (2019). Effect of informational masking on auditory working memory: Role of linguistic information in the maskers. *Hearing, Balance and Communication, 17*(4), 270–279. https://doi.org/10.1080/21695717.2019.1630980

Bell, R., Buchner, A., & Mund, I. (2008). Age-related differences in irrelevant-speech effects. *Psychology and Aging, 23*(2), 377–391. https://doi.org/10.1037/0882-7974.23.2.377

Boulenger, V., Hoen, M., Ferragne, E., Pellegrino, F., & Meunier, F. (2010). Real-time lexical competitions during speech-in-speech comprehension. *Speech Communication, 52*(3), 246–253. https://doi.org/10.1016/j.specom.2009.11.002

Bregman, A. S. (2009). Auditory scene analysis. In L. R. Squire (Ed.), *Encyclopedia of Neuroscience* (pp. 729–736). Elsevier. https://doi.org/10.1016/B978-008045046-9.00246-1

Bronkhorst, A. W. (2000). The cocktail party phenomenon: A review of research on speech intelligibility in multiple-talker conditions. *Acta Acustica united with Acustica, 86*(1), 117–128.

Brungart, D. S. (2001). Informational and energetic masking effects in the perception of two simultaneous talkers. *The Journal of the Acoustical Society of America, 109*(3), 1101–1109. https://doi.org/10.1121/1.1345696

Brungart, D. S., Iyer, N., Thompson, E. R., Simpson, B. D., Gordon-Salant, S., Schurman, J., Vogel, C., & Grant, K. (2013). Interactions between listening effort and masker type on the energetic and informational masking of speech stimuli. *Proceedings of Meetings on Acoustics, 19*(1), 1–9. https://doi.org/10.1121/1.4800033

Brungart, D. S., & Simpson, B. D. (2004). Within-ear and across-ear interference in a dichotic cocktail party listening task: Effects of masker uncertainty. *The Journal of the Acoustical Society of America, 115*(1), 301–310. https://doi.org/10.1121/1.1628683

Brungart, D. S., Simpson, B. D., Ericson, M. A., & Scott, K. R. (2001). Informational and energetic masking effects in the perception of multiple simultaneous talkers. *Journal of the Acoustical Society of America, 110*(5), 2527–2538. https://doi.org/10.1121/1.1408946

Carhart, R., Johnson, C., & Goodman, J. (1975). Perceptual masking of spondees by combinations of talkers. *The Journal of the Acoustical Society of America, 58*(S1), S35. https://doi.org/10.1121/1.2002082

Ellermeier, W., Kattner, F., Ueda, K., Doumoto, K., & Nakajima, Y. (2015). Memory disruption by irrelevant noise-vocoded speech: Effects of native language and the number of frequency bands. *The Journal of the Acoustical Society of America, 138*(3), 1561–1569. https://doi.org/10.1121/1.4928954

Ellermeier, W., & Zimmer, K. (2014). The psychoacoustics of the irrelevant sound effect. *Acoustical Science and Technology, 35*(1), 10–16. https://doi.org/10.1250/ast.35.10

Festen, J. M., & Plomp, R. (1990). Effects of fluctuating noise and interfering speech on the speech reception threshold for impaired and normal hearing. *Journal of the Acoustical Society of America, 88*(4), 1725–1736. https://doi.org/10.1121/1.400247

Finney, D. J. (1952). *Probit analysis: A statistical treatment of the Sigmoid response curve* (2nd ed.). Cambridge University Press.

Freyman, R. L., Balakrishnan, U., & Helfer, K. S. (2001). Spatial release from informational masking in speech recognition. *Journal of the Acoustical Society of America, 109*(5 Pt. 1), 2112–2122. https://doi.org/10.1121/1.1354984

Freyman, R. L., Balakrishnan, U., & Helfer, K. S. (2004). Effect of number of masking talkers and auditory priming on informational masking in speech recognition. *Journal of the Acoustical Society of America, 115*(5 Pt.1), 2246–2256. https://doi.org/10.1121/1.1689343

Gagné, J.-P., Besser, J., & Lemke, U. (2017). Behavioral assessment of listening effort using a dual-task paradigm: A review. *Trends in Hearing, 21*, 1–25. https://doi.org/10.1177/2331216516687287

Geetha, C., Kumar, K. S. S., Manjula, P., & Pavan, M. (2014). Development and standardisation of the sentence identification test in the Kannada language. *Journal of Hearing Science, 4*(1), 18–26. https://doi.org/10.17430/890267

Gnanateja, G. N. (2012). Speech in noise mixing, signal to noise ratio [Computer software]. Retrieved from http://www.mathworks.com/matlabcentral/fileexchange/37842-speech-in-noise-mixing-signal-to-noise-ratio

Gnanateja, G. N. (2016). Speech spectrum shaped noise [Computer software]. Retrieved from https://www.mathworks.com/matlabcentral/fileexchange/55701-speech-spectrum-shaped-noise

Gosselin, P. A., & Gagné, J.-P. (2010). Use of a dual-task paradigm to measure listening effort. *Canadian Journal of Speech-Language Pathology and Audiology, 34*(1), 43–51.

Hafter, E. R., & Schlauch, R. S. (1989). Factors in detection under uncertainty. *Journal of the Acoustical Society of America, 86*(S1), 12. https://doi.org/10.1121/1.2027300

Hoen, M., Meunier, F., Grataloup, C.-L., Pellegrino, F., Grimault, N., Perrin, F., Perrot, X., & Collet, L. (2007). Phonetic and lexical interferences in informational masking during speech-in-speech comprehension. *Speech Communication, 49*(12), 905–916. https://doi.org/10.1016/j.specom.2007.05.008

Howard, C. S., Munro, K. J., & Plack, C. J. (2010). Listening effort at signal-to-noise ratios that are typical of the school classroom. *International Journal of Audiology, 49*(12), 928–932. https://doi.org/10.3109/14992027.2010.520036

JASP Team. (2016). JASP (Version 0.7.5.6) [Computer software]. https://jasp-stats.org/

Jin, S., & Nelson, P. B. (2006). Speech perception in gated noise: The effects of temporal resolution. *The Journal of the Acoustical Society of America, 119*(5 Pt 1), 3097–3108. https://doi.org/10.1121/1.2188688

Johnson, J., Xu, J., Cox, R., & Pendergraft, P. (2015). A comparison of two methods for measuring listening effort as part of an audiologic test battery. *American Journal of Audiology, 24*(3), 419–431. https://doi.org/10.1044/2015_AJA-14-0058

Kidd, G., Jr., & Colburn, H. S. (2017). Informational masking in speech recognition. In J. C. Middlebrooks, J. Z. Simon, A. N. Popper, & R. R. Fay (Eds.), *The auditory system at the cocktail party, Springer handbook of auditory research* (pp. 75–109). Springer International Publishing. https://doi.org/10.1007/978-3-319-51662-2

Kidd, G., Jr., Mason, C. R., Richards, V. M., Gallun, F. J., & Durlach, N. I. (2008). Informational masking. In W. A. Yost, A. N. Popper, & R. R. Fay (Eds.), *Auditory perception of sound sources, Springer handbook of auditory research* (pp. 143–189). Springer International Publishing. https://doi.org/10.1007/978-0-387-71305-2

Koelewijn, T., Zekveld, A. A., Festen, J. M., & Kramer, S. E. (2012). Pupil dilation uncovers extra listening effort in the presence of a single-talker masker. *Ear and Hearing, 33*(2), 291–300. https://doi.org/10.1097/AUD.0b013e3182310019

Krueger, M., Schulte, M., Zokoll, M. A., Wagener, K. C., Meis, M., Brand, T., & Holube, I. (2017). Relation between listening effort and speech intelligibility in noise. *American Journal of Audiology, 26*(3S), 378–392. https://doi.org/10.1044/2017_AJA-16-0136

Leek, M. R., Brown, M. E., & Dorman, M. F. (1991). Informational masking and auditory attention. *Perception & Psychophysics, 50*(3), 205–214. https://doi.org/10.3758/BF03206743

Letowski, T. R., & Scharine, A. A. (2017). *Correlational analysis of speech intelligibility tests and metrics for speech transmission.* US Army Research Laboratory (No. ARL-TR-8227). https://doi.org/10.13140/RG.2.2.26581.93921

Li, L., Daneman, M., Qi, J. G., & Schneider, B. A. (2004). Does the information content of an irrelevant source differentially affect spoken word recognition in younger and older adults? *Journal of Experimental Psychology: Human Perception and Performance, 30*(6), 1077–1091. https://doi.org/10.1037/0096-1523.30.6.1077

Lu, Y., & Cooke, M. (2008). Speech production modifications produced by competing talkers, babble, and stationary noise. *The Journal of the Acoustical Society of America, 124*(5), 3261–3275. https://doi.org/10.1121/1.2990705

Lu, Z., Daneman, M., & Schneider, B. A. (2016). Does increasing the intelligibility of a competing sound source interfere more with speech comprehension in older adults than it does in younger adults? *Attention, Perception, & Psychophysics, 78*(8), 2655–2677. https://doi.org/10.3758/s13414-016-1193-5

Mattys, S. L., Brooks, J., & Cooke, M. (2009). Recognizing speech under a processing load: Dissociating energetic from informational factors. *Cognitive Psychology, 59*(3), 203–243. https://doi.org/10.1016/j.cogpsych.2009.04.001

Miller, G. A., & Licklider, J. C. R. (1950). The intelligibility of interrupted speech. *The Journal of the Acoustical Society of America, 22*(2), 167–173. https://doi.org/10.1121/1.1906584

Neath, I. (2000). Modeling the effects of irrelevant speech on memory. *Psychonomic Bulletin & Review, 7*(3), 403–423. https://doi.org/10.3758/BF03214356

Neff, D. L., & Green, D. M. (1987). Masking produced by spectral uncertainty with multicomponent maskers. *Perception & Psychophysics, 41*(5), 409–415. https://doi.org/10.3758/bf03203033

Peelle, J. E. (2017). Listening effort: How the cognitive consequences of acoustic challenge are reflected in brain and behavior. *Ear and Hearing, 39*(2), 204–214. https://doi.org/10.1097/AUD.0000000000000494

Pichora-Fuller, M. K., Kramer, S. E., Eckert, M. A., Edwards, B., Hornsby, B. W. Y., Humes, L. E., Lemke, U., Lunner, T., Matthen, M., Mackersie, C. L., Naylor, G., Phillips, N. A., Richter, M., Rudner, M., Sommers, M. S., Tremblay, K. L, & Wingfield, A. (2016). Hearing impairment and cognitive energy: The framework for understanding effortful listening (FUEL). *Ear and Hearing, 37*(S1), 5S–27S. https://doi.org/10.1097/AUD.0000000000000312

Rennies, J., Best, V., Roverud, E., & Kidd, G., Jr. (2019). Energetic and informational components of speech-on-speech masking in binaural speech intelligibility and perceived listening effort. *Trends in Hearing, 23*, 1–21. https://doi.org/10.1177/2331216519854597

Rennies, J., Schepker, H., Holube, I., & Kollmeier, B. (2014). Listening effort and speech intelligibility in listening situations affected by noise and reverberation. *The Journal of the Acoustical Society of America, 136*(5), 2642–2653. https://doi.org/10.1121/1.4897398

Rhebergen, K. S., Versfeld, N. J., & Dreschler, W. A. (2005). Release from informational masking by time reversal of native and non-native interfering speech. *The Journal of the Acoustical Society of America*, 118(3 Pt 1), 1274–1277. https://doi.org/10.1121/1.2000751

Rönnberg, J., Lunner, T., Zekveld, A., Sörqvist, P., Danielsson, H., Lyxell, B., Dahlström, Ö., Signoret, C., Stenfelt, S., Pichora-Fuller, M. K., & Rudner, M. (2013). The Ease of Language Understanding (ELU) model: Theoretical, empirical, and clinical advances. *Frontiers in Systems Neuroscience, 7*(31), 1–17. https://doi.org/10.3389/fnsys.2013.00031

Rosen, S., Souza, P., Ekelund, C., & Majeed, A. A. (2013). Listening to speech in a background of other talkers: Effects of talker number and noise vocoding. *The Journal of the Acoustical Society of America, 133*(4), 2431–2443. https://doi.org/10.1121/1.4794379

Rudner, M., Lunner, T., Behrens, T., Thorén, E. S., & Rönnberg, J. (2012). Working memory capacity may influence perceived effort during aided speech recognition in noise. *Journal of the American Academy of Audiology, 23*(8), 577–589. https://doi.org/10.3766/jaaa.23.7.7

Sarampalis, A., Kalluri, S., Edwards, B., & Hafter, E. (2009). Objective measures of listening effort: Effects of background noise and noise reduction. *Journal of Speech, Language, and Hearing Research, 52*(5), 1230–1240. https://doi.org/10.1044/1092-4388(2009/08-0111)

Schneider, B. A., Li, L., & Daneman, M. (2007). How competing speech interferes with speech comprehension in everyday listening situations. *Journal of the American Academy of Audiology, 18*(7), 559–572. https://doi.org/10.3766/jaaa.18.7.4

Simpson, S. A., & Cooke, M. (2005). Consonant identification in *N*-talker babble is a nonmonotonic function of *N. The Journal of the Acoustical Society of America, 118*(5), 2775–2778. https://doi.org/10.1121/1.2062650

Stone, M. A., & Canavan, S. (2016). The near non-existence of "pure" energetic masking release for speech: Extension to spectro-temporal modulation and glimpsing. *The Journal of the Acoustical Society of America, 140*(2), 832–842. https://doi.org/10.1121/1.4960483

Stone, M. A., Füllgrabe, C., & Moore, B. C. J. (2012). Notionally steady background noise acts primarily as a modulation masker of speech. *The Journal of the Acoustical Society of America, 132*(1), 317–326. https://doi.org/10.1121/1.4725766

Stone, M. A., & Moore, B. C. J. (2002). Tolerable hearing aid delays. II. Estimation of limits imposed during speech production. *Ear and Hearing, 23*(4), 325–338. https://doi.org/10.1097/00003446-200208000-00008

Summers, V., & Molis, M. R. (2004). Speech recognition in fluctuating and continuous maskers: Effects of hearing loss and presentation level. *Journal of Speech, Language, and Hearing Research, 47*(2), 245–256. https://doi.org/10.1044/1092-4388(2004/020)

Tillman, T. W., & Olsen, W. O. (1973). Speech audiometry. In J. Jerger (Ed.), *Modern developments in audiology* (2nd ed., pp. 37–74). Academic Press.

Vachon, F., Labonté, K., & Marsh, J. E. (2017). Attentional capture by deviant sounds: A noncontingent form of auditory distraction? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 43*(4), 622–634. https://doi.org/10.1037/xlm0000330

Van Engen, K. J., & Bradlow, A. R. (2007). Sentence recognition in native- and foreign-language multi-talker background noise. *The Journal of the Acoustical Society of America, 121*(1), 519–526. https://doi.org/10.1121/1.2400666

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