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Évaluation de l'effort, de l'intelligibilité de la parole et de l'intensité vocale des personnes atteintes de la maladie de Parkinson et ayant une hypophonie

Carlee Wilson
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Scott G. Adams

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BACKGROUND NOISE

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Abstract

Hypophonia is a speech deficit observed in hypokinetic dysarthria associated with Parkinson's disease. This study investigated how multi-talker background noise affects listener ratings of effort, sentence intelligibility, and perceived speech loudness of individuals with Parkinson's disease and hypophonia and explored potential relationships among these variables. Ten individuals (8 women, 2 men; 18–43 years of age [$M = 24.1$; $SD = 6.89$]) were recruited as listener participants. Speech stimuli were obtained from audio recordings of 22 adults (17 men, 5 women; 58–80 years of age [$M = 69.41$, $SD = 6.91$]) with Parkinson's disease and hypophonia. These audio recordings were comprised of 13- to 15-word sentences from the Sentence Intelligibility Test (Yorkston, Beukelman, & Tice, 2011) read aloud in no added background noise and in 65-decibel multi-talker background noise. Listeners rated the intelligibility of the sentences using orthographic transcription, then rated the "perceived effort" expended when transcribing the sentences on a 100mm visual analogue scale. Listeners also rated the perceived loudness of the speakers with Parkinson's disease using a visual analogue scale. Paired samples t tests ($p < .05$) compared ratings of listener effort, sentence intelligibility, and ratings of perceived loudness across the two background noise conditions. Pearson correlational analyses determined the degree of correlation among listener effort scores, intelligibility scores, and perceived loudness ratings. Individuals with Parkinson's disease and hypophonia were rated to have less intense speech and reduced sentence intelligibility, and listeners reported significantly higher ratings of effort in background noise.

Abrégé

L'hypophonie est une caractéristique de parole de la dysarthrie hypokinétique, qui est associée à la maladie de Parkinson. La présente étude a examiné la façon dont un bruit de fond où plusieurs interlocuteurs parlaient affectait l'évaluation de l'effort et de l'intelligibilité des phrases, ainsi que l'évaluation de la perception de l'intensité de la parole des personnes atteintes de la maladie de Parkinson et ayant une hypophonie. Cette étude a également exploré les relations potentielles entre les variables mentionnées ci-haut. Dix individus (8 femmes, 2 hommes), âgés entre 18 et 43 ans (M = 24,1; ET = 6,89), ont été recrutés à titre de participants « auditeurs ». Les stimuli de parole ont été obtenus à partir d'enregistrements audio de 22 adultes (17 hommes, 5 femmes), âgés entre 58 et 80 ans (M = 69,41, ET = 6,91). Ceux-ci étaient tous atteints de la maladie de Parkinson et avaient une hypophonie. Ces enregistrements audio comprenaient des phrases composées de 13 à 15 mots tirées du *Sentence Intelligibility Test* (Yorkston, Beukelman et Tice, 2011). Les phrases étaient lues à haute voix dans deux conditions : la première n'avait aucun bruit de fond et la deuxième avait un bruit de fond (où plusieurs interlocuteurs parlaient) de 65 décibels. Les participants « auditeurs » ont évalué l'intelligibilité des phrases à l'aide d'une transcription orthographique, puis ils ont évalué l'effort qu'ils ont déployé à transcrire les phrases sur une échelle visuelle analogique de 100 mm. Les participants « auditeurs » ont également évalué l'intensité vocale des individus atteints de la maladie de Parkinson à l'aide d'une échelle visuelle analogique. Des tests t pour échantillons appariés (p < 0,05) ont été utilisés pour comparer, entre les deux conditions de bruit de fond, les évaluations de l'effort déployé par les auditeurs, ainsi que les évaluations de l'intelligibilité des phrases et de la perception de l'intensité vocale. Des analyses corrélationnelles (Pearson) ont été utilisées pour déterminer le degré de corrélation entre les scores d'effort de l'auditeur, les scores d'intelligibilité de la parole et les évaluations de la perception de l'intensité vocale. Les évaluations effectuées montrent que l'intensité de la parole et l'intelligibilité des phrases des individus atteints de la maladie de Parkinson et ayant une hypophonie sont réduites et que l'effort devant être déployé par les participants « auditeurs » est significativement plus élevé dans la condition avec un bruit de fond.

Hypokinetic Dysarthria

It is estimated that over 75% of individuals with Parkinson's disease (PD) may experience speech and voice irregularities, referred to as hypokinetic dysarthria (Adams & Jog, 2009; Logemann, Fisher, Boshes, & Blonsky, 1978; Skodda, 2011) that can be related to disease progression. Speech and voice symptoms of hypokinetic dysarthria include short rushes of speech, inappropriate silences, variable rate, reduced stress, monopitch, monoloudness, harsh voice, breathy voice, and reduced loudness (Darley, Aronson, & Brown, 1975; Duffy, 2013). Hypokinetic dysarthria is generally associated with reduced overall movement in the orofacial regions. This can present as speech-related movements that are abnormally reduced in size and force (Adams & Dykstra, 2009; Duffy, 2013; Rusz, Cmejla, & Tykalova, 2013). Due to this reduction, articulation, speech intensity, and prosody can all seem to be attenuated (Adams & Dykstra, 2009).

One of the most prevalent and distinctive speech symptoms of hypokinetic dysarthria is hypophonia, also referred to as low speech intensity. This speech symptom can decrease speech intelligibility and hinder verbal communication in a multitude of social contexts (Darley et al., 1975). According to Gamboa et al. (1997) and Ludlow and Bassich (1984), 42% to 49% of individuals with hypokinetic dysarthria present with hypophonia. Generally, when asked to speak louder individuals with hypophonia are able to increase their speech intensity, but indicate that they feel they are speaking at an inappropriately loud level (Clark, Adams, Dykstra, Moodie, & Jog, 2014). Previous studies have demonstrated reduced loudness in people with PD (Illes, Metter, Hanson, & Iritani, 1988) and reduced speech intensity in conversation (Dykstra, Adams, & Jog, 2012b; Ho, Iansek, & Bradshaw, 1999; Moon, 2005). Often there is a dichotomy between clinical and perceptual impressions of hypophonia and the failure of measures to capture this phenomenon. For example, in clinical settings individuals with PD may seem appropriately loud due to the lack of background noise or they may increase their speech intensity because they know what is expected of them in a treatment setting (Dykstra, Adams, & Jog, 2012a, Dykstra, Hakel, & Adams, 2007).

It is typical for researchers to measure speech intensity in reading tasks (e.g., Canter, 1963) and in repetition or imitation of sentences tasks (e.g., Ludlow & Bassich, 1984). However, significant differences in speech intensity were not found between control participants and individuals with PD in these studies. Studies that use conversational tasks have been able to demonstrate reduced speech intensity in individuals with PD (e.g., Dykstra et al., 2012b; Fox & Ramig, 1997; Ho et al., 1999; Moon, 2005). Adams et al. (2006) and Adams, Haralabous, Dykstra, Abrams, and Jog (2005) have also demonstrated that under a variety of background noise conditions, individuals with hypophonia and PD have reduced speech intensity. Indeed, individuals with hypophonia and PD have been found to have lower speech intensity levels than controls by 2–5 dB SPL (Adams et al., 2006; Fox & Ramig, 1997; Ho et al., 1999; Leszcz, 2012).

Speech Intelligibility

Deficits in speech intensity regulation can contribute to reductions in the speech intelligibility of individuals with hypokinetic dysarthria (Adams et al., 2005, 2006; Adams, Dykstra, Jenkins, & Jog, 2008). Speech intelligibility is based on a combination of articulatory, respiratory, laryngeal, velopharyngeal, and prosodic aspects of speech production (Dykstra et al., 2007). Speech intelligibility tests tend to focus on single word or sentence intelligibility and these tests are typically administered in quiet testing conditions. Due to this, the speech intelligibility of individuals with PD can appear relatively unimpaired when intelligibility tests are administered in quiet conditions compared to in background noise (Dykstra et al., 2012a).

Further, hypophonia is most evident in conversational speech tasks (Fox & Ramig, 1997; Ho et al., 1999). Conversation does not always occur in quiet environments, but rather in naturalistic communicative conditions where differing levels of noise are present, such as speaking in a noisy restaurant or while travelling in a car. Previous studies have explored the conversational intelligibility of individuals with PD and hypophonia in various intensities of multi-talker background noise (Adams et al., 2006, 2008; Dykstra, 2007; Dykstra et al., 2012a). In general, these studies have demonstrated that individuals with hypophonia have reduced speech intelligibility in conversation compared to control participants, despite relatively unimpaired speech intelligibility in quiet testing conditions (Adams et al., 2008; Dykstra et al., 2012a). Further, without the addition of background noise, Dykstra et al. (2012b) found more variability in speech intensity but no significant difference in the intelligibility scores of individuals with PD versus control participants.

Lombard Effect

Introducing background noise when studying hypophonia in PD provides a relevant context because background noise can exacerbate the effect of reduced speech intensity (Dykstra et al., 2012b). When individuals are speaking in the presence of noise, there is an unconscious increase in their vocal intensity in order to be heard over the noise. This phenomenon is referred to as the Lombard effect (Lane & Tranel, 1971). The Lombard effect can be used to help gain an understanding of the relationship between background noise and speech intensity in all speakers and listeners. The Lombard effect is a listener-centred phenomenon because it serves to ensure that the listener hears the correct message from the speaker as background noise increases (Amazi & Garber, 1982; Dykstra et al., 2012b; Lane & Tranel, 1971). Therefore, speakers increase their speech intensity in noise because there is a premium on intelligible communication (Lane & Tranel, 1971). In background noise, individuals without PD will increase the duration, intensity, and fundamental frequency of their speech, specifically for informationally important words, in order to get the correct message across (Patel & Schell, 2008). The difficulty to be heard and understood over noise that individuals without PD face when speaking in background noise is assumed to be exacerbated for individuals with hypophonia (Adams et al., 2005). Studying the Lombard effect in individuals with hypophonia and PD can provide researchers with important information about the nature of this condition.

Under a variety of background noise conditions, individuals with hypophonia and PD have been found to have reduced speech intensity (Adams et al., 2005, 2006). For example, Leszcz (2012) found that control participants had a mean intensity of 71.05 dB SPL and participants with PD and hypophonia had a mean intensity of 66.87 dB SPL while reading sentences derived from the Sentence Intelligibility Test (SIT; Yorkston, Beukelman, & Tice, 2011) in no background noise. In 65 dB SPL background noise, control participants had a mean intensity of 72.25 dB SPL and participants with PD and hypophonia had a mean intensity of 69.36 dB SPL while reading sentences derived from the SIT (Yorkston et al., 2011; see also Leszcz, 2012). To avoid floor or ceiling effects in terms of speech intensity, background noise should be between 50 and 90 dB SPL to elicit the Lombard effect, and these levels are comparable to communicative situations individuals may encounter everyday (Adams et al., 2005; Dykstra et al., 2012b; Lane & Tranel, 1971). Previous studies that examined speech intensity regulation levels have found that, in general, individuals with hypophonia and PD have speech intensity levels that are 2–5 dB SPL less intense than control participants, even when speaking in background noise (Adams & Dykstra, 2009; Adams et al., 2005, 2006; Dykstra et al., 2012b; Fox & Ramig, 1997; Ho, Bradshaw, & Iansek, 2000; Leszcz, 2012). Thus, while individuals with PD do demonstrate a Lombard effect, their speech is consistently less intense than control participants (Adams et al., 2006; Dykstra et al., 2012b; Stathopoulos et al., 2014). Together these studies suggest that individuals with PD and hypophonia have reduced speech intensity relative to healthy control participants and demonstrate a similar pattern of speech intensity regulation but with an attenuated pattern of response (i.e., an overall reduction in gain for speech intensity) in background noise (Dykstra et al., 2012b).

Listener Effort

During speech production, various speech parameters (i.e., articulatory precision, rate of speech, prosody, voice quality, speech intensity) can differentially affect how well a message is understood by impacting speech intelligibility. Intelligibility in dysarthria has previously been discussed within the context of the conceptual framework of the International Classification of Functioning, Disability, and Health (World Health Organization, 2001; see Dykstra et al., 2007). In addition to affecting speech intelligibility, these speech parameters, when disordered, may also contribute to increased listener effort (Duffy, 2013). There is empirical literature suggesting that listeners need to exert an increased amount of effort when listening to dysarthric speech (e.g., Dykstra, 2007; Landa et al., 2014; Whitehill & Wong, 2006). This increased effort can cause a breakdown or a barrier to communication because listeners may be forced to reallocate cognitive and attentional resources. Also, it may reduce opportunities for people with dysarthria to communicate, thereby impacting the Participation domain of the International Classification of Functioning, Disability, and Health framework (Dykstra et al., 2007; Yorkston, Klasner, & Swanson, 2001). Participation refers to the involvement in life situations (World Health Organization, 2001). Eadie et al. (2006) extended the definition of Participation to include communication and termed it *Communicative Participation*, which is defined as "taking part in life situations where knowledge, information, ideas, or feelings are exchanged. It may take the form of speaking, listening, reading, writing, or nonverbal means of communication" (p. 309).

Landa et al. (2014) demonstrated that when listeners rated "ease of listening" for dysarthric speech, poorer speech intelligibility scores were associated with increased listening effort. Transcription based speech intelligibility tests serve to identify the percentage of words correctly understood by a listener (i.e., SIT; Yorkston et al., 2011). However, intelligibility tests do not provide information on the perceptual load experienced by a listener when transcribing a disordered speech signal, and similar intelligibility scores could be obtained at the expense of unequal resources allocated by the listener (Beukelman et al., 2011). Evaluating the perceived effort of listeners is an important aspect to examine in addition to speech intelligibility, especially in noise. For example, Beukelman et al. (2011) provided a poignant example that family members often report working very “hard” to understand the speech of an individual, despite relatively high perceptual ratings of speech intelligibility. Evaluating how listeners perceive effort has the potential to add to our knowledge of the impact of dysarthria from a holistic perspective. By understanding how hypophonia in PD impacts listener effort in background noise it is possible to explore how communicative participation is impacted in the speaker–listener communicative dyad.

Current Study

Hypophonia is a common symptom of PD that requires treatment (Adams et al., 2005). The introduction of background noise is a particularly relevant context to study hypophonia and its effect on speech intelligibility, ratings of listener effort, and ratings of perceived speech loudness because most communication occurs with some degree of background noise (e.g., speaking in noisy environments, travelling in a car). The impact of hypophonia on communication is often observed to be exacerbated by the intensity of the surrounding background noise. In general, the introduction of background noise creates communication difficulties not only for the person with hypophonia, but also creates challenges for communication partners to receive messages intelligibly from the speaker with PD. Unfortunately, little is known about how background noise affects both listener ratings and relationships among sentence intelligibility, ratings of effort, and ratings of perceived speech loudness of individuals with hypophonia and PD. Studying these variables and defining the relationships among them does not only have important implications for our understanding of hypophonia and its impact but can help to provide contextually relevant assessment and treatment.

The purpose of this study was to investigate how two different background noise conditions, (a) no added background noise and (b) 65 dB SPL multi-talker background noise, affect ratings of sentence intelligibility, listener effort, and perceived speech loudness of speakers with PD and hypophonia. This study also explored potential relationships among ratings of sentence intelligibility, listener effort, and perceived speech loudness in the two background noise conditions.

In both a no added background noise condition and a 65 dB SPL multi-talker background noise condition, the following objectives were addressed: (a) evaluate and compare ratings of perceived speech loudness with acoustic speech intensity data; (b) evaluate and compare transcription based sentence intelligibility scores, ratings of listener effort, and ratings of perceived speech loudness; (c) determine the relationship between sentence intelligibility and ratings of listener effort; (d) examine the strength of the relationship between ratings of listener effort and perceived speech loudness; and (e) examine the strength of the relationship between ratings of sentence intelligibility and perceived speech loudness.

Method

Participants

This study included the recruitment of 10 listener participants, consisting of 2 men and 8 women, 18–43 years of age (*M* = 24.1, *SD* = 6.89). All listeners spoke English as a first language; had no speech, hearing, or neurological impairments; and did not have extensive research or clinical experience with dysarthric speech or Parkinson’s disease. All listeners passed a 25 dB HL hearing screening bilaterally at 500, 1000, 2000, and 4000 Hz before participating. This study received approval from Western University’s Research Ethics Review Board (IRB 00000940).

Speech Stimuli

Speech stimuli were obtained from audio recordings of 22 adults (17 men, 5 women; age range: 58–80 years, *M* = 69.41, *SD* = 6.91) diagnosed with PD and hypophonia as their primary dysarthric symptom. The audio recordings consisted of 13- to 15-word sentences taken from the SIT (Yorkston et al., 2011). The SIT is comprised of a list of 11 sentences that can be randomly selected. Sentences range in length from 5–15 words. In the present study, only sentences 13–15 words long were used to determine speech intelligibility and to rate listener effort. Sentences were read aloud in no added background noise and in 65 dB SPL of multi-talker background noise. All speakers with PD were fluent in English (written and spoken), able to read sentences from a piece of paper, and diagnosed with PD and hypokinetic dysarthria. **Table 1** contains specific data for each speaker with PD at the time the audio recordings were made. This table includes information about the speaker’s sex, age, and years since diagnosis.

Recording task and noise conditions. The speech recordings of speakers with PD were originally recorded in a no added background noise condition and a 65 dB SPL multi-talker background noise condition which is described below. Each speaker with PD read aloud a randomly generated list of sentences unique from that of the other speakers. No two speakers received identical lists of sentences. Different sentences were read aloud by each

Table 1

Demographic Information of Speakers with Parkinson's Disease (PD)

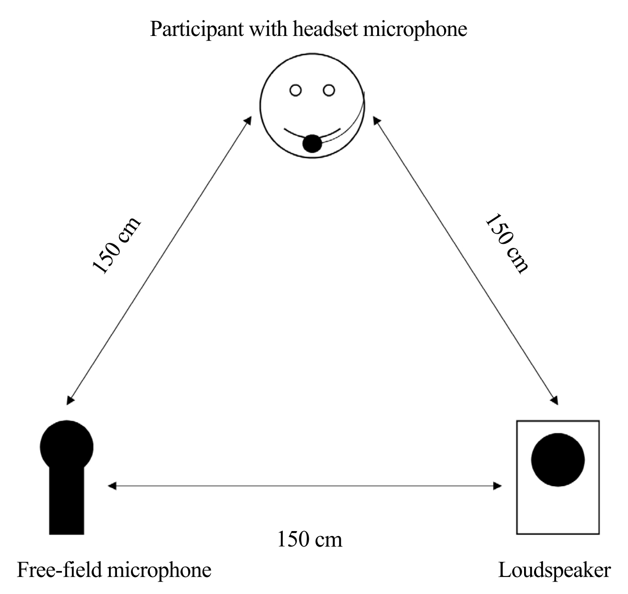
ID of speakers with PD	Sex	Age	Years since diagnosis
PD1	M	59	12
PD2	F	70	5
PD3	M	79	1
PD4	M	74	14
PD5	F	76	16
PD6	F	72	7
PD7	F	74	3
PD8	F	67	9
PD9	M	73	15
PD10	M	58	1
PD11	M	63	5
PD12	M	62	16
PD13	M	74	16
PD14	M	73	5
PD15	M	67	2
PD16	M	75	2
PD17	M	80	1
PD18	M	59	1
PD19	M	78	4
PD20	M	60	5
PD21	M	67	6
PD22	M	67	3

speaker with PD in the two background noise conditions. Each speaker with PD was instructed to read aloud 11 sentences that were 13–15 words in length from the SIT and were presented on a standard 8½ by 11-inch piece of white paper in 18-point Times New Roman font.

For both noise conditions, speakers with PD were tested in an audiometric soundproof booth (Industrial Acoustic Company). In the no added background noise condition, there was no background noise added to the room when speakers with PD read sentences from the SIT. In the 65 dB multi-talker background noise condition, a loudspeaker presented free-field multi-talker noise (Audiotech – 4 talker noise) calibrated at 65 dB SPL while each speaker with PD read sentences from the SIT.

With the examiner present in the room, the speaker with PD, a boom-mounted floor microphone (Shure SM48), and a loudspeaker were situated in an equilateral triangle, 150 centimetres (cm) away from each other (**Figure 1**). The original examiner (S. A.) adjusted the sound level (dB SPL level) of multi-talker noise via a diagnostic audiometer (GSI 10) located within the audiometric booth. The speakers with PD wore a headset microphone (AKG-C420) to record their utterances. For both conditions, the headset microphone served as the primary source for obtaining measures of speech intensity. The boom-mounted microphone was placed on a support boom at a height of 100 cm from the floor (150 cm from the speaker's mouth), and this microphone served as the primary source for obtaining listener ratings of speech intelligibility, effort, and loudness. The boom-mounted microphone was calibrated by a free-field 1000 Hz tone and a sample of the multi-talker noise was presented at 70 dB SPL from the loudspeaker (150 cm away). The recordings were made by attaching the boom-mounted floor microphone and headset microphone to a USB pre-amplifier system (M-Audio; Pre-Mobile USB system) via dual XLR connectors. The USB pre-amplifier was then attached to a laptop computer via a USB port. The laptop had the audio recorder software associated with Praat (version 5.2.14; Boersma & Weenink, 2011) installed, and the speech analysis program digitized the dual (stereo) microphone acoustic signals at 44.1 kHz and 16 bits per channel.

Figure 1



Experimental setup.

Speech intensity. Speech intensity measures were collected for each speaker with PD in the no added background noise and 65 dB SPL multi-talker background noise conditions. The speech intensity values were measured using Praat (version 5.4.04; Boersma & Weenink, 2013). Speech intensity measures were obtained by taking an average of the speech intensity between onset and offset of voicing, and then calculating an average across the three sentences for each speaker with PD in each noise condition. All speech intensity measures were based on the headset microphone recordings calibrated using a sound level meter to a 65 dB reference intensity signal that was 15 cm from the speaker's mouth.

Speech sample editing. Audio-recorded speech samples were compiled into playlists for each of the two listening sessions in the open-source program Praat (version 5.4.04; Boersma & Weenink, 2013). Each audio-recorded speech sample was comprised of three sentences (13, 14, and 15 words in length) from the SIT (Yorkston et al., 2011). With 22 PD speech samples and the samples from four randomly selected speakers with PD repeated within each playlist for determination of intra-listener reliability, the playlists were 26 samples long, with 4-second pauses between sentences. The order of presentation of the sentences was randomized so that there were five orders for each condition (i.e., no added background noise and 65 dB). This allowed for inter-rater reliability since two different listeners heard each playlist.

Listening Task

Listener participants completed the listening protocol individually over two 1.5–2 hour listening sessions. Participants completed ratings in the no added background noise condition during one session and in the 65 dB multi-talker background noise condition during the other session. The order of which noise condition was presented first was counterbalanced so that half of the participants listened to the no added background condition first, and the other half listened to the 65 dB multi-talker background noise condition first. While seated in a quiet laboratory, all participants listened to audio-recorded speech stimuli through AV 40 (M-Audio) speakers connected to a Sony Vaio laptop. Listeners were asked to rate speech intelligibility using orthographic transcription and make judgments of effort using visual analogue scaling. Finally, listeners rated the perceived speech loudness of the speech stimuli, using visual analogue scaling. This procedure was repeated for each of the 22 speakers with PD based on their audio recordings of three sentences from the SIT. The details of each task are presented below.

Speech intelligibility. During the entire listening protocol, listeners were seated 61 cm from two M-audio speakers, which were fixed at a predetermined volume of 65 dB SPL. The examiner, with the use of a multi-talker noise calibration file, predetermined the intensity level to 65 dB. Listeners rated speech intelligibility based on 13- to 15-word sentences using the scoring procedures outlined in the SIT (Yorkston et al., 2011). Listeners orthographically transcribed audio recordings of the three sentences from the SIT (Yorkston et al., 2011) in the two background noise conditions. An intelligibility score was calculated by comparing transcribed words and sentences to the stimuli on the master list.

Listener effort rating. Directly following the orthographic transcription task, listeners indicated the amount of "perceived effort" they expended when orthographically transcribing the three spoken sentences in either the no added background noise condition or the 65 dB SPL multi-talker background noise condition. This effort judgment was rated on a 100mm visual analogue scale with the anchors *no effort required* and *maximum effort required*.

Speech loudness severity rating. Listeners were presented with the audio-recorded PD speech samples again (i.e., three spoken sentences). Listeners were asked to rate their perception of reduced speech loudness using visual analogue scaling based on severity. The anchors on the 100mm visual analogue scale corresponded to *normal* and *severely abnormal/impaired*.

Data Analysis

An alpha level of $p = .05$ was used for all statistical analyses. Pearson correlational analyses determined the degree of correlation between perceived speech loudness ratings and acoustic speech intensity data in both noise conditions. Three paired samples t tests compared ratings of sentence intelligibility, listener effort, and perceived speech loudness in the two background noise conditions. Pearson correlational analyses determined the degree of correlation among sentence intelligibility scores, listener effort scores, and perceived speech loudness ratings across both noise conditions.

Results

Statistical Power

Statistical power is based on a relationship between sample size, variance in the data, effect size, and statistical significance (Portney & Watkins, 2000). Power reflects the ability to detect treatment differences and the chance of replication (Keppel, 1991). Statistical power was judged to be satisfactory in the present study. Power was calculated to be 0.80 for an effect size of 0.50, $t(25) = 1.71$, $p < .05$, GPower Version 3.1.

Reliability

Inter-rater estimates of reliability were calculated for ratings of sentence intelligibility, listener effort, and reduced loudness in no added background noise and 65 dB SPL multi-talker background noise. The values obtained for inter-rater reliability ranged from 0.87 to 0.97, $p < .01$, in the no added background noise condition and from 0.88 to 0.99, $p < .001$, in the 65 dB multi-talker background noise condition. These Intraclass Correlation Coefficient values demonstrate overall good reliability between listeners for the ratings of sentence intelligibility, listener effort, and reduced loudness. Scores from each listener for each listening task were measured against each other to obtain intra-rater reliability values. Each of the 10 listener participants re-measured 18.18% of the data to determine intra-rater reliability. **Table 2** reports Cronbach's alpha which revealed an overall intra-rater reliability estimate of 0.89, $p < .01$ across tasks, which indicates good intra-rater reliability across all task measurements.

Objective 1

The first objective sought to evaluate and compare listener ratings of perceived speech loudness with acoustic speech intensity data in both the no added background noise condition and the 65 dB SPL of multi-talker background noise condition. **Table 3** shows the mean and standard deviation values for the acoustic speech intensity data obtained from the speakers with PD across the two noise conditions. Our results show that our speakers with PD increased their speech intensity by approximately 6 dB SPL in 65 dB SPL of background noise as compared to the no noise condition.

Table 2

Summary of Intra-Rater and Inter-Rater Estimates of Reliability Across all Task Measurements

	Intra-rater reliability	Inter-rater reliability	*p* value
Average Intraclass Correlation Coefficient	.90	.96	<.01
Cronbach's alpha	.89	.96	

Pearson's correlation between visual analogue scale ratings of perceived speech loudness and acoustic speech intensity data was significant in both the no added background noise condition, *r*(22) = -.54, *p* = .01, and in the 65 dB SPL multi-talker background noise condition, *r*(22) = -.86, *p* < .001. Overall, these results suggest that acoustic measures of speech intensity are significantly related to perceived loudness rated by our listeners, especially in 65 dB of multi-talker background noise.

Objective 2

The second objective sought to evaluate and compare transcription-based sentence intelligibility scores, ratings of listener effort, and ratings of perceived speech loudness in the two background noise conditions. Three paired samples *t* tests were conducted to evaluate these variables across the two noise conditions.

The comparison of sentence intelligibility scores revealed significant differences between the no added background noise condition (*M* = 85.54, *SD* = 14.44) and the 65 dB SPL multi-talker background noise condition (*M* = 46.17, *SD* = 32.37), *t*(21) = 7.19, *p* < .001, as illustrated in **Figure 2**. The comparison of ratings of listener effort revealed significant differences between effort ratings in the no added background noise condition (*M* = 35.43, *SD* = 22.46) and the 65 dB SPL multi-talker background noise condition (*M* = 68.62, *SD* = 25.77), *t*(21) = -8.0, *p* < .001 (see **Figure 2**). The comparison of perceived speech loudness ratings revealed significant differences between listener ratings in the no added background noise condition (*M* = 32.70, *SD* = 24.38) and the 65 dB SPL multi-talker background noise condition (*M* = 54.80, *SD* = 29.90), *t*(21) = -4.19, *p* < .001 (see **Figure 2**).

Overall, the results of Objective 2 suggest that the introduction of a moderate intensity level of multi-talker background noise significantly reduced sentence intelligibility scores. In addition, the introduction of 65 dB SPL multi-talker background noise also increased ratings of listener effort, suggesting that background noise may not only impair a listener's understanding of what is being said by an individual with PD and hypophonia, but also that it creates a more effortful listening environment. These results also suggest that reduced loudness was perceived as more impaired in the 65 dB SPL multi-talker background noise.

Objective 3

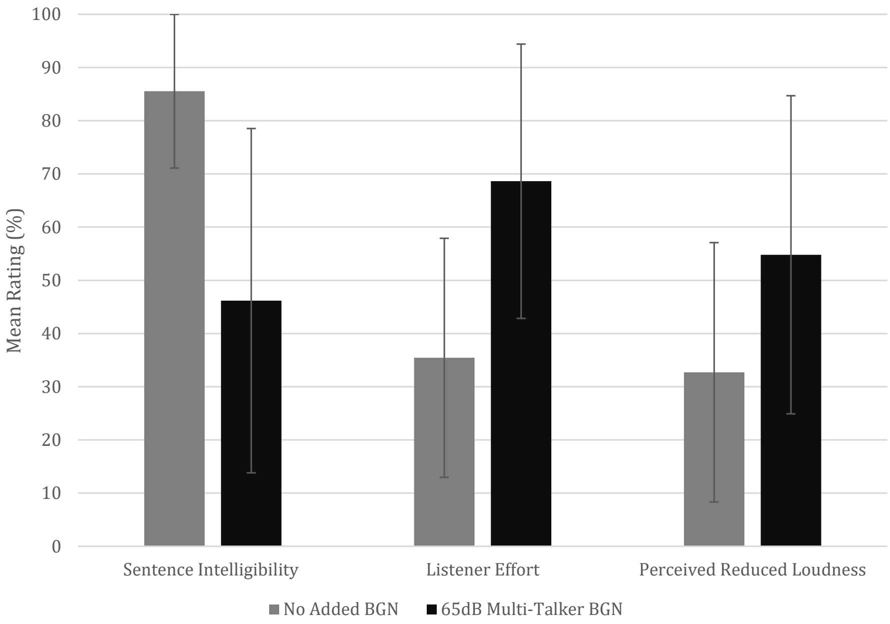
The third objective evaluated the relationship between sentence intelligibility scores and ratings of listener effort in the two background noise conditions. Pearson's correlation between sentence intelligibility scores (*M* = 85.54, *SD* = 14.44) and ratings of listener effort (*M* = 35.43, *SD* = 22.46) in the no added background noise condition was significant, *r*(21) = -.89, *p* < .001, as illustrated in **Figure 3**. The coefficient of determination suggests that 79.57% of the variance in listener effort is explained by sentence intelligibility scores when no added background noise is present. Pearson's correlation between sentence intelligibility scores (*M* = 46.16, *SD* = 32.36) and ratings of listener effort (*M* = 68.62, *SD* = 25.77) in the 65 dB SPL multi-talker background noise condition was significant, *r*(21) = -.96, *p* < .001, as illustrated in **Figure 4**. The coefficient of determination suggests that 92.74% of the variance in listener effort is explained by sentence intelligibility scores with the addition of 65 dB multi-talker background noise. In general, these negative correlations show that as intelligibility ratings increase, ratings of listener effort decrease, and as intelligibility ratings decrease, ratings of listener effort increase in both noise conditions.

Table 3

Overall Mean Speech Intensity Levels (dB SPL) in Each Noise Condition

	0 dB SPL	65 dB SPL
Mean	66.9	73.5
SD	4.6	2.1

Figure 2



Mean scores for overall ratings of sentence intelligibility, listener effort, and perceived loudness in both noise conditions. Error bars represent standard deviations. BGN = background noise.

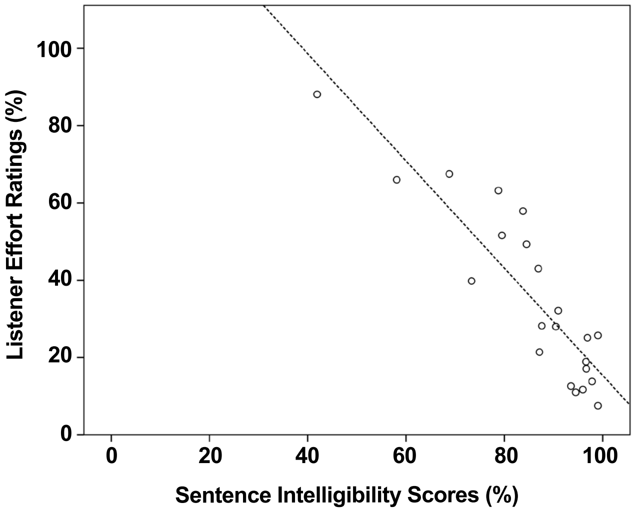
Objective 4

Objective 4 examined the strength of the relationship between ratings of listener effort and perceived speech loudness in the two background noise conditions. **Figure 5** shows the Pearson's correlation between ratings of listener effort ($M = 35.43$, $SD = 22.46$) and reduced loudness ratings ($M = 32.70$, $SD = 24.38$) in the no added background noise condition was significant, $r(21) = .84$, $p < .001$. The coefficient of determination suggests that 71.06% of the variance in listener effort is explained by ratings of reduced loudness when no added background noise is present. Pearson's correlation between ratings of listener effort ($M = 68.62$, $SD = 25.77$) and reduced loudness ratings ($M = 54.8$, $SD = 29.89$) in the 65 dB multi-talker background noise condition shown in **Figure 6** was significant, $r(21) = .96$, $p < .001$. The coefficient of determination suggests that 92.54% of the variance in listener effort is explained by ratings of reduced loudness with the addition of 65 dB multi-talker background noise. These positive correlations show that as ratings of listener effort increase, reduced loudness ratings also increase (i.e., the speaker with PD is rated as less intense/more quiet), and as ratings of effort decrease, reduced loudness ratings also decrease (i.e., the speaker with PD is rated as more intense/louder).

Objective 5

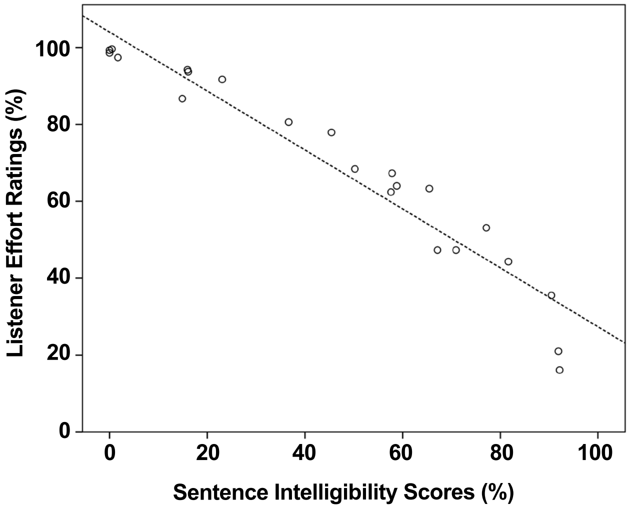
The fifth objective examined the correlations between ratings of sentence intelligibility and perceived speech loudness in the two background noise conditions. **Figure 7** shows Pearson's correlation between sentence intelligibility scores ($M = 85.54$, $SD = 14.44$) and reduced loudness ratings ($M = 32.70$, $SD = 24.38$) in the no added background noise condition was significant, $r(21) = -.68$, $p < .001$. The coefficient of determination suggests that 46.79% of the variance in sentence intelligibility scores is explained by ratings of reduced loudness when no added background noise is present. Pearson's correlation between sentence intelligibility scores ($M = 46.16$, $SD = 32.36$) and reduced loudness ratings ($M = 54.8$, $SD = 29.89$) in the 65 dB multi-talker background noise condition shown in **Figure 8** was significant, $r(21) = -.97$, $p < .001$. The coefficient of determination suggests that 93.32% of the variance in sentence intelligibility scores is explained by ratings of reduced loudness with the addition of 65 dB multi-talker background noise. These correlations show that as sentence intelligibility scores increase, reduced loudness ratings decrease (i.e., the speaker with PD is perceived as louder), and as sentence intelligibility scores decrease, reduced loudness ratings increase (i.e., the speaker with PD is perceived as less intense).

Figure 3



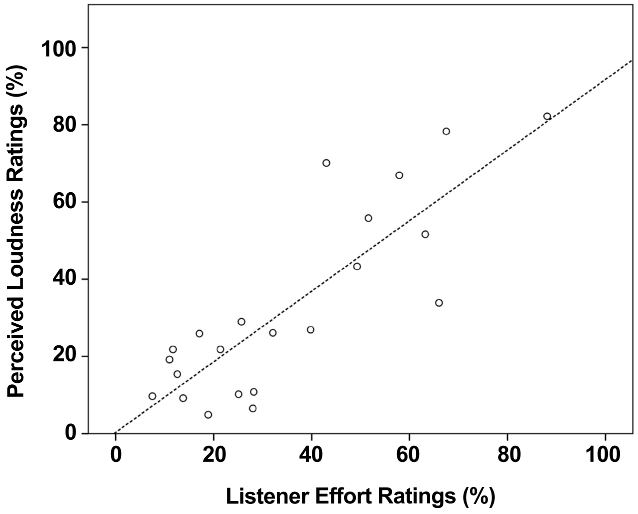
Sentence intelligibility scores vs. ratings of listener effort (no added background noise).

Figure 4



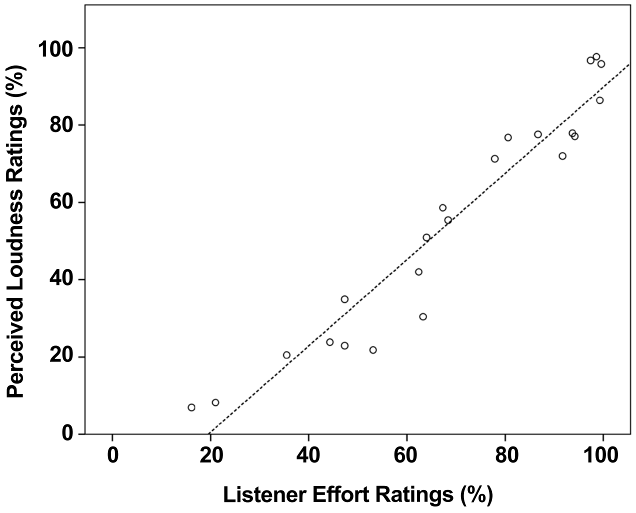
Sentence intelligibility scores vs. ratings of listener effort (65 dB multi-talker background noise).

Figure 5



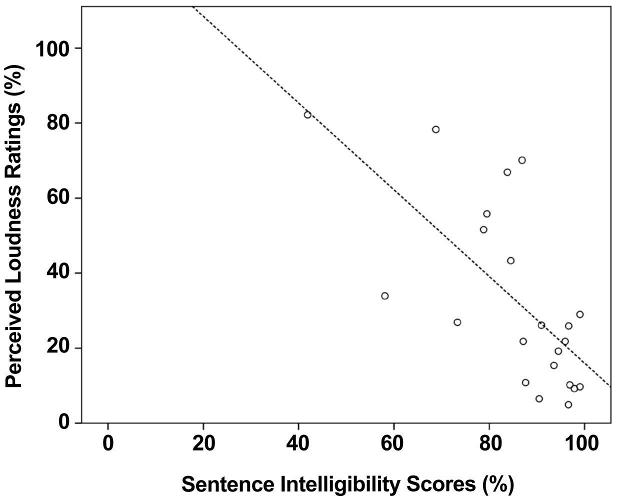
Ratings of listener effort vs. reduced loudness ratings (no added background noise). Loudness Score Scale: 0 = normal loudness/speech intensity, 100 = severely impaired loudness/speech intensity.

Figure 6



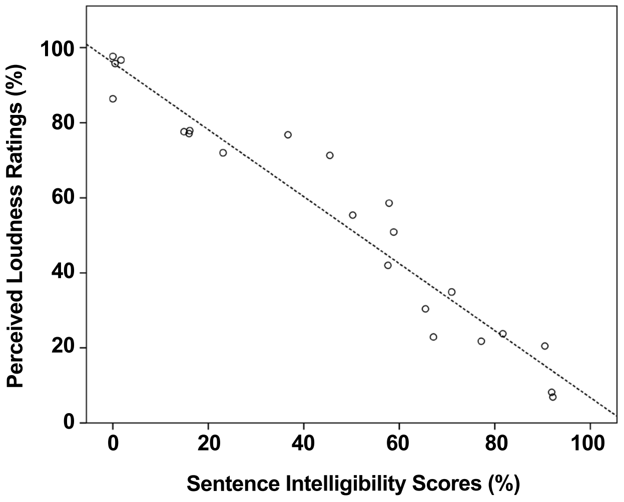
Ratings of listener effort vs. reduced loudness ratings (65 dB multi-talker background noise). Loudness Score Scale: 0 = normal loudness/speech intensity, 100 = severely impaired loudness/speech intensity.

Figure 7



Sentence intelligibility scores vs. reduced loudness ratings (no added background noise). Loudness Score Scale: 0 = normal loudness/speech intensity, 100 = severely impaired loudness/speech intensity.

Figure 8



Sentence intelligibility scores vs. reduced loudness ratings (65 dB multi-talker background noise). Loudness Score Scale: 0 = normal loudness/speech intensity, 100 = severely impaired loudness/speech intensity.

Discussion

In this study, listeners rated the speech of individuals with PD and hypophonia in two noise conditions. Across the two noise conditions, listeners rated sentence intelligibility, perceived speech loudness, and the amount of effort required to transcribe the speech of individuals with PD and hypophonia as their primary dysarthric symptom. Longer SIT sentences of 13–15 words in length were selected to rate sentence intelligibility because longer sentences are considered more complex to produce (Altmann & Troche, 2011). These longer, more complex sentences may have been more taxing on the speech production mechanism of speakers with PD, making it more challenging for these individuals with hypokinetic dysarthria to produce intelligible sentences in either of the noise conditions. More complex sentences can also make it more difficult for listeners to predict and fill in content when the speech signal is already distorted, and therefore may be representative of everyday speech demands (Yorkston & Beukelman, 1981; Yorkston, Strand, & Kennedy, 1996). Results demonstrated differences in sentence intelligibility scores, ratings of perceived speech loudness, and ratings of effort between background noise conditions. Results also demonstrated that these variables were significantly correlated regardless of noise condition.

When comparing sentence intelligibility scores across noise conditions, comparisons revealed significantly higher sentence intelligibility scores in the no added background noise condition as compared to the 65 dB multi-talker background noise. The sentence intelligibility results are consistent with the findings of Adams et al. (2008) and Dykstra et al. (2012a) who also found that the introduction of background noise significantly reduced sentence intelligibility scores. Our analysis shows the dramatic and significant effect that moderate intensity levels of multi-talker background noise have on a listener's ability to understand what was being spoken by speakers with PD. Although most of the speakers with PD in the current study were judged to have mild-moderately impaired speech intelligibility in no added background noise, the introduction of moderate intensity multi-talker background noise significantly degraded the speech intelligibility of our sample of speakers with PD and hypophonia.

Despite relatively high sentence intelligibility scores in no added background noise, listeners still reported using effort when listening to and transcribing hypophonic speech. This is supported by Beukelman et al. (2011) who indicated that measuring sentence intelligibility alone does not provide information on the perceptual load experienced by a listener when transcribing a disordered speech signal. Beukelman et al. measured attention allocation and found that dysarthric speech with relatively high sentence intelligibility still resulted in an increased perceptual load for listeners. Our findings suggest that even in ideal, quiet listening conditions listeners use effort when listening to and trying to understand individuals with hypophonia and PD. Furthermore, previous research has indicated that listeners have more difficulty understanding disordered speech in comparison to normal speech (Dykstra, 2007). Like the current findings and using the same visual analogue scale anchors for assigning ratings of listener effort to individuals with PD and control participants, Dykstra (2007) found that in no added background noise listeners assigned higher effort ratings for participants with PD than control participants in a conversational intelligibility task. When noise was introduced, this pattern was exacerbated across a variety of multi-talker background noise conditions.

There is empirical literature suggesting that listeners need to exert an increased amount of effort when listening to dysarthric speech in order to understand what is being said (e.g., Dykstra, 2007; Landa et al., 2014; Whitehill & Wong, 2006). This is consistent with the previous findings of Whitehill and Wong (2006) who observed a strong negative correlation between speech intelligibility scores and listener effort in various dysarthria types. As well, Landa et al. (2014) demonstrated that when listeners rated "ease of listening" for dysarthric speech, poorer intelligibility scores were associated with increased listening effort. The current study demonstrates that this is even more relevant with the addition of background noise. When background noise was introduced, sentence intelligibility scores decreased to *severely impaired* according to the SIT levels of impairment, and ratings of listener effort increased. The addition of background noise, in comparison to the no added background noise condition, made it even more difficult for listeners to understand the speech signal of speakers with hypophonia. It is possible that our listeners used information processing strategies relying on context and sentence structure in addition to the speech signal to determine what was being spoken (Beukelman et al., 2011). This additional effort and reallocation of resources by the listeners could contribute to cognitive overload and may cause a barrier to communicative participation and reduce opportunities for individuals with PD to communicate (Beukelman et al., 2011; Dykstra et al., 2007). This is worthy of future study.

The comparison of reduced loudness ratings across noise conditions revealed that listeners perceived speakers with PD to be significantly louder in the no added background noise condition compared to the 65 dB multi-talker background noise condition. These results demonstrate that a listener's perception and ratings of the severity of hypophonia are exacerbated in noise, especially considering the acoustic speech intensity data that demonstrates speakers with PD had increased their speech intensity (i.e., were louder) in the 65 dB SPL multi-talker background noise condition, suggesting a Lombard effect was present.

Previous studies have demonstrated the Lombard effect where in background noise control participants regulated their speech intensity, duration, and frequency to be heard over the noise (Adams et al., 2005, 2006; Lane & Tranel, 1971; Patel & Schell, 2008). Adams et al. (2005, 2006, 2008) have previously demonstrated the relationship between background noise and speech intensity regulation in individuals with PD and hypophonia. Adams et al. (2005) found that individuals with PD exhibited a Lombard effect, with participants with PD demonstrating consistently lower levels of speech intensity in comparison to control participants. In a study by McAuliffe, Kerr, Gibson, Anderson, and LaShell (2014), five individuals with PD read sentences from the SIT using their normal speech loudness as well as at a level they felt was two times louder than their normal speech loudness. This resulted in sentence intelligibility scores increasing from an average of 45.23% to 60.45% and suggested that speech intensity has a direct impact on intelligibility (McAuliffe et al., 2014). The speech intensity of individuals with PD has also been found to be more variable than that of control participants (Dysktra et al., 2012b).

However, it is also important to consider speech-to-noise ratios. Speech-to-noise ratios compare the intensity level of speech to the intensity level of background noise. Although our listeners perceived the speech of individuals with PD to be reduced in loudness in the noise condition, they were actually more intense (louder) in order to be heard over the noise. Our findings are similar to that of Leszcz (2012) who demonstrated that across tasks people with PD spoke at a higher intensity in the 65 dB condition than in no noise. Therefore, our listener ratings of reduced loudness were affected by the level of background noise (in this case 65 dB), as well as the speech-to-noise ratio. Studies that have considered speech-to-noise ratios indicate that individuals with PD have lower speech-to-noise ratios than control participants in background noise (Adams et al., 2008). As well, with an increase in background noise comes a decrease in speech-to-noise ratios, which was found to have a negative impact on intelligibility (Adams et al., 2008). This suggests that a similar phenomenon is occurring in the current study, as the presence of background noise also resulted in ratings of both reduced intelligibility and reduced loudness. It appears as if our speakers with PD did demonstrate a Lombard effect when noise was presented, but the observed increase in speech intensity was not sufficient to be heard adequately over the noise (i.e., reduced speech-to-noise ratio).

Although we found significant correlations regardless of noise condition, it remains important to assess speech intelligibility in both optimal and sub-optimal communicative environments. In clinical settings, speakers with PD may seem appropriately loud due to the lack of background noise or they may increase their speech intensity because they have learned to do so in treatment, and this may or may not be generalized to environments outside the treatment room (Dykstra, 2007; Dykstra et al., 2012a). Tjaden and Wilding (2011) suggested that intelligibility scores derived from validated intelligibility tests, such as the SIT, when administered in a quiet environment are not indicative of actual intelligibility in an ecologically valid context or in spontaneous speech. Adams et al. (2008) demonstrated that individuals with hypophonia had overall significantly lower conversational intelligibility scores in noise when compared to control participants, despite relatively unimpaired speech intelligibility when tested in quiet conditions. The results of the current study reflect this result since the SIT intelligibility ratings were within the mildly impaired range in the no added background noise condition and in 65 dB of multi-talker background noise sentence intelligibility decreased to reflect a severe impairment. This finding was also demonstrated by Dykstra et al. (2012a) when studying the conversational intelligibility of individuals with hypophonia in noise. Their study found that without added background noise there was no significant difference in the intelligibility scores of individuals with PD versus control participants. However, the speech intensity of the PD group was lower and had more variability than the control participants and when background noise was introduced participants with PD had lower conversational intelligibility scores (Dykstra et al., 2012a). The results of previous studies, as well as the current study, all demonstrate the importance of assessing the speech intelligibility of speakers with hypophonia and PD in a variety of contexts including noise, even if these speakers are quite intelligible in quiet environments. This assessment would provide clinicians more information concerning the intelligibility of their clients across different noise conditions so management plans can be tailored, and meaningful goals can be set regarding loudness and intelligibility profiles. This information also may serve to provide strategies for the communicative partner (i.e., the listener) in order to reduce listener effort and, therefore, maximize communicative interactions within the speaker–listener dyad. These strategies may include instruction relating to being face-to-face when communicating, having important conversations in quiet environments, and amplifying the speaker's voice when speaking in noisy environments.

Limitations

This study did not include speech samples of individuals without PD to serve as a control group of speakers. It would have strengthened the study to include control speakers to determine and directly compare how the listeners rate intelligibility, perceive effort, and perceive loudness in healthy speakers without PD and hypophonia. The addition of a control group of speakers is worthy of future study.

Our eligibility criteria limited our listener pool to a young, unfamiliar, and naïve population that is not representative of all listeners. In some cases, younger listeners have been found to provide higher intelligibility scores than older listeners (Jones, Mathy, Azuma, & Liss, 2004). This could be due to a natural cognitive decline that occurs with age, or in some cases—in particular older men—hearing loss (Pennington & Miller, 2007). Various studies (i.e., Liss, Spitzer, Caviness, & Adler, 2002; Tjaden & Liss, 1995a, 1995b) have demonstrated that familiar non-naïve listeners are better able to recognize speech than unfamiliar naïve listeners, and therefore give higher intelligibility scores. However, Pennington and Miller (2007) suggested that with standardized listening conditions, factors such as age, gender, and familiarity may not have a significant impact on intelligibility results.

This study used more complex sentences derived from the SIT; however, these sentences do not represent the ecological validity and complexity of natural conversational speech. Some literature suggests that hypophonia is most evident in conversational speech tasks (Fox & Ramig, 1997; Ho et al., 1999, 2000). However, Dykstra (2007) suggested that sentence intelligibility and conversational intelligibility are comparable in validity. Longer sentences from the SIT were selected to make the stimuli more ecologically valid than shorter sentences.

Since hypophonia was the primary dysarthric speech feature for the speakers in this study, it should be considered that the recordings of individuals with PD likely represents a subgroup of individuals with PD that is not representative of all speakers with hypokinetic dysarthria. Therefore, the results of this study may not be generalizable to the general PD population that may be experiencing different elements of hypokinetic dysarthria such as prosodic abnormalities or impairments in speech rate. Future studies may wish to examine and consider a more heterogeneous group of speakers with PD to ascertain the variety of speech symptoms that impact both speech intelligibility and ratings of listener effort.

Conclusion and Future Directions

Our results contribute to the evidence base demonstrating that background noise can impact listener ratings of sentence intelligibility, listener effort, and perceived speech loudness. The results of this study demonstrate that when assessing hypophonia in PD (and presumably other dysarthria types), gathering speech intelligibility data in quiet environments has the potential to underestimate the negative impact that background noise has on speech intelligibility and listener effort in this clinical population. To improve the communicative abilities of people with PD, clinicians need to consider that intelligibility and loudness have an impact on listener effort. Clinicians should ensure that they educate clients and families about good communicative practices such as reducing background noise and being face-to-face during a conversation. These educational strategies could help to reduce listener effort and provide more successful communication for people with PD.

We also need to further our knowledge and understanding of listener effort and the impact it has on communicative participation. Future exploration of the relationships among listener effort, speech intelligibility, speech intensity, and other speech symptoms associated with hypokinetic dysarthria (i.e., articulation, rate, voice quality, and prosodic abnormalities) is required. This is especially relevant because each speech subsystem (i.e., articulatory, respiratory, laryngeal, and velopharyngeal) likely contributes to speech intelligibility and listener effort in a cumulative, but differential way (Dykstra et al., 2007). It has been suggested that this information could help to provide clinicians with a better idea of what speech symptoms have a greater impact on speech intelligibility, as well as information on the underlying physiological mechanisms of hypokinetic dysarthria in PD (Yahalom, Simon, Thorne, Peretz, & Giladi, 2004). More research is required to understand the interaction of speech intelligibility, perceived speech loudness, and listener effort.

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The Role of Speech-Language Pathologists in Medical Assistance in Dying: Canadian Experience to Inform Clinical Practice

Le rôle des orthophonistes dans l'aide médicale à mourir : informer la pratique clinique par l'entremise de l'expérience canadienne

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Abstract

Communication is an integral part of the medical assistance in dying assessment process in Canada, as reflected by the legislation of Bill C-14 (2016), provincial and hospital policies, and professional association statements. For patients with communication impairments, which are common in the end-of-life patient population, the ability to communicate their wishes regarding care, including medical assistance in dying, can be very challenging. Speech-language pathologists have training in assessment and treatment of communication and cognition impairments, therefore are uniquely qualified to support these patients and ensure that their basic human right to communicate is respected. However, there is a paucity of published literature regarding the role of speech-language pathologists in medical assistance in dying. This paper reviews the role for speech-language pathologists in medical assistance in dying and recommends an approach to integrating their expertise into the medical assistance in dying assessment process.

Abrégé

Au Canada, la communication fait partie intégrante du processus d'évaluation de l'aide médicale à mourir, comme en témoignent le projet de loi C-14 (2016), les politiques provinciales et hospitalières, ainsi que les énoncés de position des associations professionnelles. Parmi les patients en fin de vie, nombreux sont ceux ayant un trouble de la communication. Pour ces patients, il peut s'avérer très difficile de communiquer les volontés qu'ils ont concernant les soins leur étant administrés, y compris ceux de l'aide médicale à mourir. La formation des orthophonistes inclut l'évaluation et le traitement des troubles de la communication et de la cognition. Ces professionnels possèdent donc des compétences uniques qui leur permettent de soutenir les patients en fin de vie et de veiller à ce que leur droit fondamental à la communication soit respecté. Peu de littérature n'a néanmoins été publiée sur le rôle des orthophonistes dans l'aide médicale à mourir. Le présent article examine le rôle des orthophonistes dans l'aide médicale à mourir et recommande une approche favorisant l'intégration de l'expertise de ces professionnels dans le processus d'évaluation de l'aide médicale à mourir.

Medical assistance in dying (MAiD) became legal in Canada in June of 2016 (Bill C-14, 2016). Worldwide, the need for clear communication, and risks of miscommunication, have been highlighted for physicians and nurses involved in MAiD (Brooks, 2019). Communication impairments can be a barrier to assessment of patients' competence and capability of making end-of-life decisions, including MAiD.

Communication is a means of connection and exchange of meaningful information between at least two individuals. The importance of communication is reflected in the Canadian legislation. Bill C-14; 241.2; 3; i (2016) states, "if the person has difficulty communicating, take all necessary measures to provide a reliable means by which the person may understand the information that is provided to them and communicate their decision." The legislation is paralleled by Ontario's Clinician Aid B (Ministry of Health and Long-Term Care, 2019), which is suggested for MAiD assessors and providers as well as hospital policies (The Ottawa Hospital, 2016).

Speech-language pathologists (S-LPs) are health care professionals who identify, diagnose, and treat communication and swallowing disorders across the lifespan (Speech-Language and Audiology Canada [SAC], 2016). They can be instrumental in cases where patients have communication disorders (e.g., expressive or receptive aphasia), motor speech disorders (e.g., dysarthria or apraxia), and cognitive-communication disorders (e.g., dementia). Disease processes which can lead to communication impairments include neurodegenerative diseases, certain types of cancer, cerebral vascular disease, brain injury, dementia, and hearing impairment (Buchel, 2018; Toner & Shadden, 2012). Patients may be capable of making medical decisions, including MAiD, despite having a communication impairment which limits their ability to express their wishes (Buchel, 2018). Across Canada, some MAiD teams have been incorporating S-LPs to assist with communication in challenging cases.

This paper will explore the role for S-LPs in MAiD and provide recommendations for the inclusion of S-LPs on MAiD teams. The purpose of this paper is to offer practical and implementable guidance on the role of S-LPs in MAiD, where previously there has been very little.

Method

A literature search was performed using keyword searches on the PubMed, SCOPUS, and CINAHL databases. Keywords used included "MAiD," "medically assisted dying," and "euthanasia," or "palliative care" and "end of life care" or "ICU" and "critical care" along with "SLP," "speech language pathology," and "communication" or "alternative and augmentative communication." Titles were screened for relevance by the first author (KD), then relevant abstracts were reviewed. If the article remained of interest, the full article was read, with review of the bibliographies for further relevant articles.

The MAiD procedure remains relatively new in Canada, with a paucity of literature about including S-LPs in this process. Therefore, grey literature such as professional organization policy statements and information from the first Canadian conference for MAiD assessors and providers were reviewed. Data were also collected from the local experience of the MAiD team at The Ottawa Hospital through personal communication with members of the team. Recommendations are based on information drawn from these sources to provide initial guidelines for the inclusion of S-LPs in the MAiD process and on MAiD teams.

Review of the Literature on the Role of S-LPs in MAiD

Despite the importance of communication for the MAiD process, there is a lack of literature on the role of S-LPs in MAiD worldwide. Published research primarily focuses on the ethical considerations, perspectives, and experiences of physicians and nurses, with no published research on the experiences of other health care providers (Brooks, 2019). Therefore, literature regarding the role of S-LPs in critical care and palliative or end-of-life care was reviewed, with applicable concepts presented below.

There is a relatively extensive body of literature on the role of S-LPs in critical care settings, with the following key take away messages relevant to this discussion. Critical care literature highlights the emotional suffering of patients who are unable to communicate their wants, needs, and desires with their health care team, friends, and family. There is an association between lack of communication and feelings of anger, frustration, anxiety, fear, and powerlessness (Braun-Janzen, Sarchuk, & Murray, 2009). Often the method of communication offered by health care providers is yes/no questions, which is insufficient for involving the patient in discussing end-of-life decisions, including MAiD (Braun-Janzen et al., 2009). The impact of access to communication is powerful, with educating staff in the use of alternative and augmentative communication techniques positively impacting measures such as length of stay and morbidity (Handburg & Voss, 2018).

At the end of life, the ability to communicate is an important contributor to quality of life for both patients and their families and can be as important as pain relief

(Chahda, Mathisen, & Carey, 2017; Toner & Shadden, 2012). The American Medical Association and National Institute of Health highlight that one of the most important components in end-of-life care is supporting communication so patients can participate in discussing and planning their care (Chahda et al., 2017; Toner & Shadden, 2012). There are several factors influencing communication at the end of life which induce variability in the patient's abilities. These include the underlying disease process, level of alertness, fatigue, pain, medication, and emotional state (Chahda et al., 2017; Pollens, 2012).

There have been specific roles described for S-LPs at the end of life, three of which are particularly relevant to MAiD (Pollens, 2004, 2012). First, S-LPs can provide consultation services regarding communication and cognition. S-LPs can provide guidance on optimal communication methods for patients with communication or cognitive limitations (Pollens, 2004, 2012). This can facilitate assessment of capability to make health care decisions, as they can help patients demonstrate their ability to understand and process information, as well as communicate their desires to their health care team (Pollens, 2004, 2012). Second, S-LPs can provide intervention to develop communication strategies with patients to support their role in health care decisions, maintain social closeness, and allow them to express emotional states and concerns about dying (Pollens, 2004, 2012). Some examples of strategies include paced rate of speech in dysarthria and the use of low- and high-technology alternative and augmentative communication devices (Pollens, 2012). Third, S-LPs can have an important role on an interdisciplinary team as communication is such an important component of patient care, including sharing information about the patient's communication abilities, contributing to optimal patient care (Pollens, 2004, 2012).

Canadian Experience

The importance of including S-LPs in the MAiD process has received attention in Canada. In 2016, SAC released a position statement on their role in end-of-life care and have started a MAiD Community of Practice forum (SAC, n.d.) to connect S-LPs who have been involved in MAiD across the country. The statement highlights that communication impairments are common in the end-of-life patient population, can cause distressing symptoms, and put patients at risk for being misunderstood by health care providers and family (SAC, 2016). It also states "that all people should have access to comprehensive end-of-life care, which includes communication health services and resources. Communication health professionals—speech-language pathologists, audiologists, and communication health assistants—are uniquely qualified to provide essential services in end-of-life care" (SAC, 2016, p. 1). S-LPs can play an important role by optimizing communication to facilitate:

1. Determination of capacity/competency for making health-care and other decisions;
2. Comprehension of prognosis and the risks and benefits of treatment options, which allows for informed decision making;
3. Self-expression and autonomy, so patients or clients can clearly indicate pain, symptoms, needs and preferences;
4. Socialization, sharing and closeness with loved ones;
5. Advance care planning, including helping patients or clients express their wishes about goals of care and physician assisted death;
6. Fulfillment of end-of-life goals. (SAC, 2016, p. 2)

At the 2018 conference of the Canadian Association of MAiD Assessors and Providers, there was a dedicated presentation regarding the role of S-LPs as communication intermediaries (Buchel, 2018). This highlighted the role that S-LPs can play to assess communication, to provide suggestions for compensatory strategies to facilitate communication, and to act as a communication intermediary by attending MAiD eligibility assessments and procedures if necessary. As a communication intermediary, S-LPs are focused on the patient and implement communication strategies as needed, clarifying the messages from both the clinician and the patient. This decreases the burden on the assessors' time, and the burden of communication from the patient and caregiver (Buchel, 2018).

In Ottawa, the MAiD team based at The Ottawa Hospital has involved S-LPs in select cases. From January to December 2018 there were 133 requests for MAiD, with 171 physician assessments (two independent assessments are required prior to the MAiD procedure) and 46 procedures. An S-LP was consulted in five cases (3.8%) and was involved throughout the entire process in two cases (M. Kekewich, personal communication, February 5, 2019).

In the experience of the S-LPs in Ottawa who are part of the MAiD team, when S-LPs are consulted, by the nature of their role, they become closely involved in all aspects of the MAiD assessments and procedure, and with all members of the MAiD team, especially with the patient and family. Working with patients, S-LPs can assess their speech and language skills and establish the best means of communication to allow them to express their wishes, understand the questions asked of them, ask their own questions, and demonstrate their competence. Acting as communication facilitators, they are also able to relieve family involvement in interpreting the person's communication and allow the team to assess the patient without family present when needed. The value of S-LPs' involvement also extends to the members of the MAiD team, who report benefiting from tools and strategies to communicate with their patients and being able to complete their assessments and interventions without the additional burden of having to manage communication barriers.

Physician providers reflect that while S-LPs may not be involved in most cases, S-LPs have been instrumental in the cases they have been involved with. The S-LPs' assistance with communication typically made it possible for patients to demonstrate their capacity to consent to the MAiD procedure, without which they would have been ineligible (V. Chaput, personal communication, January 25, 2019). One of the local cases had an initial assessment prior to involvement with an S-LP which found the patient ineligible, then subsequently was able to demonstrate capacity using the S-LP as a communication intermediary (M. Kekewich, personal communication, January 25, 2019).

The second author (EL) is an S-LP who has reflected on her personal experience based on years of working with patients with communication disorders who are critically ill. Patients have often expressed that one of their primary fears is not being able to communicate their wishes at end of life, and they fear being forced into undesired situations due to their inability to make themselves understood to their care providers. Through participation in end of life care, including the MAiD process, S-LPs are able to reassure patients that they will support their ability to communicate at all stages of their disease and help them demonstrate competence to the best of their ability. While it requires challenging conversations and intense involvement on the part of the S-LPs, working as part of the MAiD team is a rewarding part of the spectrum of services that S-LPs can provide. S-LPs have an active and valuable role to play to support the communication needs of critically ill patients with communication disorders throughout the MAiD process.

Recommendations

Communication is an important component of assessment for MAiD eligibility, and in Canada there is an expectation to take all necessary measures to facilitate reliable communication (Bill C-14; 241.2; 3; i, 2016). Therefore, the following recommendations are suggested:

1. Patients requesting MAiD who have diagnoses which may impact their communication ability should be screened for communication impairment. Examples of these diagnoses include, but are not limited to:
    - Stroke/Cerebral vascular disease, particularly if deficits include aphasia, dysarthria, or apraxia (Flowers, Silver, Fang, Rochon, & Martino, 2013)
    - Neurodegenerative conditions, including but not limited to amyotrophic lateral sclerosis, multiple sclerosis, cerebellar/ataxic disorders, Parkinson's disease, and Huntington's disease (Fried-Oken, Mooney, & Peters, 2015)
    - Certain cancers, including head and neck cancers that impair speech, or brain tumors/metastasis (Hansen, Chenoweth, Thompson, & Strouss, 2018)
    - Cognitive communication disorders, including but not limited to brain injury, dementia, psychiatric disorders, and adult autism (Papathanasiou & Coppens, 2017; Small, Gutman, Makela, & Hillhouse, 2003)
    - Pre-existing developmental language disorders (Clegg, Hollis, Mawhook, & Rutter, 2005)
    - Hearing impairments (Erber, 1994)
2. MAiD assessors and providers should consider education on basic strategies for accommodating mild communication impairments (Burns, Baylor, Dudgeon, Starks, & Yorkston, 2017).
    - These basic strategies could include speaking louder and slower for a patient with a hearing impairment, getting a patient with mild dysarthria whose speech is sometimes difficult to understand to repeat themselves or write key words, or repeating what they believe the person said to check that they have understood correctly (Burns et al., 2017).
    - Suggested resources include supportive conversation (online training module available through the Aphasia Institute at https://www.aphasia.ca/home-page/health-care-professionals/self-directed-sca-module/) or using the FRAME framework (**Table 1**).

Table 1

The FRAME Mnemonic for Accommodating Communication Deficits

	Key principle	Example strategies
F	Familiarize with how the patient communicates before starting medical interview	Find out whether patient already has a reliable and preferred communication method.
R	Reduce Rate: Slow down!	Pause between phrases, one idea at a time, allow more time for patient to respond.
A	Assist with communication: Actively help the patient with communication	Ask questions in a different way to help patient understand (e.g., multiple choice; yes/no).
M	Mix communication methods: Show, do not tell	Keep a small white board/pad of paper handy to write key words or draw. Use pictures, alphabet boards, gestures.
E	Engage the patient first: Respect each patient's abilities and autonomy	Communicate directly with the patient. Do not ignore patient and talk only to family/caregivers.

Note. From "Heath care provider accommodations for patients with communication disorders" by M. I. Burns, C. Baylor, B. J. Dudgeon, H. Starks, and K. Yorkston, 2017, *Topics in Language Disorders, 37,* p. 317. Copyright 2017 by Wolters Kluwer Health. Adapted with permission.

3. If a significant communication impairment is suspected or identified, particularly if the assessor/provider is not confident in their ability to communicate effectively with the patient, a referral to an S-LP should be considered (Bill C-14; 241.2; 3; i, 2016; SAC, 2016).

4. If a significant communication impairment is identified, an independent communication assessment by an S-LP should be carried out prior to MAiD assessments. This allows assessment of receptive and expressive abilities, and identification of potentially beneficial compensatory strategies or alternative and augmentative communication tools (Buchel, 2018; Chahda et al., 2017; Pollens, 2004).

    - Basic recommendations may include face to face assessments in a quiet room with the patient wearing all their assistive devices such as glasses and hearing aids (Buchel, 2018).

    - Compensatory strategies may include using close-ended or multiple choice questions, changing rate and/or volume of speech, over articulation, use of short simple sentences, summarization, and sign-posting (Buchel, 2018).

    - Augmentative and alternative communication device recommendations may include low-technology (e.g., white boards, paper and pen for writing/drawing, alphabet boards, picture boards, eye gaze board and portable speech amplifiers) and high technology devices (e.g., iPad apps, speech generating devices; Buchel, 2018).

    - An example of a picture-based communication board designed specifically for use in discussions and assessments for MAiD was developed in Ottawa. This will be made available through the Canadian Association of MAiD Assessors and Providers website (https://camapcanada.ca/). Other resources are being developed and distributed through the MAiD Community of Practice Forum of SAC (n.d.).

5. Following assessment, S-LPs should provide the MAiD team with information regarding the patient's communication abilities, compensatory strategies that are needed, and whether an S-LP should be present at MAiD eligibility assessments to act as a communication intermediary (Buchel, 2018; Pollens, 2004; SAC, 2016).

6. If necessary, S-LPs should attend MAiD eligibility assessments and procedures to act as a communication intermediary (Bill C-14; 241.2; 3; i, 2016; Buchel, 2018).

Anticipated Challenges

There are anticipated challenges to implement these recommendations in Canada. First, MAiD assessors and providers may not recognize cases where S-LPs' involvement may be useful. For example, a survey of family and internal medicine physicians revealed that only 46% of participants were likely to refer patients with a diagnosis of dementia to an S-LP (Korstjens, Haak, Phillips, & Molt, 2011). Addressing this knowledge gap is one of the goals of these recommendations. Second, as this is a relatively new procedure in Canada, S-LPs may not feel they have the appropriate experience to assess terminally ill patients. This may be mitigated in part by opportunities such as the MAiD Community of Practice forum through SAC (n.d.), which connects S-LPs from across the country who are involved in the MAiD process as well as provides a mechanism for sharing resources. A third anticipated challenge is access to S-LPs to be involved on MAiD teams. Certain S-LPs may not wish to be involved in the MAiD process due to conscientious objection, like other health professions including physicians and nurses (Petropanagos, n.d.). Within hospital settings the addition of involvement on a MAiD team may be challenging to balance with other clinical expectations of the institution. The MAiD team at each institution could advocate for institutional level support of S-LPs' involvement in applicable cases. Availability could be addressed by compiling a pool of experienced S-LPs who consent to be involved, both on a local and a national level.

S-LPs, like all clinicians involved in MAiD, are at risk for burnout or compassion fatigue, which would be expected to be similar to the high reported rates in palliative care of 62% (Kamal et al., 2016). S-LPs may be at higher risk than other clinicians given the extent of their involvement throughout the MAiD process, at an independent S-LP assessment, both physician assessments, and the procedure (M. Kekewich, personal communication, January 25, 2019). While clinician well-being has been acknowledged as a concern for those involved in MAiD, there is a lack of published information on management strategies (Canadian Institute for Health Information, 2017). Strategies that have been identified as helpful to prevent and improve burnout in other health care settings include mind-body skills, education, developing personal coping mechanisms, physical well-being, professional relationships, seeking emotional support from colleagues and friends, taking time away, taking a transcendental approach, clinical variety, establishing personal boundaries, and involvement in hobbies (Boyle, 2011; Kamal et al., 2016; Perez et al., 2015; Swetz, Harrington, Matsuyama, Shanafelt, & Lyckholm, 2009). In this context, initial resources could include peer support through the MAiD Community of Practice forum as well as debriefing with other members of the S-LP's local MAiD team (SAC, n.d.).

Conclusion

Communication is of key importance in MAiD assessments of eligibility in all patients. In patients with communication impairments, the involvement of speech-language pathology should be considered to assess their cognitive and communication abilities, facilitate assessment of capability to make health care decisions, and recommend strategies to augment their communication abilities.

The paucity of literature regarding the role of S-LPs in MAiD, as well as the potential impact on clinicians involved in MAiD is another challenge for implementing these recommendations. There is ample opportunity for research as clinicians gain experience with this relatively new process in Canada.

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A Pilot Study on the Mirror Effect PLUS Protocol: A Standardized and Adapted Facial Rehabilitation for Acute Bell's Palsy

Une étude pilote sur le protocole *Effet Miroir Plus*, une rééducation orthophonique standardisée et adaptée à la paralysie de Bell en phase aiguë

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Abstract

Combining early facial exercises with medication may help patients with acute Bell's palsy recover significantly faster and better than patients treated with medication alone. To date, exercise therapy in acute Bell's palsy consists mostly of transferring facial rehabilitation techniques that were developed for chronic Bell's palsy, despite the differences between those stages. The aim of this pilot study was to estimate the efficacy of the Mirror Effect PLUS Protocol, the first facial rehabilitation protocol specifically designed for acute Bell's palsy. Ten patients with acute moderate-to-severe, severe, and total Bell's palsy were recruited and assigned randomly to the Mirror Effect PLUS Protocol group or the control group. Both groups received the recommended medications. In addition, patients in the rehabilitation group performed exercises that were completed using a computer that duplicated their healthy hemiface. Compared to controls, a greater number of patients in the Mirror Effect PLUS Protocol group presented better facial symmetry and greater satisfaction towards their facial function. There were no differences in recovery between the rehabilitation and control groups; however, for the subset of patients with severe palsy, the Mirror Effect PLUS Protocol improved and accelerated recovery. These preliminary results support the hypothesis that the Mirror Effect PLUS Protocol enhances the recovery of severe acute Bell's palsy. However, replication of these results with larger samples is necessary. Additionally, the intervention's precise mechanisms of action need to be investigated thoroughly to exclude the effect of spontaneous recovery.

Abrégé

Combiner une rééducation orthophonique à la prise de médicaments pourrait favoriser un rétablissement plus rapide et optimal des patients présentant une paralysie de Bell en phase aiguë, comparativement à la prise seule de médicaments. Présentement, la rééducation qui est offerte aux patients présentant une paralysie de Bell en phase aiguë consiste principalement en l'utilisation de techniques ayant été développées pour les patients ayant une paralysie de Bell chronique, et ce, malgré les différences entre ces stades de la pathologie. L'objectif de la présente étude pilote était d'évaluer l'efficacité du protocole Effet Miroir Plus, un premier protocole de rééducation orthophonique spécifiquement conçu pour la paralysie de Bell en phase aiguë. Dix patients présentant une paralysie de Bell en phase aiguë de degré «modéré à sévère» ou «sévère», ou encore, pouvant être qualifiée de «totale» ont été recrutés. Ceux-ci ont été divisés aléatoirement dans deux groupes : un groupe de patients à qui le protocole Effet Miroir Plus a été administré et un groupe contrôle. Les deux groupes ont pris les médicaments recommandés dans le traitement standard de la paralysie de Bell. Les patients du groupe à qui une rééducation orthophonique a été offerte ont également effectué des exercices musculaires en utilisant un ordinateur qui dupliquait leur hémiface saine. Lorsque comparés aux patients du groupe contrôle, un plus grand nombre de patients du groupe Effet Miroir présentaient une meilleure symétrie faciale et une plus grande satisfaction à l'égard de leur fonction faciale. En termes de rétablissement, aucune différence n'a été notée entre les groupes, sauf pour le sous-ensemble de patients ayant une paralysie de degré «sévère». Dans ce cas précis, le protocole Effet Miroir Plus a amélioré et accéléré le rétablissement. Ces résultats préliminaires soutiennent l'hypothèse que le protocole Effet Miroir Plus améliore le rétablissement des patients ayant une paralysie de Bell en phase aiguë de degré « sévère ». Il sera toutefois nécessaire de répliquer ces résultats avec des échantillons plus importants. Ajoutons qu'il sera également important d'investiguer de façon approfondie les mécanismes d'action précis de la rééducation orthophonique pour exclure l'hypothèse d'un rétablissement spontané.

Idiopathic peripheral facial palsy, also called Bell's palsy (BP), is a distressing condition in which people abruptly lose their facial motor function (Prud'hon & Kubis, 2018). With an annual incidence estimated between 11 and 53.3 new cases per 100,000 persons, BP is the most frequent peripheral facial palsy (Ferreira, Marques, Duarte, & Santos, 2015). BP is thought to be caused by the reactivation of the herpes simplex type 1 virus at the level of the facial nerve (de Almeida et al., 2014). The virus causes inflammation and nerve entrapment in the internal auditory canal and/or stylomastoid foramen and can potentially lead to axonal injury (Ferreira et al., 2015). To date, the combination of corticosteroid and antiviral therapies is the "gold standard" for treating acute BP (Gagyor et al., 2015; Sullivan, Daly, & Gagyor, 2016). Complete recovery is expected without treatment in 70% of BP cases and this proportion increases with oral corticosteroid and antiviral treatment (Prud'hon & Kubis, 2018). Despite adequate medication, 5% to 30% of patients that present with acute severe and total BP are at risk of developing permanent sequelae, such as synkinesis, dysarthria, and oral dysphagia (Prud'hon & Kubis, 2018). Early facial rehabilitation could further reduce the proportion of patients with permanent sequelae (Ferreira et al., 2015); however, there are few efficiency studies on this topic and the rehabilitation programs that consider the specificity of acute BP are lacking (de Almeida et al., 2014).

Recent neuroimaging studies have shown that BP causes significant neuroanatomical changes in sensorimotor associative areas as soon as the first few days following onset (Klingner, Volk, Brodoehl, Witte, & Guntinas-Lichius, 2014; Song et al., 2017). These early changes suggest that these BP-induced cortical modifications are the result of a discordance between the motor efferents that are preserved and the sensory afferents that are affected (Klingner et al., 2014). In other words, in BP (as opposed to facial palsy caused by central injury, such as a stroke), the palsy prevents the efferent signal from reaching the muscles, but the sensory afferents that indicate muscle immobility are detected by the sensory cortex, which causes an early sensory-motor mismatch (Song et al., 2017). The speed at which these changes develop suggests that rapid intervention is desirable (Barbara, Antonini, Vestri, Volpini, & Monini, 2010; Monini et al., 2016). However, very few high-quality studies have been conducted to evaluate the effect of facial rehabilitation in acute BP, considering the high rates of spontaneous and complete recovery (de Almeida et al., 2014).

A literature review and meta-analysis conducted by Pereira et al. (2011) showed that data on early facial therapy were scarce and that no meta-analysis was possible on that matter; a meta-analysis was only possible for interventions in chronic facial palsy. In a more recent systematic review, Ferreira et al. (2015) searched over 200 studies to answer the following question: Can exercise therapy and standard drug treatment have positive effects on the quality and time of recovery for acute and subacute BP? Only four clinical trials met the quality criteria to be included in the review, which confirms the need for more research. The described protocols used for acute intervention in these studies were either developed for chronic BP or were not described well enough to be replicated. The rehabilitation protocols tested in these studies included Neuromuscular Retraining, which consists in individualised facial exercises (Nicastri et al., 2013); Kabat Rehabilitation, which consists of stretching and manipulating the face (Barbara et al., 2010); the Chevalier Method, which consists of analytic muscle exercises (Penteado, Testa, Antunes, & Chevalier, 2009); and finally, electrical stimulation combined with exercise therapy (Alakram & Puckree, 2010).

These studies, however, had several methodological issues such as inadequate follow-up, a lack of blind assessors, and a lack of allocation concealment. Two of these studies did not include randomization (Alakram & Puckree, 2011; Penteado et al., 2009). Only one of these studies received a good methodological quality score (Nicastri et al., 2013), which was evaluated by the PEDro Scale (see Maher, Sherrington, Herbert, Moseley, & Elkins, 2003, for more information on the PEDro scale); the others were rated as either fair or poor (Alakram & Puckree, 2011; Barbara et al., 2010; Penteado et al., 2009). Nonetheless, based on that small sample, Ferreira et al.'s (2015) conclusions are interesting: Early facial rehabilitation combined with the gold standard medication helps patients with severe, total, and persistent BP (over 14 days post-onset) to recover significantly faster and to a better extent than patients who received the medication alone.

Development of the Mirror Effect PLUS Protocol

To date, none of the existing facial rehabilitation protocols thoroughly described in the literature were specifically designed for acute BP. Very little data support the use of facial exercise therapy in acute BP despite its potential benefits for recovery (Ferreira et al., 2015). As a result, medical guidelines cannot recommend exercise therapy for acute BP (de Almeida et al., 2014). The Mirror Effect PLUS Protocol (MEPP) was thus developed to fill this important gap. **Table 1** offers an overview of the characteristics of the MEPP.

The MEPP is the first standardized facial rehabilitation protocol designed for acute moderate-to-severe, severe,

Table 1

Description of the Mirror Effect PLUS Protocol

	Mirror Effect Plus Protocol
Structure	
Assessments	First assessment between day 10 and 14 post-onset
	Monthly follow-up assessments. Allow adjustments of the exercises if needed and if apparition of synkinesis is detected
Therapy sessions	45 minutes, twice a week for 2 weeks. Add therapies weekly for trouble shooting if needed • Education on facial anatomy and function • Description of the facial exercises and adjustments made if needed • Progressive diminution of commentaries/feedback during therapy. This should help motor learning even if it decreases spontaneous motor performance
Home exercises	10 minutes of facial massages (twice a day)
	15 minutes of daily facial exercises with a specialised website using the mirror effect. (see below)
	Motor imagery sessions for total facial palsy and to help integrate the facial anatomy as well as subtle kinaesthetic cueing
	*In case of synkinesis: make target movement without eliciting the synkinesis by reducing amplitude of target movement. Repeat in series of 5 repetitions, twice a day
	Education on facial anatomy and function
Exercises	
Nature	Think about something surprising and rise gently the eyebrows. Release.
	Think about something frustrating and gently frown the eyebrows. Release.
	Close and open the eyes very SLOWLY while feeling progressively the opening and closing on the eyelid.
	Think about something disgusting and wrinkle your nose GENTLY and briefly. Release.
	Think about something funny and smile with closed mouth. Release.
	Think about something funny and smile with open mouth. (The index finger should follow the movement on the cheeks). Release.
	Think about someone you love and send him/her a kiss. Release.
	Think about something disgusting and make a gentle inverted smile. Release.
Repetitions	5 times each
Randomization	Each exercise sequence should be done in a random order, from session to session.
Contraction/Rest time ratio	Hold contraction for 3 seconds, rest for 3 to 5 seconds.

Note. * = optional.

and total BP. It was developed as a two-step procedure. First, it is based on relevant components from two existing facial rehabilitation protocols: the Mirror Effect Protocol (Blanchin, Martin, & Labbe, 2013; Garmi, Labbé, Coskun, Compère, & Bénateau, 2013) and Neuromuscular Retraining protocol (Diels, 1995). The Mirror Effect Protocol was designed to help patients regain smile symmetry after corrective facial surgery. It uses modified visual biofeedback that is created by a computer application, software, or a website that duplicates the patient's healthy hemiface during facial exercises (Blanchin et al., 2013). We included the use of a modified visuo-feedback mechanism in the MEPP because it should decrease the early cortical sensory-motor disturbances that occur in acute BP, which makes the MEPP particularly well-suited for early intervention in BP. Interestingly, the Mirror Effect Protocol has been shown to be effective (Blanchin et al., 2013) and to increase patients' compliance (Martineau, Rahal, Dufour-Fournier, & Marcotte, 2018). As the Mirror Effect Protocol was developed to help regain smile symmetry, it mainly focuses on moving the muscles around the mouth (Blanchin et al., 2013). In the MEPP, exercises for different facial regions (forehead, eyes, nose, and neck) were added.

Also, components of the Neuromuscular Retraining protocol (Diels & Combs, 1997) were included in the MEPP. For chronic BP, Neuromuscular Retraining is considered to be the gold standard for facial rehabilitation (Pereira et al., 2011). It mostly consists of re-learning adequate facial movements through individualized, slow, and specific facial exercises (Diels, 1995). Some of its components regarding the neural and motor mechanisms of the facial musculature, such as the importance of working slowly and using emotional feedback (Diels & Beurskens, 2014), are also relevant for acute BP therapy. Taking those components into account allowed us to provide more precise instructions than the original instructions for the original Mirror Effect Protocol. For example, we used "Think about something surprising and gently raise the eyebrows. Release," rather than "Lift the eyebrows."

Some parameters of both the Mirror Effect Protocol and Neuromuscular Retraining, particularly the exercises (i.e., their precise nature, the number of repetitions, and the contraction/rest time ratio), are not well-defined in the literature. Consequently, as a second step for the development of the MEPP, all the missing components were defined using motor learning principles (Caramazza, Anzellotti, Strnad, & Lingnau, 2014; Cisek & Kalaska, 2010; Eaves, Riach, Holmes, & Wright, 2016; Maas et al., 2008; Macuga & Frey, 2012; Ramachandran & Altschuler, 2009; Ramachandran, Rogers-Ramachandran, & Cobb, 1995; Shea, 2014; Shumway-Cook & Woolacott, 2017; Vogt, Di Rienzo, Collet, Collins, & Guillot, 2013; Wright, Williams, & Holmes, 2014) and based on the characteristics of the facial muscles in acute BP (Devriese, 1994; Diels & Beurskens, 2014; Mancini et al., 2014; Monini et al., 2016; Nicastri et al., 2013; Nusser-Müller-Busch, 2015; Pohl, Anders, Schulte-Ruther, Mathiak, & Kircher, 2013; Prud'hon & Kubis, 2018; Ranganathan, Siemionow, Liu, Sahgal, & Yue, 2004; Sittel & Stennert, 2001; Stal, 1994). By combining motor learning principles and the characteristics of the facial muscles in acute BP, we developed a well-defined protocol specifically designed for acute interventions in patients with BP.

Very few facial rehabilitation programs have been thoroughly described and there is no specific standardized re-education protocol for acute BP. The purpose of this article is to describe the MEPP, a protocol that was based on the Mirror Effect Protocol and Neuromuscular Retraining and developed based on relevant motor learning principles and the particularities of the facial muscles and issues encountered in acute BP. To demonstrate the clinical use of the MEPP, we present a pilot study to estimate the efficacy of the MEPP in acute moderate-to-severe, severe, and total BP by comparing two different conditions: medical treatment (i.e., medication) alone, which is the gold standard treatment for acute BP, and medical treatment combined with the MEPP. Our hypothesis was that the combination of medical treatment and the MEPP would enhance patients' recovery from severe and total BP, compared to medical treatment alone.

Method

Participants and Procedure

This pilot study is part of a larger study. Of the 123 referrals received between January 2017 and October 2018, 10 patients (4 men, 6 women, M_{age} = 50.7 years) were recruited. All patients were recruited from the emergency rooms at the Hôpital du Sacré-Coeur de Montréal and Hôpital Maisonneuve-Rosemont as well as the Otorhinolaryngology department of the Hôpital Maisonneuve-Rosemont. The participants had no other diseases or health problems and took no medications on a regular basis prior to BP onset. This was their first episode of BP, and they all received the recommended medications for severe and total BP (1000 mg of valacyclovir three times a day for 7 days and 50 mg of prednisone once a day for 10 days) within 72 hours of disease onset (Gagyor et al., 2015). Patients provided their free and informed consent to participate in the experiment, which was conducted with the approval of the ethics committee of *Centre de recherche du Centre intégré universitaire de santé et services sociaux du Nord-de-l'île-de-Montréal* (MP-32-2017-1365).

To assess the severity of facial palsy, most studies use the Facial Nerve Grading System (FNGS; Di Stadio, 2015), also called the House-Brackmann Scale (House & Brackmann, 1985). The Sunnybrook Facial Grading System (SB; Ross, Fradet, & Nedzelski, 1996) was developed a few years after the FNGS and is more sensitive to changes than

FNGS (Kanerva, Poussa, & Pitkaranta, 2006). More recently, Vrabec et al. (2009) developed the Facial Nerve Grading System 2.0 (FNGS 2.0) to incorporate regional scoring and synkinesis scoring. The FNGS 2.0 shows high intra- and inter-observer agreement with the FNGS scale, as well as better sensitivity to changes than the original FNGS (Vrabec et al., 2009). Although the FNGS 2.0 and SB facial nerve grading scales have excellent agreement and validity (Fattah et al., 2015), these scales do not evaluate the effect of the facial palsy on the patient's quality of life (Coulson, O'Dwyer, Adams, & Croxson, 2004) and its functional impact on speech and the oral stage of swallowing (i.e., lip seal and bolus preparation). The Facial Disability Index is one of the most frequently used and best-validated self-report questionnaires for the assessment of physical and social/well-being functions in facial palsy (Brach, VanSwearingen, Delitto, & Johnson, 1997). The Facial Disability Index provides additional information on the handicap caused by the facial palsy and describes how the facial palsy affects the patient's quality of life.

For the present study, a certified speech-language pathologist (SM) assessed the severity of BP, 10 to 14 days after onset, using the FNGS 2.0 (Vrabec et al., 2009) and SB (Ross et al., 1996) grading systems. Both scales were chosen for their high inter-observer agreement and validity (Fattah et al., 2015). Only patients who still presented moderate-to-severe, severe, or total BP (FNGS 2.0 grades 4, 5, or 6) on this initial assessment were recruited for the study.

To measure the patients' perception regarding their speech and swallowing impairments, each participant was asked the Facial Disability Index's first three questions on physical function during the initial assessment and at 2 months post-onset. These three questions were related to swallowing solids, drinking liquids, and making specific sounds with their mouths. A disability score for speech and swallowing was calculated at both timepoints using the formula proposed by VanSwearingen and Brach (1996):

$$\frac{\text{Total Score (questions 1-3)} - N}{N} \times \frac{100}{4}$$

where N = 3 (number of questions answered in the present study), which gives a score that ranges from -25 (worst) to 100 (best).

After the first assessment, patients were assigned using balanced block randomization to either the MEPP intervention group (*n* = 5; 1 man, 4 women) or the control group (*n* = 5; 3 men, 2 women). Computerized randomization was performed by an external researcher who was not in direct contact with the patients. Two reassessments were conducted at 1 and 2 months post-onset. Each assessment was video-recorded with a Samsung Galaxy S5-Neo, transferred to a PC, and converted into an MP4 video file.

The position of the camera was standardized and always positioned in front of the patient at a distance of approximately 1 meter. The video files of these two assessments were analyzed by three independent, certified speech-language pathologists who were blinded to the assessment time and group assignment. All the FNGS 2.0 grades and SB scores reported in this study were determined by the blinded assessors based on their observations of the videos.

Intervention protocols. **Table 1** provides a detailed description of the MEPP. We also provide details on each therapy session for clarity and replicability (see Appendix), including the duration, objectives pursued, and intervention techniques. Briefly, the intervention group received the MEPP, which was administered during four in-clinic sessions that took place in the first 2 weeks after the first assessment. During those four sessions, the patients received information on facial function and anatomy and practiced motor imagery (see Eaves et al., 2016). The facial exercises were then explained and executed with the help of a free web page that provides modified visual biofeedback and a symmetrical face (www.webcamtoy.com). Facial exercises were provided for each muscle group of the face with emotional cueing, a specific pace, and a contraction/rest time ratio. A written document that contained detailed information about the exercises was given to each patient. Exercises were continued at home twice a day until recovery.

The control group received basic counselling, such as instructions on how to avoid excessive facial movements, but did not attend any therapy sessions.

Outcome definition and measurement. Based on the work of Nicastri et al. (2013), the primary outcome was the improvement in recovery at each assessment time as measured by the FNGS 2.0 and SB scales. Recovery was defined as an FNGS 2.0 grade of 2 or less (Nicastri et al., 2013) and an SB score of 60 or more (Neely, Cherian, Dickerson, & Nedzelski, 2010). The secondary outcome was any improvement reported by the patients with regard to their speech and swallowing impairments, which were assessed using the difference (over time) in the physical function score of the Facial Disability Index. Recently, patient-related outcome measures have gained attention as important measures of satisfaction towards interventions in facial palsy (Gyori et al., 2018); however, their use remains relatively scarce compared to the use of impairment-based scales, which are clinician-administered. Gyori et al. (2018) reported that only 12% of the professionals that worked with facial palsy patients used the Facial Disability Index. In comparison, Santosa, Fattah, Gavilán, Hadlock, and Snyder-Warwick (2017) reported that 60% of clinicians used the FNGS and 58% used the SB. Therefore, to be able to compare our findings with other studies and render them uniform with clinical and research settings worldwide, we chose to use the scores from the FNGS 2.0 and SB as primary outcomes and the Facial Disability Index score as a secondary outcome.

Statistical analysis. To illustrate the effect of the treatment between the two samples, we calculated the Cohen's *d* standardized mean effect. This descriptive statistic is based on the mean difference between two subjects, divided by the pooled standard deviation (Cohen, 1977). We calculated it for the FNGS 2.0 and SB results. According to Cohen's convention, an effect is considered large if $d = 0.8$, moderate if $d = 0.5$, and small if $d = 0.2$ (Cohen, 1977). To ensure a more reliable and accurate comparison of the two groups, we included a stratification as previously performed by Nicastri et al. (2013). In their study, they stratified their patients by FNGS grades and showed that therapy was efficient only for patients with grade 5 (severe) and grade 6 (total) palsies and not for patients with grade 4 (moderate to severe) palsies. A similar post-hoc procedure was performed in the present study. Based on Nicastri et al. (2013), the stratification was performed to include only initial FNGS 2.0 grades 5 (severe). We did not include grades 6 as only one patient, which was in the MEPP group, had this initial grade.

Results

Table 2 presents the demographic characteristics of both groups, their FNGS 2.0 grades, and their SB and Facial Disability Index scores, all of which were obtained during the first assessment (i.e., 10–14 days post-onset). The inter-rater agreement between the blinded assessors was measured for both the FNGS 2.0 and SB and revealed intra-class correlation coefficients of 0.98, 95% CI [0.97, 0.99] and 0.97, 95% CI [0.95, 0.99], respectively. At baseline, the MEPP group presented with more severe BP than the control group (mean FNGS 2.0 grades of 5 and 4.6, respectively, and mean SB scores of 17 and 27, respectively), but these differences were not statistically significant when evaluated by the Mann-Whitney test ($p = .643$ and $.310$, respectively).

As reported in **Table 3**, at 1 month post-onset, one patient in the MEPP group reached the primary outcome, but none of the patients in the control group reached this outcome. At 2 months post-onset, four patients in the MEPP group reached a grade of 2 or less, but only one patient in the control group reached a grade of 2. **Table 4** displays the SB scores obtained for each patient at each of the assessment times. At 1 month post-onset, two patients in the MEPP group and three patients in the control group had scores of 60 or more (i.e., recovery). At 2 months post-onset, four patients in each group had scores of 60 or more, but the MEPP group had higher scores overall. Finally, **Table 5** presents the individual scores for speech and swallowing from the physical function of the Facial Disability Index at the initial and final assessments. In the MEPP group, three patients indicated that they had no difficulties with speech

Table 2

Initial Demographic and Clinical Characteristics of Both Groups

	Controls	MEPP
Sex, *n* (%)		
Female	2 (40%)	4 (80%)
Male	3 (60%)	1 (20%)
Age, *M* (*SD*) in years	43.6 (11.3)	57.8 (13.3)
FNGS 2.0 grade 10–14 D.P.O., *n* (%)		
4	2 (40%)	1 (20%)
5*	3 (60%)	3 (60%)
6	0 (0%)	1 (20%)
SB score, *M* (*SD*)	27.0 (7.6)	17.0 (8.0)
FDI score, *M* (*SD*)	39.8 (14.6)	41.5 (12.9)

Note. * identifies the 6 patients included for the stratification. Facial Nerve Grading Scale 2.0 (FNGS 2.0) scores: 6 = total palsy; 5 = severe palsy; 4 = moderate-to-severe palsy. Sunnybrook (SB) scores: minimum possible = 0 or total palsy; maximum possible = 100% or normal. Speech and swallowing scores of the Facial Disability Index (FDI): below 25 = worst function; 100 = best function. D.P.O. = Days post-onset; MEPP = Mirror Effect Plus Protocol.

Table 3

Individual FNGS 2.0 Grades and Means at Each Assessment Time in Both Groups

	FNGS 2.0 grade		
	10–14 D.P.O.	1 M.P.O.	2 M.P.O.
MEPP group			
Participant 1*	5	3	**2**
Participant 4	4	3	**2**
Participant 5	6	6	5.3
Participant 9*	5	**2**	**1.6**
Participant 10*	5	2.3	**2**
M (*SD*)	5 (0.7)	3.2 (1.5)	2.5 (1.5)
Control group			
Participant 2*	5	5	4.6
Participant 3	4	2.6	2.6
Participant 6	4	3	2.3
Participant 7*	5	3	**2**
Participant 8*	5	3	2.3
M (*SD*)	4.6 (0.5)	3.3 (0.9)	2.7 (1.5)

Note. * identifies the 6 patients included for the stratification. The reported FNGS 2.0 are a mean of 3 blind assessors. Scores in bold represent those who achieved recovery. Facial Nerve Grading Scale 2.0 (FNGS 2.0) scores: 6 = total palsy; 5 = severe palsy; 4 = moderate-to-severe palsy; 3 = moderate; 2 = mild; 1 = normal function. D.P.O. = Days post-onset; MEPP = Mirror Effect Plus Protocol; M.P.O. = Months post-onset.

Table 4

Individual SB Grades and Means at Each Assessment Time in Both Groups

	SB grade		
	10–14 D.P.O.	1 M.P.O.	2 M.P.O.
MEPP group			
Participant 1*	21	59.3	**92.6**
Participant 4	28	57.3	**80**
Participant 5	7	4	9
Participant 9*	24	**88.3**	**91.3**
Participant 10*	22	**66.6**	**85**
M (*SD*)	20 (7.9)	55 (31.1)	71 (35.3)
Control group			
Participant 2*	22.6	30	34
Participant 3	38	**66.6**	**66.6**
Participant 6	30.6	**75**	**82.3**
Participant 7*	25	**61**	**87**
Participant 8*	19	59.6	**80**
M (*SD*)	27 (7.4)	58 (17)	69 (21.5)

Note. * identifies the 6 patients included for the stratification. The reported SB mean grades are a mean of 3 blind assessors. Scores in bold represent those who achieved recovery. Sunnybrook (SB) scores: minimum possible = 0 or total palsy; maximum possible = 100% or normal. D.P.O. = Days post-onset; MEPP = Mirror Effect Plus Protocol; M.P.O. = Months post-onset.

Table 5

Individual Scores and Means for Speech and Swallowing of the Facial Disability Index at Initial and Final Assessments in Both Groups

	Speech and swallowing scores of the Facial Disability Index	
	10–14 D.P.O.	2 M.P.O.
MEPP group		
Participant 1*	57.5	**100.0**
Participant 4	33.3	**100.0**
Participant 5	41.6	50.0
Participant 9*	50.0	**100.0**
Participant 10*	25.0	83.0
M (*SD*)	41.5 (12.9)	86.6 (21.7)
Control group		
Participant 2*	57.5	57.5
Participant 3	25.0	75.0
Participant 6	41.6	91.0
Participant 7*	50.0	**100.0**
Participant 8*	25.0	83.0
M (*SD*)	39.8 (14.6)	81.3 (16.2)

Note. * identifies the 6 patients included for the stratification. Scores in bold represent those who indicated having perfect function. Speech and swallowing scores of the Facial Disability Index scores: below 25 = worst function; 100 = best function. D.P.O. = Days post-onset; MEPP = Mirror Effect Plus Protocol; M.P.O. = Months post-onset.

or swallowing, and thus obtained the best possible score (100%). Only one patient in the control group indicated that they had no difficulties with speech or swallowing.

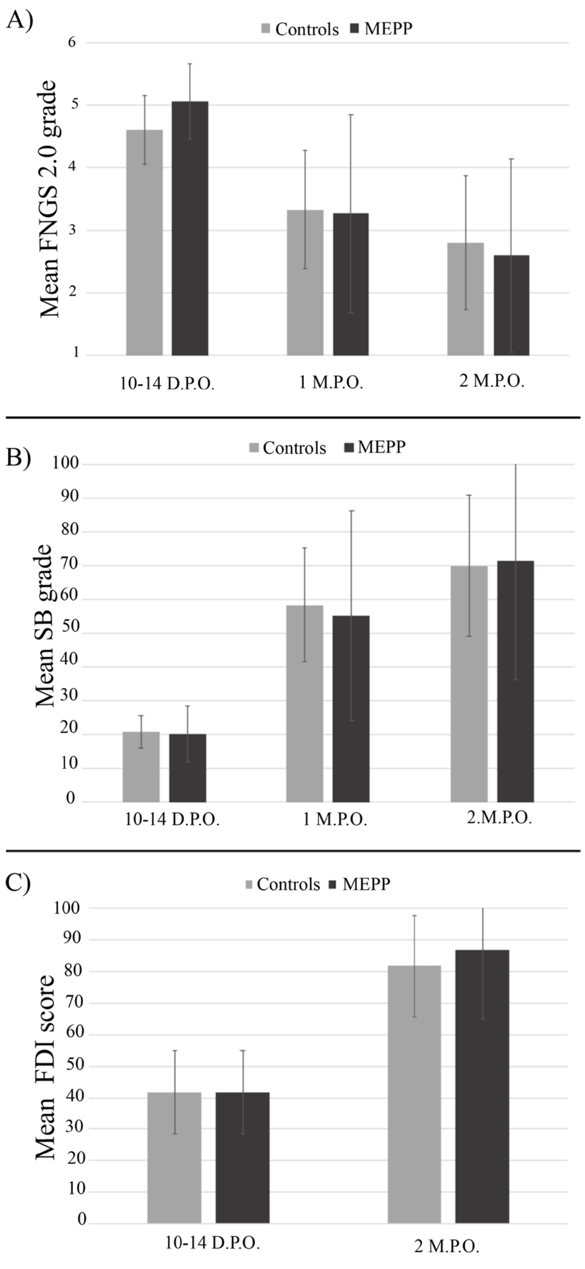
Figure 1 presents the mean FNGS 2.0 grades and SB scores obtained by each group at each assessment time, as well as the physical function score of the Facial Disability Index at the initial assessment and 2 months post-onset. There was no significant effect of MEPP treatment on the primary and secondary outcomes for the entire study sample.

As mentioned in the Method, we used a post-hoc stratification procedure, based on the work of Nicastri et al. (2013). Three patients in each group presented with FNGS 2.0 grades of 5 at the first assessment, which constituted two-thirds of our sample. We quantified the treatment effect size on those six patients using a Cohen's *d* measure on the difference between the 2 months post-onset scores and the initial scores. Although our groups were small, the effect size for FNGS 2.0 (*d* = 0.81), SB (*d* = 1.29), and the physical function score of the Facial Disability Index (*d* = 0.82) exceeded Cohen's convention for a large effect (*d* = 0.80). **Figure 2** presents the mean FNGS 2.0 grades and SB scores obtained by each subgroup at each assessment time, as well as the physical function score of the Facial Disability Index at the initial assessment and 2 months post-onset. On the FNGS 2.0 scale, the results indicate that individuals in the MEPP group recovered to a greater extent (*M* = 3.1, *SD* = 0.2) than patients in the control group (*M* = 2.0, *SD* = 1.4). Similarly, for the SB scores, the MEPP group underwent greater changes between the 2 months post-onset assessments and the initial assessments (*M* = 71.6, *SD* = 4.3) than did the control group (*M* = 44.8, *SD* = 29.0). Patients in the MEPP group also reported greater changes in their speech and swallowing abilities between the 2 months post-onset assessments and the initial assessments (*M* = 47.2, *SD* = 4.8) than the control group (*M* = 33.3, *SD* = 28.9) on the physical function score of the Facial Disability Index.

Discussion

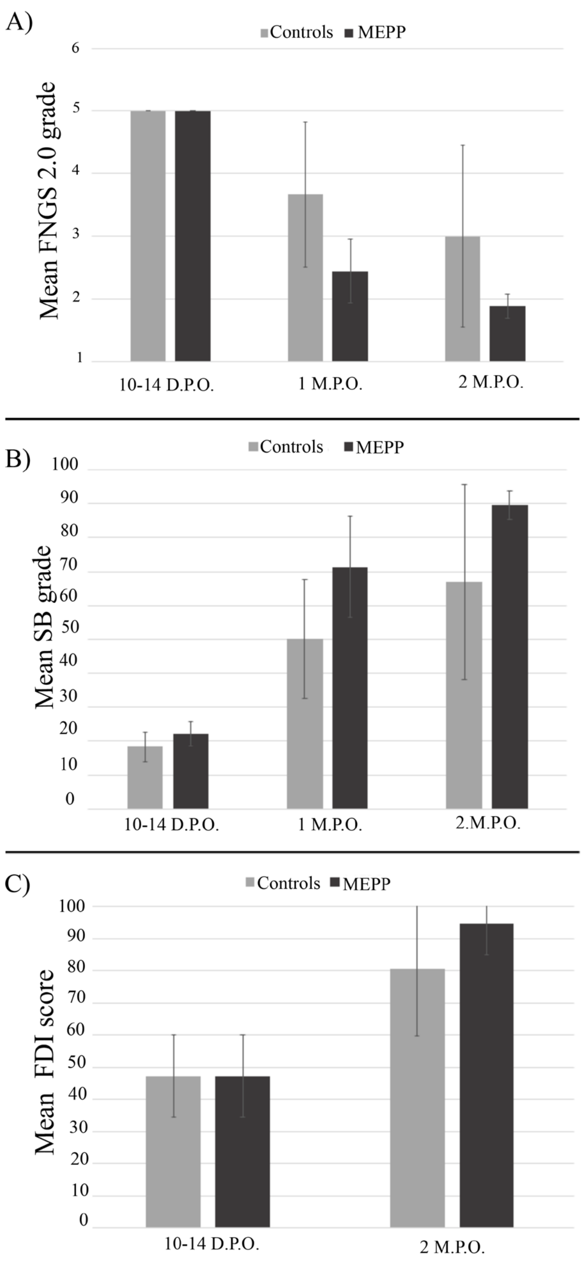
Here we described a detailed intervention protocol adapted for acute moderate-to-severe, severe, and total BP, called the MEPP. Although facial rehabilitation for chronic BP has been a research topic for more than 40 years, this is

Figure 1



Mean scores of Facial Nerve Grading System 2.0 grade (A), Sunnybrook (B), and physical function score of the Facial Disability Index (C) by each group at each assessment time. Facial Nerve Grading System 2.0 (FNGS 2.0): VI = total palsy; V = severe palsy; IV = moderate-to-severe palsy; III = moderate palsy; II = mild palsy; I = normal function. Sunnybrook (SB): 0 = total palsy; 100 = normal function. Facial Disability Index: -25 = worst score; 100 = best score. Bars = standard deviation. D.P.O. = days post-onset; FDI = Facial Disability Index; MEPP = mirror effect PLUS protocol; M.P.O. = months post-onset.

Figure 2



Mean scores of Facial Nerve Grading System 2.0 grade (A), Sunnybrook (B), and physical function score of the Facial Disability Index (C) in subgroups of patients with an initial MHB grade of V at each assessment time. Facial Nerve Grading System 2.0. (FNGS 2.0): VI = total palsy; V = severe palsy; IV = moderate-to-severe palsy; III = moderate palsy; II = mild palsy; I = normal function. Sunnybrook (SB): 0 = total palsy; 100 = normal function. Facial Disability Index: -25 = worst score; 100 = best score. Bars = standard deviation. D.P.O. = Days post-onset; FDI = Facial Disability Index; MEPP = mirror effect PLUS protocol; M.P.O. = months post-onset.

the first protocol specifically designed for the rehabilitation of acute BP. The MEPP was developed based on some principles of two other facial rehabilitation protocols (i.e., the Neuromuscular Retraining and the Mirror Effect Protocol) that were designed for chronic facial palsies (Blanchin et al., 2013; Garmi et al., 2013; Martineau et al., 2018; Teixeira, Valbuza, & Prado, 2011) as well as relevant motor learning principles that accounted for the characteristics of the facial muscles in acute BP. We also provided a detailed description of the clinical parameters of this new rehabilitation for a clear clinical overview and to make the protocol easy to replicate (see Appendix). This pilot study showed that, when comparing homogeneous groups, the MEPP improves and accelerates the patient's recovery from acute and severe BP. This is a promising start for establishing the potential efficiency of the MEPP.

In order to compare our results with previous studies, our primary outcome measures were the improvement in recovery, as measured using the FNGS 2.0 and SB scales at three different assessment times. The results from the FNGS 2.0 scale showed that more patients in the MEPP group had recovered at the final assessment, compared to the patients in the control group. As for the SB scale, at 2 months post-onset, the same number of patients reached the recovery criterion in the two groups, but the scores were higher (i.e., better recovery) in the MEPP group. Taken together, these results suggest that the MEPP may improve the recovery from acute BP. However, the functional impacts on speech and swallowing are not covered by these grading systems (Marsk, Hammarstedt-Nordenvall, Engstrom, Jonsson, & Hultcrantz, 2013), which provides an incomplete picture of the effect of our facial rehabilitation (Gyori et al., 2018). Therefore, the physical function questionnaire of the Facial Disability Index on speech and swallowing was included as a secondary outcome. The number of participants who indicated being 100% satisfied with their speech and swallowing was higher in the MEPP group than in the control group. This suggests that the MEPP could not only be effective in reducing the severity of the facial palsy, but could also improve speech and swallowing functions. Also, the results of the present pilot study support the idea that future studies that measure the impact of facial rehabilitation on BP symptoms must also include measures of functional impairments (Moverare, Lohmander, Hultcrantz, & Sjogreen, 2017).

Strict inclusion criteria were established for this study, particularly with regard to the severity of BP, the medication given, and the time post-onset. This procedure helped us to control for the high number of spontaneous recoveries encountered in BP (Fujiwara, Hato, Gyo, & Yanagihara, 2014; Mancini et al., 2014), but it also reduced the number of patients that could be included in the study and, consequently, affected our statistical power and generalization capacity. The strict inclusion criteria were meant to control for patient variability. Furthermore, we applied a stratification strategy, as did Nicastri et al. (2013), that allowed us to consider even more homogeneous groups (e.g., only patients with initial FNGS grades of 5). The results following that procedure showed greater changes in the MEPP group on both scales at 1 and 2 months post-onset, suggesting that the MEPP reduced the severity of the facial palsy and accelerated the patient's recovery from severe BP, which is a promising start for establishing the potential efficacy of the MEPP.

However, our results still displayed high standard deviations. It is generally accepted that severe BP has a poor prognosis (Prud'hon & Kubis, 2018), but the variation of recovery within this group remains unclear because the exact pathogenesis of the disease has not yet been elucidated (Bucak et al., 2014). Our results also highlight the fact that, as the exact mechanisms of BP recovery are largely unknown, larger samples must be recruited for studies that evaluate therapeutic strategies in order to compensate for the unexplained variability in recovery.

One of the central tenets of the MEPP is that it is based on modified visual feedback, or mirror feedback, as originally described by Ramachandran and Altschuler (2009). There are two main reasons why this feature is of great importance during facial rehabilitation for acute BP. First, the visual mirror biofeedback is a concrete application of motor learning principles, even if this was not originally (explicitly) mentioned in the Mirror Effect Protocol literature. The visual mirror biofeedback is an example of using and controlling a sensory stimulus to sustain motor (re)learning. This reflects bottom-up processing, which is the basis of all motor rehabilitation (Shumway-Cook & Woolacott, 2017).

Recently, studies on motor learning principles have precisely identified action observation as a form of motor learning reinforcement and motor imagery as another form. A large body of research supports the use of these two means in motor rehabilitation to improve motor skills (e.g., Berends, Wolkorte, Ijzerman, & van Putten, 2013; Eaves et al., 2016; Vogt et al., 2013; Wright et al., 2014). Action observation involves the observation of the movement, whereas motor imagery involves a mental practice that involves the internal visual and kinesthetic representations of the movement (Eaves et al., 2016). When applied together, action observation and motor imagery are thought to enhance motor learning by activating a neural signature that resembles that of motor execution (Vogt et al., 2013). For example, Wright et al. (2014) reported that single-pulse transcranial magnetic stimulation of the cortical representation of the hand produced greater motor-evoked potentials when stimulation was given during combined action observation and motor imagery than during action observation alone. These results suggest that simultaneously applying action observation and motor imagery facilitates corticospinal excitability.

When this idea is applied to the field of facial re-education, it suggests that visual and kinesthetic inputs, along with instructions that promote concrete mental representations of movements (motor imagery), should be used during facial exercises to enhance motor learning and to compensate for altered facial motor execution. These principles were therefore included in the MEPP with the use of a mirror-effect visual display, which allows action observation. Moreover, motor imagery sessions and the type of instructions provided for facial exercises (i.e., "... concentrate on muscular contractions and try to visualize the movement, even though the face doesn't move") were chosen to facilitate motor execution. Also, based on the available evidence, there is no indication that the MEPP could be deleterious if used to rehabilitate patients with chronic BP.

Second, as mentioned previously, the early cortical modifications that follow BP demonstrate a change in sensorimotor areas, which is thought to be caused by discrepancies between the preserved motor commands and impaired sensory feedback that prevail in the cortex after BP (Song et al., 2017). Indeed, a recent neuroimaging study of acute BP revealed decreased functional connectivity in the secondary somatosensory cortex, insula, thalamus, and cerebellum between 2 and 5 days post-onset (Klingner et al., 2014). Because the MEPP uses modified visual biofeedback during facial exercises, we hypothesize that it could correct these early discrepancies, thus helping to maintain normal functional connectivity and sustain recovery in a bottom-up manner (Blanchin et al., 2013; Garmi et al., 2013). Although we did not collect imaging data in this pilot study, it would be interesting to investigate the neurobiological mechanisms of the MEPP using functional neuroimaging.

The results presented here are limited to 10 patients, and a subset of six patients after stratification, which prevents generalization and does not allow us to distinguish our results from spontaneous recovery. Larger samples will help control for patient variability during the evolution of BP and to draw clearer conclusions regarding the effect of early facial rehabilitation. Moreover, our randomized allocation to the experimental and control groups led to a sex imbalance. To our knowledge, two studies have tested the influence of sex on BP. First, Hsieh, Wu, Wang, and Lee (2009) investigated the factors that correlate with the degree of nerve involvement in early BP and the factors that predict the evolution of the disease. Using a group of 563 patients, no sex effect was found. This finding was confirmed by Fujiwara et al. (2014) who reported that the disease prognosis was not influenced by sex. Therefore, it is unlikely that the sex imbalance in the present study could affect our results.

In future studies, it will be important to assess the progression of patients with a longer follow-up (6 months to 1 year post-onset) in order to determine the stability of the therapeutic effect and its impact on preventing the development of synkinesis (involuntary movements during volitional facial movements), which normally appear 3 to 4 months post-onset (Nicastri et al., 2013). Because recovery was defined by an FNGS 2.0 grade of 2 or less (as in Nicastri et al., 2013) and an SB score of 60 or more, recovery occurred at different times. Therefore, the therapy length differed between patients. It will be important to assess the length of therapy as a potential confounding variable in a larger study that includes more patients in order to measure how this variable influences the stability of recovery during the longitudinal follow-up. The results from these patients serve as a starting point for investigating the efficacy of the MEPP.

Conclusion

The MEPP is the first standardized re-education protocol specifically designed for acute moderate-to-severe, severe, and total BP. Our preliminary results support the hypothesis that the MEPP is effective in enhancing patients' recovery from acute severe BP. This study also highlights the need for the recruitment of a larger population and longer follow-up times as well as better computing tools in order to obtain a more complete understanding of the effects of the treatment.

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Appendix
Clinical Structure of the MEPP

Session 1 (75 min approximately)	
Objective 1: Teaching on facial muscles and massages (45 min)	
Means	• Use any facial muscles schema that details the facial muscles and their innervation with the facial nerve. Begin with education on anatomy and function of each muscle region. • Demonstration and practice of facial massages following the schema: » For each muscular region (forehead, eyes, cheeks, nose, mouth, neck) follow muscle fibers orientation and retain the muscle at its anchor point. Apply a considerable pressure, so that discomfort can be felt (but won't last after massage is done). » Apply a considerable pressure. A discomfort could be felt (but won't last after massage is done).
Objective 2: Teaching of Motor Imagery Sessions **Developing the ability to lightly and specifically move on muscle region at a time. (30 min)**	
Means	• Relax the face, close the eyes and concentrate. • Every day until the next appointment, realize 10 minutes of motor imagery as follows: » Imagine doing ample complete and symmetrical movements of the face. Activate lightly and selectively each different muscle region. Refer to the schema if needed. » Repeat 5 times each with a 5 second pause between each visualization: Lift the eyebrows, Frown the eyebrows, Close the eyes, Open the eyes, Wrinkle your nostrils, Smile with closed mouth, Give a kiss, Stretch the lower lip downwards.

Session 2 (60 min approximately)	
Objective 1: Return on the massages (15 min)	
Means	• Execution of the massages by the patient. Corrections/Troubleshooting if needed
Objective 2: Teaching the exercises on the website (45 min)	
Means	• Instructions: » The healthy side is the reflected side. Stabilize your head with your hand or any other support. The exercises should be done slowly 5 times each, with a 5 second pause between each. While doing the exercises, concentrate on the specific facial movements and try to feel them even though the face doesn't move. Don't force! The other parts of your face should be relaxed. During the exercise, if you feel any movement, you have to touch your paralysed side with your thumb and index finger. Your fingers should follow the ongoing movement for more kinesthesic input. Everyday, mix the order of the exercises given, in a random way. • Exercises: » Think about something surprising and rise gently the eyebrows; Think about something frustrating and gently frown the eyebrows; Close and open the eyes very slowly while feeling progressively the opening and closing on the eyelid; Think about something disgusting and wrinkle your nose gently and briefly; Think about something funny. Smile with the mouth closed; Think about something funny and smile with open mouth. (The index finger and the thumb should follow the movement on the cheeks); Think about someone you love and send him/her a kiss; Think about something disgusting and make an inverted smile.

Session 3 (60 min approximately)	
Objective 1: Return on the exercises with the website (45 min)	
Means	• Invite the patient to do his exercise session in front of you. • Make any necessary correction on speed, precision, and use of sensitive biofeedback. • Decrease verbal instructions to promote motor learning. • When improvement occurs, progressively modify the exercises in order to treat only the remaining impairments.
Objective 2: Counselling regarding specific problems (15 min)	
Means	• Invite the patient to ask any questions about how to do his/her exercises or how to manage its difficulties regarding eating, drinking, and speaking.

Session 4 (45 min)
• Idem as session 3 but with less verbal instructions during exercises, to promote motor learning.

Extra material (30 min)
• Procedure to inhibit synkinesis (approximately around 3-5 months post-onset): Relax face. Do the target movement till the synkinesis is felt. Then relax the synkinesis while holding the target movement. OR Do the target movement with reduced amplitude and hold it just before the synkinesis starts. * If synkinesis are still present at 6 months post-onset, management in the chronic phase should be considered.

Systemic Equity of Access to Speech-Language Rehabilitation for Ontarians With Communicative Disabilities

L'équité systémique de l'accès à la rééducation orthophonique pour les Ontariens ayant un trouble de la communication

Anna Victoria Wong

KEYWORDS

COMMUNICATIVE DISABILITY

POLICY EVALUATION

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ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT

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Abstract

Ontario was the first province to enact accessibility legislation in Canada—the Accessibility for Ontarians with Disabilities Act (2005). Historically, policies, programs, and resources have focused more on people with visible (often mobility) rather than invisible (especially communicative) disabilities. This study examined whether Ontarians affected by invisible communicative disabilities enjoy equitable access to speech-language rehabilitation services under the Act and the current public health service model. To evaluate whether the Act prescribes equitable treatment for Ontarians with communicative disabilities, the statute was compared with the United Nations' (2008) *Convention on the Rights of Persons with Disabilities and Optional Protocol* and the World Health Organization's (2011b) *World Report on Disability*. The Act was also analyzed using Gil's (1992) social policy analysis framework. Population data for people with communicative versus mobility disabilities were drawn from census data published by Statistics Canada. Access to speech-language rehabilitation services in the public domain was compared with that to mobility rehabilitation services using service usage and wait-time data collected from the Ministry of Health and Long-Term Care's Health Data Branch Web Portal (https://hsim.health.gov.on.ca/hdbportal/). Results showed that Ontarians with communicative disabilities have been significantly less well-served in most health settings than those with mobility disabilities, primarily due to a lack of system capacity. More health investments are recommended to increase professional capacity and to improve service accessibility.

Abrégé

L'Ontario a été la première province canadienne à adopter une loi sur l'accessibilité, soit l'*Accessibility for Ontarians with Disabilities* Act [Loi sur l'accessibilité pour les personnes handicapées de l'Ontario] (2005). Historiquement, les politiques, programmes et ressources visaient davantage les personnes ayant des handicaps visibles (souvent moteurs) plutôt qu'invisibles (particulièrement ceux reliés à la communication). L'objectif de la présente étude était d'examiner si les Ontariens ayant un trouble invisible de la communication bénéficiaient d'un accès équitable aux services de rééducation orthophonique en vertu de la loi et du modèle actuel de services de santé publique. Afin d'évaluer si la loi prévoit une prise en charge équitable des Ontariens ayant un trouble de la communication, celle-ci a été comparée à la *Convention on the Rights of Persons with Disabilities and Optional Protocol* [Convention relative aux droits des personnes handicapées et protocole facultatif] des Nations Unies (United Nations, 2008) et au *World Report on Disability* [Rapport mondial sur le handicap] de l'Organisation mondiale de la santé (World Health Organization, 2011b). La loi a également été analysée en utilisant le cadre d'analyse de la politique sociale proposé par Gil (1992). Les données démographiques des personnes ayant un trouble de la communication et celles des personnes ayant un trouble moteur ont été tirées des données de recensement publiées par Statistique Canada. L'accès aux services publics de rééducation orthophonique a été comparé à celui des services de rééducation motrice en utilisant les données d'utilisation des services et de temps d'attente provenant du portail Web des données de santé du *Ministry of Health and Long-Term Care* [Ministère de la santé et des soins de longue durée] (https://hsim.health.gov.on.ca/hdbportal/). Les résultats ont montré que les Ontariens ayant un trouble de la communication étaient significativement moins bien servis dans la majorité des établissements de santé que ceux ayant un trouble moteur, principalement en raison d'un manque de capacité des services professionnels du système. Il est recommandé d'investir davantage dans le secteur de la santé afin d'accroître les capacités des services professionnels et d'améliorer l'accessibilité des services.

Ontario was the first province in Canada to enact legislation specific to the rights of people affected by disabilities to equitable access to services. Canada currently has no relevant federal statutes; instead, provinces enact healthcare statutes to govern a publicly funded healthcare system with publicly accessible healthcare data. Analysis of government-published health outcomes, census data on people with disabilities, and surveys published by service providers and advocacy agencies can show whether the current system meets the needs of people with disabilities.

Social Background

In 2011, 13.7% of Canadians and 15.4% of Ontarians self-identified with a disability (Statistics Canada, 2014). Average annual incomes were lower for men and women with a communicative disability than for those with no disability (Human Resources and Skills Development Canada, 2011). In 2006, over half a million people in Canada reported a communicative disability. This large, and largely underserved, population could partially explain why while over two thirds of people with disabilities in Canada and in Ontario received some type of caregiving that year, almost one third reported unmet caregiving needs (Human Resources and Skills Development Canada, 2011; see **Table 1**).

Despite these statistics, the Canadian government now screens for only 10 types of disability: seeing, hearing, mobility, flexibility, dexterity, pain, learning, developmental, mental/psychological, and memory (Statistics Canada, 2014). Most of these, but not all, may be considered visible rather than invisible disabilities. Woodward (2015) defined invisible disabilities as "not immediately noticeable ... [including] brain injuries, chronic pain, mental illness, gastro-intestinal disorders, and much more" (p. 2). Interestingly, this list does not specifically include communicative disorders, nor does the Invisible Disabilities Association (n.d.). Communicative disabilities may therefore be considered one of the most invisible of the invisible disabilities, which by their very nature "the very fact that these symptoms are invisible, can lead to misunderstandings, false perceptions and judgments" (Invisible Disabilities Association, n.d., p. 2). Eliminating communicative disability from the Canadian survey reduces the influence of people with such disabilities on public policy. Because of their lack of representation in the data, analyses of current policies and provisions are necessary to ensure that they address the needs of people with communicative disabilities.

The results of this study reveal successes, opportunities for improvement, strengths, and weaknesses in current policy and the direction of speech-language pathology (S-LP) in policy and public health. This knowledge could be used to address previously unmet needs and improve quality of life for people with communicative disabilities, their caregivers, and society.

Table 1

Canadian and Ontarian 2006 and 2011 Disability Statistics

	Number (%) of individuals above 15 years*	Population of all ages in 2006 census†	Average income (CAD$) by population aged 25 to 54†	% of Population receiving caregiving †
Canada whole population	27,516,200	-	Men = 52,865 Women = 34,305	-
Canada self-identified with disability	3,775,910 (13.7)*	Communicative disability = 557,970 Men = 302,450 Women = 255,520	Communicative disability = 64,923 Men = 39,245 Women = 25,678	Receiving = 73.9 Unmet needs = 30.6
Ontario whole population	10,727,900	-	-	-
Ontario self-identified with disability	1,651,620 (15.4)	-	-	Receiving = 70.7 Unmet needs = 32.5

Note. * = Information retrieved from Statistics Canada (2014); † = Information retrieved from Human Resources and Skills Development Canada (2011).

Evaluation Framework

To optimize the role of the S-LP profession in improving health outcomes and quality of life for Ontarians, this study was designed to identify whether Ontarians with communicative disabilities are treated with equity under the *Accessibility for Ontarians with Disabilities Act* (AODA; 2005) and the current health service model in the public domain.

The AODA was analyzed against two seminal international standards to evaluate whether and how effectively it complies with international guiding principles. The *World Report on Disability* (World Health Organization [WHO], 2011b) was chosen for its mandate to suggest steps for all stakeholders "to create enabling environments, develop rehabilitation and support services, ensure adequate social protection, create inclusive policies and programs, and enforce new and existing standards and legislation, to the benefit of people with disabilities and the wider community" (p. xi). The *Convention on the Rights of Persons with Disabilities* (United Nations, 2008) was chosen for its international mandate to "promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity" (p. 1). AODA provisions were also analyzed according to Gil's (1992) policy analysis framework, chosen for its status as an established policy analysis theory commonly used in the health care arena, to understand the role of the AODA for Ontarians with communicative disability. Government-published, publicly available census and health service usage data (i.e., Home Care Database, 2006a, 2006b) were used to compare access to communication rehabilitation with access mobility rehabilitation.

Research Questions

Research Question 1: Does the policy design of the AODA (2005) take into consideration the population affected by communicative disability?

Research Question 2: Does the current health service model in the public domain meet the rehabilitation service needs of the population with communicative disabilities and their caregivers by providing equitable access to this population as well as it serves populations with mobility disabilities, which are more visible?

These research questions are adapted from *Disability and Inclusion Based Policy Analysis* (Institute of Research and Development on Inclusion and Society, 2012). The policy analysis of the AODA (2005) was guided by Gil's updated version of his 1973 framework (Gil, 1973, 1992).

Method

Instruments

The policy in the AODA (2005) was qualitatively analyzed against the *World Report on Disability* (WHO, 2011b) and the *Convention on the Rights of Persons with Disabilities* (United Nations, 2008). The AODA was also evaluated according to Gil's (1992) policy analysis framework. Apart from the AODA, government-published, publicly available census and health service usage data (i.e., Home Care Database, 2006a, 2006b) were collected to compare service access between Ontarians seeking communicative rehabilitation services and those seeking mobility rehabilitation services.

Health and population data routinely collected and reported by municipal, provincial, and federal governments (Statistics Canada, 2006, 2012, 2013, 2014; see also Arim, 2015) were also analyzed. The population sizes of people with communicative versus mobility disabilities were acquired through census reports published by Statistics Canada (2006). Access to public speech-language rehabilitation services was compared with access to mobility rehabilitation services using service usage and wait-time data sets downloaded from the Ontario Ministry of Health and Long-Term Care's Health Data Branch Web Portal (Home Care Database, 2006a, 2006b), a database accessible by request. Communicative rehabilitation data were compared with those of mobility rehabilitation.

Data Collection

Available data on patient characteristics, geography, demographics, disability types and severity, service format, number of visits, wait time, service costs, access challenges, caregiver burdens, and suggestions for improvement across different healthcare settings were collected to understand the needs of Ontarians affected by communicative disabilities. Equitable access was analyzed by comparing wait time, length of care, and cost of care for people with communicative disabilities with those with more visible mobility disabilities, based on data from the Health Data Branch Web Portal (https://hsim.health.gov.on.ca/hdbportal/). Data on S-LP services were compared with physiotherapy (PT) and occupational therapy (OT) data. Search criteria included data from January 1, 2005, to December 31, 2016.

Service statistics were compared across different settings, including in-home health professional services (HPS), in-home HPS community support services, and hospitals (Ministry of Health and Long-Term Care, 2013a, 2013b, 2014, 2015, 2016a, 2016b, 2017). It is worth noting that in-home HPS staff were employed by the funding government agency/local health integration network, while providers of in-home HPS community support services were self-employed through multiple agencies contracted by the government to increase service capacity.

Data were collected on access and services for Ontarians with communicative disabilities requiring speech-language rehabilitation, OT, and/or PT (Home Care Database, 2006a, 2006b). Data were aggregate, contained no personal identifiers, and may have included people with both mobility and communicative disabilities. Such inclusion, however, would not affect the analysis, which compared access to speech-language rehabilitation with that of OT and PT services. Anyone with multiple needs including language rehabilitation, OT, or PT services would have been included in aggregate data.

This study was found by the Institutional Review Board to be exempt from further review under 45 CFR 46.101(b) Exempt Category 1.

Results

Research Question 1: Does the Policy Design of the AODA (2005) Take Into Consideration the Population Affected by Communicative Disability?

Gil's (1992) evaluation questions and the relevant results of analyses are shown below. The AODA (2005) principles were also benchmarked against *The World Report on Disability* (WHO, 2011b) and the *Convention on the Rights of Persons with Disabilities* (United Nations, 2008). Results of analyses from all three benchmarks follow.

Section A: Issues dealt with by the policy. The purpose of AODA (2005) was found to be aligned with the recommendations of WHO, which advocates using the *International Classification of Functioning, Disability and Health* (WHO, 2001). This classification defines limitations in functioning as *impairments* (problems with body functions or alterations in body structure), *activity limitations* (difficulties in carrying out activities), and *participation restrictions* (problems with involvement in any aspect of life, including discrimination and access. It applies the classifications *environmental factors* (products and technology, natural and built environment, support and relationships, attitudes, and services, systems, and policies) and *personal factors* (enough motivation and self-esteem to influence social participation and the discrepancy between one's capacities to perform actions and the actual performance).

To meet WHO (2001, 2011a, 2011b, 2013, 2014) environmental requirements to prevent impairments and activity limitations adversely affecting access for individuals with disabilities, AODA (2005) emphasized access to goods, services, facilities, accommodation, employment, buildings, structures, and premises. It also addresses *participation restrictions* by providing guidelines for corporations and public service providers to ensure accessibility.

The definition of *disability* in the AODA (2005) was analyzed to determine whether the policy's design includes people with communicative disabilities as well as those with other more visible disabilities. Part I Section 2 of the AODA defined disability in five categories, three of which cover invisible disabilities including mental, developmental, and learning disabilities. Part I Section 2(c) covers the impact of communicative disabilities ("a learning disability, or a dysfunction in one or more of the processes involved in understanding or using symbols or spoken language;" AODA, 2005, p. 1). This shows that the AODA does take the communicatively disabled population into account in its policy design.

Gil (1992) also called for consideration of causal theories or hypotheses about the dynamics of the issue. Therefore, the AODA (2005) was evaluated on whether it considered major theories of disability, beginning with a review of the major theories about disability: the medical model and the social model. The medical approach tends to treat disability as either pathology or social deviance, while the social model focuses on "the social oppression" of people with disabilities and the use of language about disability (Mauri, 2011, p. 5–6).

The AODA (2005) defined *barrier* as anything in the physical, architectural, informational or communications, attitudinal, technological, policy, or practice realms that prevents a person from full social participation because of a disability (AODA, 2005). It specifies that accessibility standards require the timely identification, removal, and prevention of all barriers to "goods, services, facilities, accommodation, employment, buildings, structures, premises or such other things as may be prescribed" (AODA, 2005, p. 1). The AODA therefore considers the social exclusion faced by people with disability and aims to rectify this by enforcing compliance. This demonstrates that the rationale and design of the AODA are in line with Section A of Gil's (1992) model.

Section B: Objectives, value premises, theoretical positions, target segments, and substantive effects of the policy. The community-based rehabilitation guidelines initiated by WHO (2014) were useful in assessing the value premises and substantive effects prescribed in this section within the context of a disability policy. WHO

(2011b) recommended community-based rehabilitation to (a) promote inclusive development for people with disabilities in the mainstream health, education, social, and employment sectors and (b) emphasize the empowerment of people with disabilities and their family members; and (c) through the provision of practical suggestions, position community-based rehabilitation as a tool that countries can use to implement the *Convention on the Rights of Persons with Disabilities* (2011b).

Part III of AODA (2005) discusses development and implementation, Part IV prescribes the enforcement of accessibility, and Part V prescribes penalties for their violation. All these parts address accessibility to business, goods, services, facilities, accommodation, employment, dwellings, and building infrastructures by or before January 1, 2025 (AODA, 2005). To determine whether the services referred to included education and health as recommended by WHO (2011) in community-based rehabilitation, accessibility plans covering customer service, information and communications, employment accommodation, built environment, and general procurement at Ontario's ministries of health and long-term care, education, finance, and others were reviewed (Government of Ontario, 2014; Ministry of Citizenship and Immigration, 2013; Ministry of Economic Development, Employment & Infrastructure, 2014; Ministry of Economic Development, Trade and Employment, 2014; Ministry of the Environment, 2013; Ministry of Finance, 2013; Ministry of Health and Long-Term Care, 2013b). All met both clients' and employees' needs for accessibility in the work environment, but not their needs for accessibility to education or health as recommended by WHO (2011) in community-based rehabilitation.

The mandate of the *Convention on the Rights of Persons with Disabilities and Optional Protocol* (United Nations, 2008) was used as another benchmark to analyze the value premises and ideological orientation underlying the AODA (2005) policy objectives. The protocol targets individuals affected by long-term physical, mental, intellectual, or sensory impairments that may become barriers against full and effective participation in society (United Nations, 2008). AODA's definition of "barrier" shows that this value premise is its raison d'être.

WHO's (2014) *Draft Global Disability Action Plan 2014-2021* was used as a benchmark to evaluate the theories and hypotheses underlying the strategy and substantive provisions of the AODA (2005). The action plan identified three objectives: (a) to remove barriers and improve access to health services and programs; (b) to strengthen and extend rehabilitation, habilitation, assistive technology, assistance services, support services, and community-based rehabilitation; and (c) to strengthen collection of relevant and internationally comparable data on disability and support research on disability and related services (WHO, 2014).

Substantive actions meeting the requirements of clause (b) above are included in AODA (2005) Regulation 429/07, Section 3 that policies must address "the use of assistive devices by persons with disabilities to obtain, use or benefit from the provider's goods or services or the availability, if any, of other measures which enable them to do so" (AODA, 2005, p. 2). The Regulation also specifies that staff training include a review of the purposes of the Act and the requirements of the Regulation and instruction in interacting and communicating with people with various types of disability, including those who use an assistive device, guide dog or other service animal, or the assistance of a support person. The AODA was thus designed to enforce accommodation of the needs of people with disabilities, including those requiring assistive devices or service animals, and require properly trained staff to enable such accommodation. However, access to and availability of supportive devices, animals, or people are not covered by the Act. Users with a communicative disability would likely find the system challenging to navigate, and such supports difficult or impossible to obtain, should they lack someone to advocate on their behalf.

To satisfy WHO's (2014) requirement (c) above, to strengthen local and international data collection and support research on disability and related services, the AODA (2005) assigns the Accessibility Director of Ontario the responsibility to "conduct research and develop and conduct programs of public education on the purpose and implementation of this Act" (AODA, 2005, p. 5). This provision addresses the need for research, but it requires no benchmarking against international data.

Gil's (1992) framework focused on "(a) ecological, demographic, biological, psychological, social, economic, political, and cultural characteristics; and (b) the size of relevant subgroups and of entire target segment(s) projected over time" to define the target population and examine whether the policy meets its needs (p. 71). The characteristics in (a) were aligned with WHO's (2017) social determinants of health and implied the need for social policies to ensure health equity. AODA (2005) does not address the social determinants of health and thus does not align with WHO's (2011b) advocacy of disability as a development issue, because of its bidirectional link to poverty. Gil's (1992) characteristics in (b) require the policy to understand and project the needs of the subgroups (in this study, different types of disability) over time. While the Act provides for ongoing research on demographics and needs, the Government of Canada failed in this in 2016. Canada intentionally removed communicative disability from the 2016 census, thus hindering the identification of our target population.

The intended effects of policy objectives and the extent of their attainment were also required, as supported by Gil (1992) and United Nations (2008). As reported in *Convention on the Rights of Persons with Disabilities—First Report of Canada* (Government of Canada, 2014), AODA (2005) has resulted in a few provincial regulatory and policy changes, some of which pertain to people with a communicative disability. The report suggested that AODA establishes "the goal of an accessible Ontario by 2025" (p. 34) through developing, implementing, and enforcing accessibility standards in "customer service, transportation, employment, information and communications, and the built environment" (Government of Canada, 2014, p. 34).

Several other provincial regulations have been enacted or revised to meet AODA (2005) requirements through ensuring access and providing staff with training in relevant rules and regulations. One example of accessibility improvement in the judiciary system was by the Ontario Provincial Police Force. The Force introduced video conferencing to provide sign language interpreters for the deaf or hard-of-hearing and revised its policy to ensure an accused with a cognitive disability could have a support person during interviews (Government of Canada, 2014). Not only does this provide more accommodation for the visible disability of hearing impairment, but it may also be expanded to help people with cognitive disabilities that often impair their receptive communication. This would improve equity for interviewees who would normally be disadvantaged by their cognitive disability during police interviews. Other Ontario regulations and policies were instilled to ensure effective information dissemination to people with communicative disabilities (Beer, 2015), including emergency and safety information, workplace emergency safety information individualized according to disability and needs, and compliance of corporate websites and web content to the international *Web Content Accessibility Guidelines 2.0* (Government of Canada, 2014).

To ensure fair access to health services, AODA (2005) has effected changes in health-related policies. The Ontario *Personal Health Information Protection Act* (2004) balances individuals' right to the privacy of their health information with the legitimate needs of health care providers to access and share such information. Before any treatment, health practitioners in Ontario must now obtain consent either from the patient or a substitute decision maker authorized for the relevant time period (Government of Canada, 2014).

Gil's (1992) framework also considered the unintended effects of a policy. Disproportionately more human rights cases were heard in Ontario than federally. Of the 3,242 applications received by the Human Rights Tribunal of Ontario in 2013–2014, 54% concerned individuals with disability (Social Justice Tribunal Ontario, 2014). These legal proceedings are typically very time-consuming, complex and costly. Individual case law is also less likely to facilitate broader systemic change (Moran, 2014), which is one reason advocates for people with disabilities began to examine other paths to inclusion.

Gil's (1992) model also examined the costs and benefits of the policy. For 4 years, starting in 2008–2009, the Directorate of Ontario had an annual budget of $4 million for developing new accessibility standards (Accessibility Directorate of Ontario, 2009) and a framework for AODA (2005) compliance (Accessibility for Ontarians with Disabilities Act Alliance, 2008). This is a stark contrast to the economic benefit proper funding and implementation could have yielded—a possible increase of up to $600 per capita per year in Ontario gross domestic product (Kemper, Stolarick, Milway, & Treviranus, 2010).

Section C: Implications of the policy for the operating and outcome variables for social policies. Section C of Gil's (1992) framework examined changes, consequences, and social control of changes in resources, work, and production; rights, governance, and legitimation; and reproduction, socialization, and social control in relation to (a) circumstances of living of individual, groups, and classes; (b) power of individual, groups, and classes; (c) nature and quality of human relations among individuals, groups, and classes; and (d) overall quality of life.

The AODA (2005) has 13 references to workplace or employment, but no reference to education or health, showing its limited regard for users of health and education services. Part III of the statute addresses the governance and legitimation of the policy. Part V Sections 21 and 22 address the rights of the user to accessibility and to appeal. Part III Section 7 specifies the different classes of business obligated and individuals protected. The AODA did address the WHO's (2011) recommended need for research as mandated for the Accessibility Directorate of Ontario (2009) in Part VIII Section 32(3e). Contrary to WHO recommendations, it did not require benchmarking their provisions and evaluation efforts or comparing with international data. The onus of obtaining assistive support rests on the users with communicative disability.

Research Question 2: Does the Current Health Service Model in the Public Domain Meet the Rehabilitation Service Needs of the Population With Communicative Disabilities and Their Caregivers by Providing Equitable Access to This Population as Well as it Serves Populations With Mobility Disabilities, Which are More Visible?

This is a quantitative analysis that involves comparison of rehabilitation service usage data against census data, and comparison of rehabilitation service data between the population affected by communicative disability with that affected by mobility disability (Home Care Database, 2006a, 2006b). Service usage between the population with communicative disability and mobility disability, published health service data, costs, and wait times for speech-language pathologists were used for communicative disability, and for occupational therapists and physiotherapists mobility disability were compared. Data were drawn from the Ontario Ministry of Health and Long-Term Care—Community Care Access Centres Management Information System comparative reports (Ministry of Health and Long-Term Care, 2013a, 2013b, 2014, 2015, 2016a, 2016b, 2017). Comparisons published in the Ontario Ministry of Health and Long-Term Care's (2016b) healthcare indicator tool from 2013–2017 were also collected for analysis and comparison.

Service statistics were also compared across different settings, including in-home HPS, in-home HPS community support service, and hospitals (Ministry of Health and Long-Term Care, 2013a, 2013b, 2014, 2015, 2016a, 2016b, 2017), as this study focused on access by the adult population with disability in relation to their overall health indicators. To compare rehabilitation service usage data across all disciplines, the 90th percentile and median were used as they are the two standard comparison points used by the Office of the Auditor General of Ontario (2015, 2016)—the provincial government organization that audits all provincial ministries and programs. The 90th percentile and median were the comparison points used to audit service data.

Based on available census data (Statistics Canada, 2006, 2012), the prevalence of all disability and mobility disability decreased in Canada and Ontario from 2006 to 2011. In 2006, the relationship among people with communicative disability and mobility disability in Ontario was similar to that across Canada. In 2006, the proportion of people with communicative disability was 19% of that of those with mobility disability in Canada and 17.3% in Ontario. Projecting that the population of people with communicative disability followed the same trend and percentage of decrease as people with mobility disability, they would form 10% of the total population with disability in Canada and 8.95% in Ontario in 2011.

To compare accessibility to health services between populations with communicative disability and with mobility disability, with the absence of census data on communicative disability in Ontario and Canada in 2011, benchmarks were created through extrapolation of available data. The percentage of the population with communicative disability was estimated by averaging the projected 10% in Canada and 8.95% in Ontario (above) to 9.5%, or 385,711 people with communicative disability out of 3,775,910 with any disability, equivalent to 1.3% of the total population of 27,516,200 in 2011. In the same vein, the percentage of population with communicative disability in relation to that with mobility disability was projected as 18.2%. These figures are required to show the variance between services received by populations with communicative disability versus mobility disability. Based on these benchmarks, health service usage statistics, operating costs, and workloads of health professionals for the population with communicative disability were compared with those of the population with mobility disability across different settings.

Two pieces of contextual information are important to note. First, healthcare providers of in-home HPS were employed by the funding government agency, while providers of in-home HPS community support services were self-employed members of a network of multiple community support agencies contracted by the government to increase service capacity. Second, hourly pay rates of S-LP professionals, OTs, and PTs range widely. In labor injury cases, hourly rates for registered services in 2016 were CAD$80 for S-LP, CAD$24 for PT, and CAD$59 for OT services (Workplace Safety & Insurance Board Ontario, 2018a, 2018b). For regular rehabilitation cases covered by major insurance companies, the 2016 hourly rates were CAD$150 for S-LP, CAD$150 for PT, and CAD$145 for OT services (University of British Columbia, 2016). S-LP services generally cost more than PT and OT services, attributing to the difference in operating expenses.

Service usage data showed a few areas where people with communicative disability fared better than their mobility counterparts from 2013 to the end of September 2016 in both 90th percentile and median data (Home Care Database, 2006a, 2006b). In in-home HPS community support services, people with communicative disability had 46% to 424% of the level of service provided to those with mobility disability and 98% to 175% more visits than were made to those with mobility disability; higher operating costs and unit cost per individual were incurred for people with communicative disability rather than mobility disability. For in-home services, people with communicative disability had a higher unit cost per visit than those with mobility disability. People who required S-LP services enjoyed much better access to care with in-home community support services than those in other settings, including hospitals.

There are, however, more areas of access disparity based on the service usage data in non-community support services in-home HPS settings from 2013 to the end of September 2016: (a) S-LP services accounted for one third or less of OT and PT services combined, (b) one third fewer individuals had S-LP service than OT and PT service, (c) there were 25% fewer visits made by S-LP professionals than by OT and PT professionals, and (d) total service hours rendered by S-LP professionals were 27% to 43% of those by OT and PT professionals. In the hospital setting during the same period, all S-LP indicators in the 90th percentile data were consistently worse than those of OT and PT. The operating expenses for S-LP services were one third less than for PTs and OTs combined, the total S-LP attendance days were less than half of mobility disability therapy days rendered, and the workload for S-LP professionals in the hospital setting was 1.3 to 1.5 times heavier than for OT and PT professionals combined. Results from the median data were even worse, showing a significant gap in resource investment that under-empowers service providers to match client needs.

In the in-home setting during 2013–2016, client interactions and individuals receiving S-LP were only 20% to 30% of those receiving OT and PT and the average waiting time for S-LP service was 2.9 to 4.1 times longer than for OT and PT combined. Although people with communicative disability had access to more services through in-home, outsourced S-LP services than other settings, they also waited much longer than their mobility counterparts.

Service access for people with communicative disabilities during the time period researched was not equitable to that for people with mobility disabilities. Overall service capacity was proportionally lower for S-LP services than for OT and PT services, as shown by the lower number of individuals served, lower number of client interactions, and longer wait times across all settings. Equally apparent are the lower operating expenses, fewer attendance days, and higher workload for S-LP professionals in the hospital setting.

The disproportionate workload of S-LP professionals was confirmed in a research report by graduate-level S-LP students at the University of Toronto and published by Ontario Association of Speech-Language Pathologists and Audiologists (2014, 2016). The reported caseload of 47 per speech-language pathologist should be taken with caution, however, as it represents only school-based caseloads and is therefore not necessarily representative of other work settings (University of Toronto Students of Speech-Language Pathology Graduate Program, 2011).

Discussion

The data substantiating the answers to the two research questions showed that the current version of the AODA (2005) has gaps that can be addressed by including provisions to mandate data collection, international benchmarking, and support from professional service providers to users seeking access to assistive support. Findings from service usage data also show that access to S-LP rehabilitation services by populations affected by communicative disability was not at par with access to OT and PT rehabilitation services by populations affected by mobility disabilities. To improve access and reduce wait times, the public health system could expand professional training and employment opportunities to increase the supply of S-LP professionals, streamline the system for users to access S-LP services, and invest in S-LP services as well as it does in OT and PT services.

Implementing these changes would ensure fair access to health services and better chances for more equitable social determinants of health for people affected by communicative disabilities. These changes would also improve social, employment, and economic participation by individuals with communicative disability and their caregivers. Positive social effects would likely be lasting and widespread. The additional health care investment would ensure health equity, distributive justice, and fair access for all, and would bring Canada and Ontario up to par with international guidelines.

An increase in service capacity would not only improve accessibility to services in general, but it would also allow for more specialized services for individuals with communicative disabilities. Roulstone and Harding (2013) suggested policy makers and service providers adopt the concepts of *service availability* and *service accessibility* to prevent medically underserving the community's S-LP needs on a systematic basis. These systemic challenges could be addressed if the overall capacity for S-LP services was increased according to the size of the population with communicative disability to match the service capacity per capita for the population with mobility disabilities. As Wickenden (2013) proposed, a country should have both capacity and structures in place to develop a specialized professional service to serve people with communication disabilities. This process could begin with talent development at graduate schools and increased funding for more S-LP employment opportunities across all clinical settings, and result in the establishment of a more efficient referral process for clients.

Apart from improved access to health services within the system, the AODA (2005) also has some gaps to fill to meet WHO (2011) and United Nations (2008) recommendations. Necessary improvements are discussed in detail below.

Help in Obtaining Assistive Support

The AODA (2005) could require service providers to help individuals and caregivers affected by communicative disability to navigate the system to seek the appropriate, financially subsidized assistive support. This would be feasible since the S-LP Code of Ethics already requires S-LP professionals to advocate for the best interests of their client, use all possible resources to ensure quality and comprehensive services, and inform the client of all appropriate programs and services (College of Audiologists and Speech-Language Pathologists of Ontario, 2011). What is missing is a requirement for the S-LP professional to support the client throughout the process. Explicit mention of that in the AODA would empower and mandate all relevant service providers to support individuals with disabilities throughout the process of seeking, sourcing, applying for, and obtaining funding for assistive support.

Match Access to Health Services With Access to Employment and Add Provisions to Ensure the Social Determinants of Health

Individuals with communicative disability are at the bottom of the hierarchy of exclusion, not only because they are disabled, but also because they cannot advocate for themselves. Their communication barriers often deny them the right to participate in education, employment, community, and politics and deprive them of access to health care, social protection, and justice (Wickenden, 2013). These gaps could be addressed by ensuring improvements in the social determinants of health for people with communicative disabilities.

Require That Research Data be Benchmarked Against International Data

The AODA (2005) could mandate the Accessibility Director of Ontario to conduct research and benchmark against international data, and to develop and conduct programs to educate the public on the purpose of the Act (Government of Ontario, 2014). This would meet WHO's (2011, 2014) recommendations to expand research programs, improve information and access to good practice guidelines, and collect internationally comparable data on disability and support research on disability and related services.

Socioeconomic profiling of the population with communicative disability. In existing census and disability reports, economic statistics reflect the overall disability population in Ontario, but not specifically those affected by communicative disability. Filling in the data gaps on the quality of life and social determinants of health for people with communicative disabilities would shed light on socioeconomic disparities between people with communicative versus mobility disabilities and inform future policy and service development decisions. To address the discrepancies in health service usage data between populations with communicative and mobility disabilities, the overall system capacity for S-LP services needs to increase. This would entail increased professional training, employment opportunities across all clinical settings, and referrals of patients to S-LP services.

Professional training of speech-language pathologists. Ontario, with a population of 13.6 million, currently has three graduate schools, with class sizes under 50 each, developing S-LP professionals. Illinois, with a comparable population, has 13 graduate schools, with class sizes over 100 each, accredited by the American Speech-Language-Hearing Association to train S-LP professionals (American Speech-Language-Hearing Association, n.d.). To increase the supply of S-LP professionals, new funding would be required to develop more programs and support clinical placements.

Employment opportunities in all clinical settings. As the health system in Ontario is mostly government funded, new health investments are required to increase employment opportunities for speech-language pathologists. Most of the investment should be made in settings other than in-home community support services, to create positions for government healthcare employees rather than self-employed practitioners from outsourced agencies.

Referral of patients to speech-language pathology services. Because most S-LP services outside of the hospital setting are not funded by government health care, clients need to understand the system to refer themselves to a speech-language pathologist, a process through which they are not well supported. With new investments in all settings outside of in-home community support services, more clients requiring S-LP services would benefit because there would be more S-LP jobs, government-funded S-LP services would remove the financial barrier for clients, and speech-language pathologist caseloads should fall below

50, allowing more in-depth services and longer-lasting programs.

With increased capacity and reduced barriers, more referrals to S-LP services would be feasible. There could be a formal process to match appropriately skilled speech-language pathologists with the needs of clients and their families. Currently, clients outside the hospital system either contact their local community care access centre for assessment and referral to government funded S-LP services or they search the Ontario Association of Speech-Language Pathologists and Audiologists website (https://www.osla.on.ca/default.aspx) for areas of practice, geographical coverage, client age group, and language of service. With government investment in S-LP jobs, the two processes could be combined. Service users could still go through the Ontario Association of Speech-Language Pathologists and Audiologists website to identify their preferred practitioners and they could apply through their local community care access centre for health service coverage.

Apart from professional capacity, the capacity of people with communicative disabilities also needs to be increased. Speech-language pathologists with capacity-building training for people with communicative disability could help them develop "skills and confidence to lobby and self-advocate within political arenas … [and] bring about the emancipatory change they want" (Wickenden, 2013, p. 19). Inequalities faced by people with disabilities include being denied equal access to health care, employment, education, or political participation. Wickenden (2013) advocated for speech-language pathologists to work in a more empowering way to disrupt the existing hierarchy that excludes people with communicative disabilities from assuming equal roles in the social system.

Recommendations for Future Research

To address the needs of people with other invisible disabilities, this study could be repeated for people with learning disabilities and mental disabilities. The same methodology could be used to analyze AODA's (2005) provisions and health usage data for mental health and learning disabilities in contrast with more visible disabilities.

Conclusion

Lack of accessible communication and information has affected the lives of many people with disabilities. Individuals with receptive and expressive challenges are at a significant social disadvantage, which is particularly acute in sectors where effective communication is critical, such as health care, education, local government, and justice.

This study serves to monitor the areas of health access disparity between communicative and mobility rehabilitation, the under-met needs of the population with communicative disabilities, and the need for policy and system modification to ensure health equity and distributive justice. Aligned with WHO (2001, 2011a, 2011b, 2013, 2014) and United Nations (2008) recommendations, the proposed improvements are designed to address the gaps with minimal changes to the system. These recommendations would remove barriers to rehabilitation services for people with communicative disability through reforming policies, laws, and delivery systems. Financial barriers would be removed by developing funding mechanisms to address service costs. Accessibility barriers would be minimized by increasing human resources for capacity and expanding and decentralizing service delivery. Barriers against independence would be overcome by widespread use of affordable technology and assistive devices. Studies like this one provide critical input for policymakers using evidence to facilitate a higher level of equity in health service accessibility for all.

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TELEQ : création et pré-validation d'un outil québécois d'évaluation de l'orthographe

TELEQ: creation and pre-validation of a Québec spelling assessment tool

MOTS-CLÉS
LANGAGE ÉCRIT
OUTIL D'ÉVALUATION
ORTHOGRAPHE
DYSORTHOGRAPHIE
ENFANCE
VALIDATION

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Abrégé

La plupart des outils disponibles en clinique pour évaluer la dysorthographie ont été créés en Europe et ne permettent pas de mesurer adéquatement les habiletés d'orthographe des enfants québécois. Pour répondre à ce manque d'outils adaptés, le *Test d'évaluation du langage écrit québécois* a été créé. L'objectif de cette étude était de décrire la performance d'enfants québécois du primaire au sous-test « Dictée de mots et de pseudomots » du *Test d'évaluation du langage écrit québécois* et de vérifier les qualités psychométriques (fidélité et validité) de ce sous-test. Cent dix-sept enfants franco-québécois de la 2^e à la 6^e année du primaire n'ayant pas de difficultés en langage écrit ont participé à l'étude. L'outil a été administré à deux reprises, avec un intervalle de deux à six semaines entre les passations. D'autres tests évaluant les habiletés d'orthographe ont également été administrés aux enfants. Les résultats préliminaires ont suggéré que l'outil présentait une très bonne fidélité test-retest et une excellente consistance interne. De plus, les corrélations élevées entre le nouvel outil et les autres tests évaluant les habiletés d'orthographe ont laissé entrevoir une excellente validité concordante et de construit. En somme, les résultats ont suggéré que le sous-test « Dictée de mots et de pseudomots » présentait de bonnes qualités psychométriques et évaluait adéquatement les habiletés orthographiques des enfants normolecteurs québécois du primaire. Éventuellement, cet outil pourrait permettre une évaluation plus adéquate de l'orthographe chez les jeunes québécois.

Abstract

Most of the tools available in clinics to assess dysorthographia were created in Europe and do not adequately measure the spelling skills of Québec children. In response to this lack of adapted tools, the *Test d'évaluation du langage écrit québécois* [a test evaluating the written language skills of Quebecers] was created. The objective of this study was to describe the performance of Québec elementary school children on a subtest of the *Test d'évaluation du langage écrit québécois,* entitled *Dictée de mots et de pseudomots* [dictation of words and pseudowords], and to verify the psychometric qualities (fidelity and validity) of this subtest. One hundred and seventeen Québec French-speaking children in Grades 2 to 6 without written language difficulties participated in the study. The tool was administered twice, 2 to 6 weeks apart. Other tests assessing spelling skills were also administered to the children. Preliminary results suggested that the tool had very good test-retest fidelity and excellent internal consistency. In addition, the high correlations between the new tool and other tests assessing spelling skills suggested excellent concordant and construct validity. In summary, results suggested that the *Dictée de mots et de pseudomots* subtest had good psychometric qualities and adequately assessed the spelling skills of Québec elementary school children that are typical readers. Eventually, this tool could allow a more adequate evaluation of spelling among young Quebecers.

La dysorthographie est un trouble spécifique d'apprentissage de l'orthographe lié à de nombreuses conséquences, tant sur le plan académique que psychologique et social. La cinquième édition du *Manuel diagnostique et statistique des troubles mentaux* ne mentionne pas le terme «dysorthographie» parmi les troubles spécifiques d'apprentissage (American Psychiatric Association [APA], 2013). On y trouve toutefois le trouble spécifique d'apprentissage dans le domaine de l'expression écrite, qui englobe à la fois des difficultés au niveau de l'orthographe, de la grammaire, de la ponctuation, ainsi qu'au niveau de la clarté et de l'organisation de l'expression écrite. La dysorthographie[1], quant à elle, touche spécifiquement les habiletés d'orthographe et concerne principalement l'ajout, l'omission ou la substitution de voyelles ou de consonnes dans les mots (APA, 2013; Institut national de la santé et de la recherche médicale, 2007). Pour poser un diagnostic de dysorthographie, les habiletés en orthographe doivent se situer en deçà de celles attendues pour l'âge chronologique (APA, 2013). Les symptômes doivent occasionner des difficultés dans les activités de la vie quotidienne et doivent persister depuis au moins six mois en dépit d'interventions. Puisque la dysorthographie est souvent associée à la dyslexie (un trouble d'apprentissage spécifique de la lecture), la prévalence de ces troubles est similaire chez les enfants d'âge scolaire, soit entre 3% et 10% (Institut national de la santé et de la recherche médicale, 2007; Victoor et de Hemptinne, 2012).

Les troubles spécifiques d'apprentissage de la lecture et de l'orthographe peuvent engendrer de nombreuses conséquences. Parmi celles-ci, notons les retards d'apprentissage en français, ainsi que dans plusieurs autres matières scolaires où la lecture et l'écriture sont requises (Daniel et al., 2006). Il y a également un risque élevé de décrochage scolaire (Huntington et Bender, 1993), de troubles psychiatriques (Beitchman et Young, 1997), de dépression sévère, ou encore, de tentatives de suicide (Huntington et Bender, 1993). Des études ont également rapporté la présence de troubles d'anxiété (Casey, Levy, Brown et Brooks-Gunn, 1992; Willcutt et Pennington, 2000) et d'humeur dépressive (Boetsch, Green et Pennington, 1996; Maughan, Rowe, Loeber et Stouthamer-Loeber, 2003; Willcutt et Pennington, 2000) chez les enfants qui présentaient des difficultés de lecture ou d'orthographe. À l'âge adulte, les personnes ayant des difficultés de lecture ou d'orthographe seraient plus nombreuses à être sans emploi et auraient de plus faibles revenus que celles n'en ayant pas (APA, 2013). Ainsi, les individus présentant une dyslexie/dysorthographie souffriraient des conséquences rattachées à leur(s) trouble(s) tout au long de leur vie (Snowling, 2013).

Sur le plan cognitif, la plupart des auteurs postulent l'existence de deux voies distinctes lors de l'apprentissage de l'orthographe et de l'épellation, soit la voie d'assemblage (ou phonologique) et la voie d'adressage (ou lexicale). Celles-ci proviennent du modèle à deux voies de la lecture qui est largement cité dans la littérature (Coltheart, 1978; Coltheart, Rastle, Perry, Langdon et Ziegler, 2001; Morton et Patterson, 1980; Patterson et Morton, 1985). La voie d'assemblage repose sur la connaissance des règles de correspondance entre les phonèmes (les plus petites unités de sons présentes dans un langage) et les graphèmes (les plus petites unités d'un système d'écriture; Berndt, Reggia et Mitchum, 1987; de Partz et Zesiger, 2000). Cette procédure nécessite un traitement séquentiel des mots à écrire et est principalement utilisée pour écrire les mots réguliers (p. ex. «fleuve»), les mots peu fréquents (p. ex. «tabou») et les pseudomots (c.-à-d. des mots sans signification qui respectent les règles de correspondances phonèmes-graphèmes; de Partz et Zesiger, 2000). Une atteinte à cette voie est à l'origine du développement de la dysorthographie phonologique, caractérisée par des difficultés à effectuer correctement la conversion phonographémique (Guay, 2018; Victoor et de Hemptine, 2012). Quant à la voie d'adressage, elle repose sur des représentations mentales orthographiques des mots, emmagasinées dans un lexique mental situé dans la mémoire à long terme. Cette procédure serait particulièrement utile pour l'écriture des mots fréquents (p. ex. «table») et des mots irréguliers (c.-à-d. des mots ne respectant pas les règles générales de conversion phonographémique, comme «femme» et «printemps»; de Partz et Zesiger, 2000; Lussier et Flessas, 2009; Mazeau et Pouhet, 2014). Une atteinte à la voie d'adressage est liée au développement de la dysorthographie lexicale, caractérisée par des difficultés à mémoriser la forme visuelle globale des mots et à se bâtir un lexique orthographique (Guay, 2018; Victoor et de Hemptine, 2012). Finalement, une atteinte des deux voies (assemblage et adressage) est reliée à la dysorthographie mixte, qui combine les attributs des dysorthographies phonologique et lexicale (Guay, 2018; Victoor et de Hemptine, 2012).

La dysorthographie s'évalue le plus souvent en concomitance avec le trouble spécifique d'apprentissage de la lecture (Ordre des psychologues du Québec, 2014). Toutefois, peu d'outils sont présentement disponibles pour

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[1] Les termes « dysorthographie » et « trouble spécifique d'apprentissage de l'orthographe » sont traités comme des synonymes dans cet article.

les cliniciens afin de poser ce diagnostic. Une évaluation de l'enfant à l'aide d'outils standardisés ayant de bonnes qualités psychométriques est primordiale afin d'identifier correctement un trouble d'apprentissage (Ordre des psychologues du Québec, 2014). Or, ce n'est pas tous les outils actuellement disponibles dans les milieux cliniques qui ont de bonnes qualités psychométriques (ou qui ont été validés) et qui évaluent les deux voies de l'orthographe. Plusieurs auteurs déplorent d'ailleurs le manque d'outils, ainsi que les faibles qualités psychométriques et l'absence de normes québécoises pour les outils disponibles (Bouchard, Fitzpatrick et Olds, 2009; Garcia, Paradis, Sénécal et Laroche, 2006; Monetta et al., 2016). Les quelques outils possédant des normes franco-canadiennes, soit le *Test individuel de rendement de Wechsler, version pour francophone* (2e éd.; Wechsler, 2005b) et le *Test de rendement pour francophones* (Sarrazin, 1995), évaluent le rendement en orthographe, mais n'évaluent pas séparément les voies d'assemblage et d'adressage, ce qui s'avère pourtant essentiel pour déterminer le type de dysorthographie et les interventions à mettre en place. Les cliniciens québécois se tournent alors souvent vers des outils européens pour l'évaluation des troubles d'apprentissage (Garcia et Desrochers, 1997). Parmi ceux-ci, la *Batterie Analytique du Langage Écrit* (BALE; Jacquier-Roux, Lequette, Pouget, Valdois et Zorman, 2010) et la *Batterie d'évaluation du langage écrit* (BELEC; Mousty et Leybaert, 1999) sont fréquemment utilisés au Québec. Alors que la BALE évalue les deux voies de l'orthographe par la présence à la fois de mots irréguliers et de pseudomots dans son sous-test «Dictée de mots et de non-mots»[2], la BELEC ne présente pas de pseudomots et ne sépare pas les mots irréguliers des mots réguliers dans son sous-test d'orthographe «ORTHO3». De plus, les normes pour ces deux outils sont limitées : la BALE possède des normes uniquement pour la 2e, 3e, 4e et 5e année du primaire, alors que la BELEC possède des normes seulement pour la 2e, 4e et 6e année du primaire (Mousty et Leybaert, 1999; Wessang et Gariel, 2008). Par ailleurs, la BALE et la BELEC ont été conçues et normées respectivement en France et en Belgique. Puisque le système scolaire européen ne correspond pas au système scolaire québécois et que la progression des apprentissages des enfants n'est pas la même en Europe qu'au Québec (Bouchard et al., 2009), il apparaît inadéquat de comparer les enfants québécois aux normes françaises et belges. Cela pourrait notamment sous-estimer ou surestimer leurs habiletés d'orthographe. Considérant le manque flagrant d'outils pour évaluer la dysorthographie et les multiples impacts que peut entrainer ce trouble, la création d'un outil d'évaluation de l'orthographe basé sur les mots enseignés dans les écoles québécoises et normé auprès d'enfants franco-québécois s'avère indispensable. C'est pour cette raison que le *Test d'évaluation du langage écrit québécois* (TELEQ) a été développé. Le modèle théorique guidant la création de ce test est le modèle à double voie de la lecture et de l'orthographe. Ce modèle a été préconisé étant donné son utilité reconnue par plusieurs auteurs dans la littérature pour le diagnostic de la dyslexie/dysorthographie (Coltheart, 1978; de Partz et Valdois, 2000, Mousty, Leybaert, Alegria, Content et Morais, 1994; Ordre des psychologues du Québec, 2014) et en raison de son utilisation fréquente en clinique lors de l'évaluation du langage écrit. Le TELEQ, dans sa version finale, comprendra les sous-tests « Lecture de mots et de pseudomots », « Dictée de mots et de pseudomots », ainsi que « Compréhension de lecture ». La présente étude vise à décrire les performances d'enfants québécois francophones de la 2e à la 6e année du primaire au sous-test « Dictée de mots et de pseudomots » et à examiner les propriétés psychométriques en termes de fidélité et de validité de ce sous-test.

Méthodologie

Participants

Un total de 153 enfants de la 2e à la 6e année du primaire ont participé à l'étude. Pour être éligibles, les enfants devaient être scolarisés en français depuis le début de leur scolarité et parler le français à la maison. Ils ne devaient avoir subi aucun échec scolaire en français (c.-à-d. n'avoir aucune note en bas de 60% dans leur bulletin) et ne devaient pas avoir bénéficié de suivi (en orthophonie ou en orthopédagogie) en lien avec le langage écrit. Les enfants ayant redoublé une année scolaire, subi un traumatisme crânien ou reçu un diagnostic de trouble neurodéveloppemental (c.-à-d. de trouble de la communication, incluant le trouble développemental du langage et le trouble développemental des sons de la parole; de trouble du spectre de l'autisme; de trouble du déficit de l'attention avec ou sans hyperactivité (TDA/H); de trouble d'apprentissage; de retard intellectuel ou de trouble de tics – voir la cinquième édition du *Manuel diagnostique et statistique des troubles mentaux*; APA, 2013) ont également été exclus de l'étude. De plus, les participants sans diagnostics précédents qui ont obtenu un score situé à plus de deux écarts-types sous la moyenne pour leur âge aux mesures d'habiletés de lecture ou de quotient intellectuel (QI) et ceux ayant obtenu un score

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[2] Les termes « non-mot » et « pseudomot » sont traités comme des synonymes dans cet article et sont utilisés de façon interchangeable.

supérieur au 98^e rang centile aux symptômes d'inattention ou d'hyperactivité ont été exclus.

Procédures

Le présent projet a été approuvé par le comité d'éthique et de la recherche en arts et sciences de l'Université de Montréal (n° de certificat : CERAS-2015-16-080-P). Les participants ont été recrutés dans des écoles primaires et des camps de jour sur une base volontaire. Les parents intéressés à participer à l'étude ont rempli un formulaire de consentement et l'ont rapporté à l'école ou au camp de jour. Après avoir reçu les formulaires de consentement signés, les chercheurs ont contacté par téléphone les parents afin de vérifier les critères d'inclusion et d'exclusion et de prendre rendez-vous pour une première évaluation de leur enfant.

La durée de la première rencontre était d'environ une heure et demie. L'évaluation comprenait une estimation du QI verbal et non verbal, ainsi qu'un examen du langage écrit (lecture et écriture) et des prérequis à la lecture (traitement phonologique et traitement visuel de la séquence des lettres ; voir la section « Mesures » ci-dessous). Durant cette évaluation, les parents remplissaient également un questionnaire sociodémographique et un questionnaire de dépistage des symptômes du TDA/H chez leur enfant, soit la version traduite en français du *ADHD Rating Scale IV* (DuPaul, Power, Anastopoulos et Reid, 1998). Une deuxième évaluation d'une durée d'environ 30 minutes avait lieu de deux à six semaines après le premier rendez-vous, afin d'administrer de nouveau le TELEQ, et ainsi, examiner la fidélité test-retest. Les rencontres se sont déroulées dans les locaux de l'Université de Montréal, à une clinique privée en Haute-Yamaska ou au domicile des parents. Les évaluations ont été réalisées par des étudiantes au doctorat en neuropsychologie ou par des étudiantes du baccalauréat en psychologie formées pour l'administration des tests. L'enfant et l'évaluatrice disposaient d'un endroit calme pour procéder à l'évaluation et les parents n'étaient pas invités à assister à l'évaluation afin de ne pas influencer les résultats de l'enfant.

Mesures

Les tests utilisés dans le cadre de cette étude possédaient de bonnes qualités psychométriques lorsque disponibles. Pour chacun des tests, seuls les scores globaux ont été retenus pour les analyses.

Échelle d'intelligence de Wechsler pour enfants, version pour francophones du Canada (4^e éd. ; Wechsler, 2005a). Cet outil permet d'obtenir une mesure du QI global, ainsi que des aptitudes verbales et non verbales. Deux sous-tests ont été administrés, soit le sous-test « Matrices », qui évalue la capacité de l'enfant à sélectionner une image permettant de compléter logiquement des matrices incomplètes (estimation du QI non verbal), et le sous-test « Vocabulaire », qui évalue la capacité de l'enfant à définir des mots oralement (estimation du QI verbal). Les participants ayant des scores situés à plus de deux écarts-types sous la moyenne pour leur âge à l'un ou l'autre de ces sous-tests ont été exclus de l'étude.

Alouette-R (Lefavrais, 2005). Cet outil évalue le niveau de lecture chez les enfants âgés de 6 à 16 ans. L'enfant dispose de trois minutes pour lire à voix haute un texte de 265 mots. Le nombre d'erreurs, le nombre de mots lus et le temps de lecture sont mesurés afin d'obtenir des indices de précision et de vitesse de lecture. Ces scores peuvent ensuite être comparés à des normes obtenues auprès de 415 enfants français âgés de 6 à 16 ans et réparties selon l'âge ou le niveau scolaire de l'enfant (Lefavrais, 2005). L'*Alouette-R* est l'un des tests les plus utilisés, tant en recherche qu'en clinique, pour le dépistage des troubles d'apprentissage de la lecture (Bertrand, Fluss, Billard et Ziegler, 2010 ; Cavalli et al., 2018 ; Olivier, 2007). Les participants ayant obtenu des scores situés à plus de deux écarts-types sous la moyenne pour leur âge ont été exclus.

ADHD Rating Scale IV (DuPaul et al., 1998). Ce questionnaire vérifie la présence de comportements reliés au TDA/H selon les symptômes décrits dans la cinquième édition du *Manuel diagnostique et statistique des troubles mentaux* (APA, 2013). Les comportements de l'enfant sont évalués par le parent sur une échelle de Likert allant de 0 à 3 et correspondant à « jamais ou rarement », « quelques fois », « souvent » et « très souvent ». Une adaptation française maison de ce questionnaire a été utilisée. Les normes disponibles pour la version anglophone proviennent d'un échantillon de 2000 enfants américains âgés de 4 à 20 ans (DuPaul et al., 1998). Cet outil a été privilégié, étant donné qu'il est relativement court, simple et facile à remplir pour les parents. De plus, ce questionnaire évalue exclusivement les symptômes d'inattention et d'hyperactivité retrouvés dans le TDA/H et décrits dans le *Manuel diagnostique et statistique des troubles mentaux* (éditions 4 et 5; APA, 2000, 2013), comparativement à d'autres questionnaires plus longs qui évaluent plusieurs symptômes autres que l'inattention et l'hyperactivité. Le score global a été utilisé afin d'évaluer la présence de symptômes liés au TDA/H chez les participants de l'étude. Les participants ayant obtenu des scores supérieurs au 98^e rang centile aux symptômes d'inattention ou d'hyperactivité ont été exclus.

TELEQ — Sous-test «Dictée de mots et de pseudomots». Le sous-test «Dictée de mots et de pseudomots» du TELEQ permet de mesurer les habiletés d'orthographe de mots isolés des enfants de la 2e à la 6e année du primaire. Il est constitué de listes de pseudomots et de mots irréguliers que l'enfant doit orthographier et dont les résultats permettent d'inférer le niveau de fonctionnement des voies d'assemblage et d'adressage, respectivement. La durée de passation des deux listes varie entre 15 et 20 minutes au total chez les enfants ne présentant pas de difficultés de langage écrit. Les mots/pseudomots de ce sous-test ont été enregistrés vocalement et c'est cet enregistrement qui a été joué aux enfants, en suivant leur rythme d'écriture, afin de favoriser une passation standardisée.

Le sous-test «Dictée de mots et de pseudomots» du TELEQ, tout comme les autres sous-tests qui feront partie du TELEQ (soit «Lecture de mots et de pseudomots» et «Compréhension de lecture»), ont été développés en collaboration avec des neuropsychologues, orthophonistes et orthopédagogues. L'expérience de ces professionnels en évaluation et en intervention auprès d'enfants ayant des troubles du langage écrit a été mise à profit afin d'orienter la création des items de la liste de pseudomots et le choix des items de la liste de mots irréguliers. Ces professionnels ont donc participé à la validité de contenu de l'outil en s'assurant que les items représentaient bien la voie à laquelle ils appartenaient (voies d'assemblage ou d'adressage) et en s'assurant que chaque voie était évaluée adéquatement.

Liste de pseudomots. Cette liste comprend 24 pseudomots classés selon leur longueur et leur complexité orthographique, ainsi que selon la progression des apprentissages des enfants québécois au primaire (Ministère de l'Éducation, du Loisir et du Sport [MELS], 2009).

Longueur des pseudomots. La liste est composée de 11 pseudomots courts formés de deux à six lettres (p. ex. «no» et «orgati») et de 13 pseudomots longs formés de sept à 13 lettres (p. ex. «bourvoi» et «carmieubrasse»). Parmi ceux-ci, quatre sont formés d'une seule syllabe (p. ex. «prin»), neuf sont formés de deux syllabes (p. ex. «bourvoi»), huit sont formés de trois syllabes (p. ex. «flatireau»), deux sont formés de quatre syllabes (p. ex. «trompertasse») et un est formé de cinq syllabes («bartolarègne»).

Complexité orthographique. La complexité orthographique tient compte du nombre de syllabes en fonction de la longueur des mots. Ainsi, si deux mots ont le même nombre de lettres, c'est celui qui a le moins de syllabes qui est considéré comme étant le plus complexe. En ce sens, les pseudomots complexes du TELEQ présentent au moins une syllabe de moins que les pseudomots simples de même longueur (p. ex. «fluir» est plus complexe que «atran»).

Progression des apprentissages. Les pseudomots impliquant des graphies acontextuelles ont été classés avant ceux impliquant des graphies contextuelles, afin de respecter l'ordre d'acquisition de ces notions au primaire (MELS, 2009). Les graphies acontextuelles possèdent des règles de correspondance phonographémique qui ne dépendent pas du contexte (Mousty et Leybaert, 1999). Les pseudomots ayant ce type de graphie contiennent, par exemple, des consonnes simples comme [f] ou [p], des consonnes complexes comme [ch] ou [gn] ou des voyelles complexes comme [on] ou [in]. Les graphies contextuelles, quant à elles, possèdent des règles de correspondance phonographémique qui dépendent du contexte (p. ex. pour que le « g » se prononce [gue] devant un « e » ou un « i », il faut ajouter un « u » après le « g »; Mousty et Leybaert, 1999). L'apprentissage des graphies contextuelles ne débute qu'au 2e cycle du primaire et n'est acquis qu'au cours du 3e cycle (MELS, 2009). La liste de pseudomots a également été construite de façon à ce qu'une grande variété de correspondances phonèmes-graphèmes soient représentées, incluant celles qui sont moins bien maîtrisées par les enfants présentant une dysorthographie (selon l'expérience clinique des auteurs et collaborateurs du test).

Pilotage de la liste de pseudomots. Avant d'utiliser la liste de pseudomots dans la présente étude, une version pilote a été administrée à 14 enfants de 6 à 12 ans n'ayant pas de difficulté de langage écrit afin de déterminer la pertinence de chacun des pseudomots et l'ordre final de présentation de ceux-ci selon leur taux de réussite. Certains pseudomots ont été modifiés ou supprimés à la suite de ce projet pilote. À titre d'exemple, le pseudomot «nulota» a été retiré puisque son taux de réussite était trop élevé pour l'ensemble des participants. De même, le pseudomot «lurchidien», qui avait un taux de réussite trop faible, a été remplacé par «lurvidien». L'ordre des pseudomots a également été légèrement modifié à la suite de ce projet pilote sans aller à l'encontre des principes de complexité orthographique.

Passation et correction. Il n'y a pas de critère d'arrêt pour la liste de pseudomots; les 24 pseudomots doivent être administrés à tous les enfants. Pour chaque item de la liste, l'examinateur fait écouter à l'enfant l'enregistrement vocal du pseudomot et lui demande de le répéter à voix haute. L'enregistrement est rejoué jusqu'à ce que l'enfant l'ait bien compris. L'enfant écrit ensuite le pseudomot entendu. Un point est attribué par pseudomot correctement écrit (c.-à-d. par pseudomot pouvant être lu de la même façon qu'il a été prononcé dans l'enregistrement). Aucun point n'est attribué en cas d'erreur. Le score maximal de la liste de pseudomots est de 24.

Liste de mots irréguliers. Cette liste contient 60 mots irréguliers (10 par niveau scolaire). Ceux-ci ont été tirés de la liste orthographique du Ministère de l'Éducation, du Loisir et du Sport[3] dans le cadre de son Programme de formation de l'école québécoise afin de bien refléter les mots qui sont enseignés dans les écoles québécoises (MELS, 2014). Tous les mots ont été classés selon les niveaux scolaires dans lesquels ils sont enseignés (p. ex. le mot «garçon» a été classé parmi les mots appris en 1re année et le mot «appuyer» parmi les mots appris en 6e année) et ordonnés selon leur fréquence de réussite par niveau scolaire (p. ex. le mot «juin» a été classé avant le mot «descendre» en 3e année puisqu'il est mieux réussi que le mot «descendre» par les enfants de 3e année). La fréquence de réussite des mots a été déterminée à l'aide de l'*Échelle d'acquisition en orthographe lexicale pour l'école élémentaire* (Pothier et Pothier, 2004), puisque l'*Échelle québécoise d'acquisition de l'orthographe lexicale* (Stanké, et al., 2018) n'était pas encore disponible lors de la création du TELEQ en 2016. Bien que l'*Échelle d'acquisition en orthographe lexicale pour l'école élémentaire* soit d'origine française, il s'agissait de l'instrument le plus complet et le plus informatif en termes de fréquences de réussite des mots au moment de la construction du TELEQ. De plus, il présente l'avantage d'inclure les 60 mots irréguliers du TELEQ (versus 58 dans *l'Échelle québécoise d'acquisition de l'orthographe*, dans laquelle les mots « instinct » et « hygiène », enseignés en 6e année, ne sont pas inclus), ainsi que le taux de réussite selon le niveau scolaire pour tous les mots irréguliers (versus pour la moitié des mots dans *l'Échelle québécoise d'acquisition de l'orthographe lexical*). Après vérification, à l'intérieur des différents niveaux scolaires, l'ordre des mots aurait été légèrement différent si l'*Échelle québécoise d'acquisition de l'orthographe lexicale* avait été utilisée pour la création du test. Cela n'a toutefois eu aucun impact sur le résultat global obtenu à la liste de mots irréguliers du TELEQ puisque, selon les consignes d'administration, les 10 mots de chaque niveau scolaire doivent être présentés à l'enfant.

Passation et correction. Lors de la passation de la liste de mots irréguliers, l'enfant est d'abord amené à écrire les dix mots correspondant à son niveau scolaire. Un score de précision est ensuite calculé par le clinicien (un point est donné par mot correctement écrit). Si l'enfant obtient un score de précision de 7/10 ou moins pour les mots correspondant à son niveau scolaire, une règle de marche arrière est appliquée. Les 10 mots du niveau précédent sont alors administrés, et ce, jusqu'à ce que l'enfant obtienne un score de 8/10 ou plus pour les mots correspondant à un même niveau scolaire. Ensuite, les 10 mots du niveau supérieur sont administrés, et ce, jusqu'à ce que le critère d'arrêt soit atteint (c.-à-d. jusqu'à ce que l'enfant obtienne un score de 3/10 ou moins pour les mots correspondant à un même niveau scolaire). Le score maximal à la liste de mots irréguliers est de 60.

La correction des listes de mots irréguliers et de pseudomots du TELEQ a d'abord été effectuée par l'assistante de recherche les ayant administrées. Puis, une double cotation a été réalisée par une chercheuse-étudiante au doctorat en neuropsychologie. La double-cotation a été réalisée pour tous les enfants. Dans les quelques cas où les deux correctrices ne s'entendaient pas sur la correction, elles en ont discuté ensemble et se sont entendues sur une décision finale. Ce processus a mené à la création d'une liste d'orthographe acceptée (p. ex. «flatiro» accepté pour «flatireau») et à une liste d'erreurs fréquentes (p. ex. «golfieur» non accepté pour «jolfieur»). Pour les mots irréguliers, seule l'orthographe exacte a été acceptée, sauf en ce qui a trait au mot «parcours» où les conjugaisons du verbe parcourir à sonorité identique ont également été acceptées (c.-à-d. parcourt, parcourent, parcoure). Par la suite, les correctrices se sont référées à la liste d'orthographe acceptée afin d'assurer une correction standardisée.

BALE (Jacquier-Roux et al., 2010). Trois sous-tests de cette batterie ont été retenus pour la présente étude, soit ceux intitulés «Dictée de mots et de non-mots» (listes de pseudomots bisyllabiques, de pseudomots trisyllabiques et de mots irréguliers), «Identification de la consonne initiale» et «Comparaison de séquences de lettres». Le sous-test «Dictée de mots et de non-mots» permet d'évaluer l'intégrité des procédures d'assemblage et d'adressage de l'écriture. Les autres sous-tests évaluent les prérequis à la lecture et à l'écriture. Plus spécifiquement, le sous-test «Identification de la consonne initiale» permet d'analyser la discrimination auditive de phonèmes et le sous-test «Comparaison de séquences de lettres» permet de vérifier la procédure d'analyse visuelle de la séquence des lettres. La BALE possède des normes françaises pour les enfants de la 2e à la 5e année du primaire. Pour les analyses,

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[3] Le Ministère de l'Éducation, du Loisir et du Sport est devenu le Ministère de l'Éducation et de l'Enseignement supérieur. Cependant, à la date de publication de la liste orthographique, l'auteur est désigné comme étant le Ministère de l'Éducation, du Loisir et du Sport, donc cette appellation sera utilisée dans le présent article.

le score global de temps a été retenu pour le sous-test «Comparaison de séquences de lettres», alors que le score de précision a été retenu pour les deux autres sous-tests. Aucune donnée psychométrique n'est disponible dans la littérature pour la BALE.

Analyses et prédictions

Performances au sous-test «Dictée de mots et de pseudomots» du TELEQ. Les performances au sous-test «Dictée de mots et de pseudomots» du TELEQ devraient s'améliorer selon le niveau scolaire de l'enfant, ce qui a été vérifié à l'aide d'analyses de variance.

Fidélité test-retest. La fidélité test-retest fait référence au fait qu'un outil devrait fournir des résultats relativement similaires entre différentes passations (Bouchard et al., 2009). Ainsi, des corrélations significatives et fortes entre deux passations du TELEQ devraient être présentes pour assurer de la stabilité de l'outil dans le temps.

Cohérence interne. La cohérence interne (ou l'homogénéité) informe sur le degré de cohésion des items d'un test. Plus spécifiquement, il s'agit du degré avec lequel des items censés mesurer un même construit mènent à des résultats similaires (Bouchard et al., 2009). Pour mesurer la cohérence interne, des alphas de Cronbach ont été obtenus, et ce, tant pour la liste de pseudomots que la liste de mots irréguliers du TELEQ. Ceux-ci devraient être élevés pour chacune des deux listes de mots/pseudomots du TELEQ afin d'assurer la présence d'une bonne cohérence interne.

Validité concordante. La validité concordante correspond au degré avec lequel un test corrèle bien avec d'autres mesures déjà validées pour mesurer un même construit (Bouchard et al., 2009). Ainsi, pour que le sous-test «Dictée de mots et de pseudomots» du TELEQ soit considéré valide, les performances des participants aux listes de pseudomots et de mots irréguliers du TELEQ et de la BALE devraient être similaires, et ce, considérant que les listes homologues de ces tests devraient évaluer les mêmes processus orthographiques (c.-à-d. l'intégrité de la voie d'assemblage pour les listes de pseudomots et l'intégrité de la voie d'adressage pour les listes de mots irréguliers). Des corrélations de Pearson significatives et fortes sont donc attendues entre les scores des listes homologues du TELEQ et de la BALE. Toutefois, comme le TELEQ est un outil construit à l'aide de mots enseignés dans les écoles primaires du Québec et classés selon la progression des apprentissages des enfants québécois, il est également attendu que les performances à cet outil soient supérieures à celles obtenues à la BALE. Afin d'obtenir cette mesure de validité, des normes préliminaires du TELEQ (c.-à-d. moyenne et écart-type) ont été construites pour chacune des listes de mots/pseudomots, et ce, selon le niveau scolaire. Les scores bruts des enfants ont ensuite été transformés en scores standardisés (scores z : $M = 0$ $É.-T. = 1$) selon le niveau scolaire, afin d'être comparés aux scores standardisés obtenus à la BALE[4]. Les comparaisons des performances des enfants aux listes de mots/pseudomots des deux outils ont été effectuées à l'aide de tests t à échantillons appariés.

Validité de construit. La validité de construit vise à assurer qu'un instrument mesure les construits pour lesquels il a été conçu (Anastasi, 1976; McCauley et Swisher, 1984). Elle peut être mesurée à l'aide de corrélations convergentes (Bouchard et al., 2009). Comme la liste de pseudomots du TELEQ vise à vérifier l'intégrité de la voie d'assemblage (c.-à-d. la voie impliquant la discrimination de phonèmes et la correspondance phonèmes-graphèmes), le score pour cette liste devrait corréler avec le score du sous-test «Identification de la consonne initiale» de la BALE (qui évalue la discrimination phonémique). Quant à la liste de mots irréguliers du TELEQ, qui vise à vérifier l'intégrité de la voie d'adressage, le score pour cette liste devrait corréler avec le score de vitesse du sous-test «Comparaison de séquences de lettres» de la BALE. En effet, le sous-test «Comparaison de séquences de lettres» évalue la perception visuelle des séquences de lettres, qui est à la base de la représentation visuelle orthographique des mots. Des corrélations entre les listes de mots/pseudomots du TELEQ et les sous-tests non reliés de la BALE sont également attendues, puisque les deux voies (assemblage et adressage) peuvent être utilisées pour orthographier les pseudomots et les mots irréguliers. Toutefois, les corrélations entre les sous-tests n'évaluant pas les mêmes processus devraient être inférieures à celles des sous-tests évaluant les mêmes processus.

Validité critériée concomitante. La validité critériée concomitante d'un test est déterminée en évaluant dans quelle mesure le résultat d'un individu est lié à son résultat sur une variable critère qui est mesurée environ au même moment où le résultat du test est obtenu (McCauley et Swisher, 1984). Ainsi, il est attendu que les performances au sous-test «Dictée de mots et de pseudomots» du TELEQ soient liées aux résultats scolaires obtenus en écriture,

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[4] Comme aucune norme de la BALE n'était disponible pour la 6^{e} année du primaire, les comparaisons entre le TELEQ et la BALE ont été effectuées uniquement avec les performances des enfants de la 2^{e} à la 5^{e} année du primaire.

dans la discipline du français. Des corrélations de Pearson ont donc été effectuées entre les performances au sous-test « Dictée de mots et de pseudomots » du TELEQ et la note la plus récente ayant été obtenue en écriture, dans la discipline du français (et rapportée dans le bulletin).

Analyses statistiques. Les analyses ont été effectuées avec le logiciel IBM SPSS Statistics 25. Pour la majorité des analyses, le seuil de signification utilisé était de 0,05 ($\alpha_{critique}$ = 0,05). Ce seuil a été corrigé avec la correction de Bonferroni pour comparaisons multiples pour les huit corrélations entre les mesures du TELEQ et de la BALE ($\alpha_{corrigé}$ = 0,00625). Il est à noter que le nombre de participants dans les analyses était différent pour les deux listes, des erreurs d'administration lors de la passation de la liste de mots irréguliers ayant fait en sorte que seulement 114 participants ont pu être inclus dans les analyses pour cette liste, alors que l'ensemble des 117 participants de l'échantillon ont pu être inclus dans les analyses concernant la liste de pseudomots. De plus, les corrélations entre les résultats obtenus au sous-test « Dictée de mots et de pseudomots » du TELEQ et la note obtenue en écriture, dans la discipline du français (et rapportée dans le bulletin) ont été réalisées avec les 107 participants de l'échantillon pour lesquels une note était disponible (notons que sur ces 107 participants, seuls 105 avaient également un score valide pour la liste de mots irréguliers). Finalement, ajoutons qu'après une analyse visuelle des nuages de points, tous les résultats obtenus en effectuant des corrélations de Pearson ont été comparés à ceux qui auraient été obtenus en effectuant des corrélations de Spearman, et ce, afin de s'assurer que l'utilisation des corrélations de Pearson était adéquate. Puisque les résultats obtenus étaient similaires, seules les corrélations de Pearson ont été incluses dans le présent article.

Résultats

Description de l'échantillon

Sur les 153 participants potentiels, un total de 36 participants ont été exclus. Vingt-trois d'entre eux avaient reçu un diagnostic officiel de trouble neurodéveloppemental, 10 avaient un score situé à plus de deux écarts-types sous la moyenne (selon leur âge) aux mesures d'habiletés de lecture (*n* = 5) ou de QI (*n* = 5) et trois avaient des scores supérieurs au 98^e rang centile aux symptômes d'inattention (*n* = 2) ou d'hyperactivité (*n* = 1). Ainsi, l'échantillon final était composé de 117 enfants (60 filles et 57 garçons) âgés de 7 à 12 ans (*M* = 9,63, *É.-T.* = 1,40). La plupart des participants ne parlaient que le français (*n* = 99) et certains parlaient l'anglais (*n* = 5), l'espagnol (*n* = 3), l'arabe (*n* = 6) ou le créole (*n* = 4) en plus du français à la maison. Les caractéristiques sociodémographiques de l'échantillon final sont présentées dans le **tableau 1**. Les participants étaient majoritairement en 2^e, 3^e, 4^e ou 5^e année du primaire; peu d'entre eux étaient en 6^e année du primaire. Le revenu familial annuel brut des participants était majoritairement égal ou supérieur à 100 000$. De plus, un peu plus de la moitié des enfants ont été évalués au trimestre d'hiver et la majorité provenait de la région du Grand Montréal. Les statistiques descriptives sont présentées dans le **tableau 2**. Les scores moyens à tous les tests utilisés se situaient dans les limites de la moyenne (scores *z* entre -0,7 et 0,7; Wechsler, 2005a).

Analyses préliminaires

La normalité des distributions des scores pour l'ensemble des variables a d'abord été vérifiée à l'aide de scores d'asymétrie et de voussure (Curran, West et Finch, 1996). Toutes les variables utilisées dans les analyses étaient distribuées normalement. Des analyses préliminaires ont ensuite été conduites afin d'examiner l'influence potentielle de certaines variables sur les résultats au sous-test « Dictée de mots et de pseudomots » du TELEQ. La taille de l'échantillon ne permettait pas de faire ces analyses selon les différents niveaux scolaires; elles ont donc été effectuées sur l'échantillon total. Les scores obtenus au sous-test « Dictée de mots et de pseudomots » ne différaient pas selon le genre des participants, tel que mesuré par un test *t* à échantillons indépendants (pseudomots : *t*(111) = 1,53 *p* = 0,13; irréguliers : *t*(112) = 0,84, *p* = 0,40). D'autres tests *t* à échantillons indépendants ont indiqué que le revenu familial annuel (100 000$ et plus comparativement à 99 999$ et moins) avait une influence sur les scores obtenus à la liste de pseudomots du TELEQ (*t*(115) = -2,51, *p* = 0,01), alors qu'il n'en avait pas sur ceux obtenus à la liste de mots irréguliers (*t*(112) = -1,27, *p* = 0,21). Les participants ayant un revenu familial annuel de 99 999$ et moins ont donc obtenu un score moyen pour la liste de pseudomots (*M* = 16,33/24) significativement plus bas que les participants ayant un revenu familial de 100 000$ et plus (*M* = 18,24/24). Ajoutons que la taille d'effet du test *t* pour la liste de pseudomots (R^2 = 0,052) était considérée moyenne selon Cohen (1988) et que le revenu familial expliquait 5,2% de la variance de la performance à la liste de pseudomots.

Performances au sous-test « Dictée de mots et de pseudomots » du TELEQ

Les **tableaux 3 et 4** rapportent les performances des enfants au sous-test « Dictée de mots et de pseudomots » du TELEQ selon le niveau scolaire. La moyenne de la performance des enfants de la 2^e à la 6^e année a passé de 14/24 à 19/24 pour les pseudomots et de 12/60 à 56/60

Tableau 1

Caractéristiques sociodémographiques de l'échantillon

	Niveau scolaire					Échantillon total	
	2e année n	3e année n	4e année n	5e année n	6e année n	N	%
Sexe							
Fille	16	13	10	15	6	60	51,72
Garçon	8	20	9	13	7	57	48,72
Revenu familial annuel brut							
39 000$ et moins	1	3	1	1	0	6	5,13
40 000$ à 59 000$	1	1	4	4	1	11	9,40
60 000$ à 79 000$	2	4	2	2	1	11	9,40
80 000$ à 99 000$	6	5	0	4	0	15	12,82
100 000$ et plus	14	20	12	17	11	74	63,25
Région							
Brome-Missisquoi	2	1	1	4	2	10	8,55
Haute-Yamaska	3	4	1	6	0	14	11,97
Laval	12	15	13	13	6	59	50,43
Longueuil	0	1	0	0	2	3	2,56
Montréal	5	12	3	4	3	27	23,08
Autre	2	0	1	1	0	4	4,42
Trimestre au moment de l'évaluation							
Automne	4	8	1	2	3	18	15,38
Hiver	13	15	14	10	8	60	51,28
Printemps	6	7	3	14	2	32	27,35
Été[1]	1	3	1	2	0	7	5,98

Note. [1]Le niveau scolaire attribué aux enfants évalués durant le trimestre d'été était le dernier complété.

pour les mots irréguliers. Une analyse de variance a indiqué que la performance au niveau de la liste de pseudomots augmentait selon le niveau scolaire de l'enfant ($F(4, 112) = 11{,}85$, $p < 0{,}001$). Cependant, la courbe de performance tendait à plafonner entre la 3e et la 6e année du primaire. En effet, une comparaison des moyennes des participants selon les différents niveaux scolaires (par le test post hoc de Tukey) a montré que les enfants de la 2e année du primaire ($M = 13{,}50$) différaient significativement des enfants de la 3e à la 6e année du primaire ($M = 17{,}61$, $p < 0{,}001$; $M = 18{,}16$, $p < 0{,}001$; $M = 19{,}86$, $p < 0{,}001$; $M = 18{,}92$, $p < 0{,}001$). Cependant, les enfants de 3e et 4e année ($p = 0{,}98$), de 3e et 5e année ($p = 0{,}09$), de 3e et 6e année ($p = 0{,}78$), de 4e et 5e année ($p = 0{,}47$), de 4e et 6e année ($p = 0{,}97$) et de 5e et 6e année ($p = 0{,}93$) ne différaient pas significativement entre eux.[5] Concernant la performance des enfants à la liste de

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[5] Nous avons effectué une analyse de variance avec les résultats obtenus à la dictée de pseudomots de la BALE (dictée de pseudomots totale), afin de déterminer si cet effet plafond se retrouvait aussi dès la 3e année du primaire avec cet outil d'évaluation. Les résultats ont également montré la présence d'un effet plafond avec la BALE. En effet, une comparaison des moyennes des participants selon les différents niveaux scolaires (par le test post hoc de Tukey) a montré que les enfants de la 2e année du primaire ($M = 13{,}50$) différaient significativement des enfants de la 3e à la 6e année du primaire ($M = 16{,}36$, $p = 0{,}001$; $M = 16{,}16$, $p = 0{,}01$; $M = 18{,}04$ $p < 0{,}001$; $M = 18{,}08$, $p < 0{,}001$). Cependant, les enfants de 3e et 4e année ($p = 1{,}00$), de 3e et 5e année ($p = 0{,}09$), de 3e et 6e année ($p = 0{,}25$), de 4e et 5e année ($p = 0{,}11$), de 4e et 6e année ($p = 0{,}24$) et de 5e et 6e année ($p = 1{,}00$) ne différaient pas significativement entre eux.

Tableau 2

Statistiques descriptives de l'échantillon

Variables	Scores standardisés (z)			
	M	*ÉT*	*Min*	*Max*
WISC-IV : vocabulaire	0,46	0,98	-1,70	2,30
WISC-IV : matrices	0,33	0,84	-1,70	2,70
WISC-IV : séquences de chiffres	0,35	0,81	-1,30	2,90
Alouette-R : vitesse	0,64	1,00	-1,43	3,84
Alouette-R : précision	0,11	0,67	-1,93	1,43
BALE : identification de la consonne initiale	0,36	0,73	-2,94	1,28
BALE : comparaison de séquences de lettres- vitesse	0,42	0,99	-2,49	2,42
	Rang centile			
ARS-IV : score inattention	47,22	27,71	1,00	97,50
ARS-IV : score hyperactivité	45,09	28,86	5,50	95,00
ARS-IV : score total	48,19	26,91	1,00	95,00
	Pourcentage (%)			
Note en écriture au bulletin	82,53	7,73	62,50	99,00

Note. WISC-IV = Échelle d'intelligence de Wechsler pour enfants. Version pour francophones du Canada (4e éd.); BALE = Batterie Analytique du Langage Écrit; ARS-IV= ADHD Rating Scale-IV.

Tableau 3

Performances à la liste de pseudomots du TELEQ en fonction du niveau scolaire

Niveau scolaire	*n*	Scores bruts (/24)					Scores standardisés (z)				
		M	*Méd.*	*ÉT*	*Min*	*Max*	*M*	*Méd.*	*ÉT*	*Min*	*Max*
2e	24	13,50	14,00	4,49	5	21	0,00	0,11	1,00	-1,89	1,67
3e	33	17,61	17,00	3,33	9	23	0,00	-0,18	1,00	-2,59	1,62
4e	19	18,16	19,00	3,98	8	24	0,00	0,21	1,00	-2,55	1,47
5e	28	19,86	20,00	2,21	15	23	0,00	0,06	1,00	-2,20	1,42
6e	13	18,92	20,00	3,20	12	23	0,00	0,34	1,00	-2,16	1,28
Échantillon total	117	17,54	19,00	4,08	5	24	0,00	0,06	0,98	-2,59	1,67

Note. TELEQ = Test d'évaluation du langage écrit québécois.

mots irréguliers, celle-ci tendait à augmenter selon le niveau scolaire, telle que mesurée par une analyse de variance ($F(4, 109) = 66{,}08$, $p < 0{,}001$). Toutefois, lorsque les moyennes des niveaux scolaires étaient comparées entre elles, à l'aide du test post hoc de Tukey, aucune différence significative n'était présente entre les niveaux scolaires faisant partie d'un même cycle. Ainsi, aucune différence significative ne se retrouvait entre les niveaux de 2e cycle du primaire (p =

Tableau 4

Performances à la liste de mots irréguliers du TELEQ en fonction du niveau scolaire

Niveau scolaire	*n*	Scores bruts (/60)					Scores standardisés (*z*)				
		M	*Méd.*	*ÉT*	*Min*	*Max*	*M*	*Méd.*	*ÉT*	*Min*	*Max*
2e	23	11,65	12,00	6,49	0	28	0,00	0,05	1,00	-1,80	2,52
3e	33	30,58	30,00	10,49	9	51	0,00	-0,06	1,00	-2,06	1,95
4e	18	32,50	37,00	13,85	3	53	0,00	0,32	1,00	-2,13	1,48
5e	27	47,74	50,00	8,03	31	59	0,00	0,28	1,00	-2,08	1,40
6e	13	55,85	58,00	4,04	46	60	0,00	0,53	1,00	-2,44	2,52
Échantillon total	114	34,01	36,00	17,04	0	60	0,00	0,19	0,98	-2,44	2,52

Note. TELEQ = Test d'évaluation du langage écrit québécois.

0,96), soit entre les enfants de 3e année (*M* = 30,58) et ceux de 4e année (*M* = 32,50) ni entre les niveaux de 3e cycle du primaire (*p* = 0,09), soit entre les enfants de 5e année (*M* = 47,74) et ceux de 6e année (*M* = 55,85). Cependant, bien que les différences n'étaient pas statistiquement significatives, les moyennes tendaient tout de même à augmenter d'un niveau scolaire à l'autre, tel qu'attendu. De plus, des différences significatives (*p* < 0,001) se retrouvaient entre les différents cycles du primaire. En effet, les participants de premier cycle du primaire, soit ceux en 2e année (*M* = 11,65), différaient significativement des participants des deux autres cycles et les participants du deuxième cycle (3e et 4e année) différaient significativement des participants du troisième cycle (5e et 6e année).

Fidélité

Fidélité test-retest. Les résultats obtenus au retest sont présentés dans le **tableau 5**. Au total, 102 participants ont été inclus dans les analyses de fidélité test-retest pour la liste de pseudomots et 97 pour la liste de mots irréguliers. La diminution de l'échantillon relève de l'attrition et la différence entre les deux listes de mots/pseudomots est due à des erreurs d'administration lors des évaluations au retest. Le délai entre les deux passations variait entre 11 et 43 jours. Les corrélations entre les scores des deux passations de la liste de pseudomots (*r* = 0,83, *p* < 0,001) et de la liste de mots irréguliers (*r* = 0,96, *p* < 0,001) étaient fortes et significatives (Cohen, 1988). Cependant, les résultats aux tests *t* appariés entre les deux passations

Tableau 5

Performances au retest du sous-test « Dictée de mots et de pseudomots » du TELEQ en fonction du niveau scolaire

Niveau scolaire	Scores bruts à la liste de pseudomots (/24)						Scores bruts à la liste de mots irréguliers (/60)					
	n	*M*	*Méd.*	*ÉT*	*Min*	*Max*	*n*	*M*	*Méd.*	*ÉT*	*Min*	*Max*
2e	22	14,00	14,50	4,68	5	21	21	14,52	14,00	8,84	4	34
3e	32	18,22	18,50	2,77	11	23	31	33,90	35,00	11,53	9	53
4e	13	18,54	21,00	4,41	10	24	12	34,58	37,00	10,87	18	48
5e	23	20,30	21,00	2,06	16	24	22	48,50	51,50	7,27	33	58
6e	12	21,08	21,00	2,43	15	24	11	57,91	58,00	1,30	56	60
Échantillon total	102	18,16	19,00	4,08	5	24	97	35,82	39,00	16,63	4	60

Note. TELEQ = Test d'évaluation du langage écrit québécois.

étaient significatifs tant pour les pseudomots (t(101) = -3,37, p = 0,001) que pour les mots irréguliers (t(96) = -4,95, p < 0,001). Ainsi, les enfants étaient significativement meilleurs au retest qu'au test. En effet, ils ont obtenu un score moyen 3,27% plus élevé pour la liste de pseudomots et 3,73% plus élevé pour la liste de mots irréguliers.

Cohérence interne. Des alphas de Cronbach ont permis de mesurer la cohérence interne de chacune des listes de mots/pseudomots du TELEQ. Ainsi, l'alpha était de 0,80 pour la liste de pseudomots, alors qu'il était de 0,98 pour la liste de mots irréguliers, indiquant une excellente cohérence interne pour les deux listes (Nunnally et Bernstein, 1994). Notons toutefois qu'un alpha de Cronbach supérieur à 0,90, comme celui obtenu pour la liste de mots irréguliers, pourrait suggérer une redondance entre les items (Streiner, 2003; Tavakol et Dennick, 2011).

Validité

Validité concordante. Les **tableaux 6, 7 et 8** rapportent les performances des enfants aux listes de pseudomots et de mots irréguliers de la BALE selon le niveau scolaire. Les corrélations entre les listes homologues de pseudomots et de mots irréguliers du TELEQ et de la BALE ont été effectuées sur l'échantillon total et étaient significatives et fortes (Cohen, 1988; voir **tableau 9**), ce qui indique une bonne validité concordante. La différence entre les coefficients de corrélations pour les listes de mots/

Tableau 6

Performances à la liste de pseudomots bisyllabiques de la BALE en fonction du niveau scolaire

Niveau scolaire	*n*	Scores bruts (/10)					Scores standardisés (*z*)				
		M	*Méd.*	*ÉT*	*Min*	*Max*	*M*	*Méd.*	*ÉT*	*Min*	*Max*
2e	24	7,42	8,00	2,06	3	10	-0,19	0,10	1,02	-2,36	1,08
3e	33	8,82	9,00	1,13	6	10	0,40	0,52	0,77	-1,53	1,21
4e	19	8,47	9,00	1,35	5	10	-0,69	-0,19	1,27	-3,96	0,75
5e	28	9,54	10,00	0,69	7	10	0,19	0,59	0,59	-1,96	0,58
6e	13	9,54	10,00	0,78	8	10	-[1]	-	-	-	-
Échantillon total	117	8,73	9,00	1,50	3	10	0,01	0,31	0,97	-3,96	1,21

Note. [1] Les scores standardisés de la 6e année ne sont pas disponibles dans les normes de la BALE. BALE = Batterie Analytique du Langage Écrit.

Tableau 7

Performances à la liste de pseudomots trisyllabiques de la BALE en fonction du niveau scolaire

Niveau scolaire	*n*	Scores bruts (/10)					Scores standardisés (*z*)				
		M	*Méd.*	*ÉT*	*Min*	*Max*	*M*	*Méd.*	*ÉT*	*Min*	*Max*
2e	24	6,08	7,00	2,36	0	9	-0,43	-0,05	0,98	-2,95	0,78
3e	33	7,55	8,00	1,56	2	10	-0,26	-0,03	0,80	-3,09	0,99
4e	19	7,68	8,00	1,49	4	10	-0,75	-0,55	0,97	-3,14	0,75
5e	28	8,50	9,00	0,96	7	10	-0,54	-0,12	0,82	-1,81	0,73
6e	13	8,54	9,00	1,27	6	10	-[1]	-	-	-	-
Échantillon total	117	7,61	8,00	1,81	0	10	-0,46	-0,12	0,88	-3,14	0,99

Note. [1] Les scores standardisés de la 6e année ne sont pas disponibles dans les normes de la BALE. BALE = Batterie Analytique du Langage Écrit.

Tableau 8

Performances à la liste de mots irréguliers de la BALE en fonction du niveau scolaire

Niveau scolaire	n	Scores bruts (/10)					Scores standardisés (z)				
		M	*Méd.*	*ÉT*	*Min*	*Max*	M	*Méd.*	*ÉT*	*Min*	*Max*
2e	24	3,42	3,00	1,89	0	7	-0,22	-0,37	0,69	-1,46	1,08
3e	33	6,18	6,00	2,07	1	10	0,06	-0,02	0,91	-2,23	1,75
4e	19	6,79	7,00	1,93	2	10	-0,66	-0,53	1,14	-3,49	1,24
5e	28	8,36	8,00	1,34	5	10	-0,20	-0,44	0,89	-2,44	0,89
6e	13	9,46	10,00	0,66	8	10	-[1]	-	-	-	-
Échantillon total	117	6,60	7,00	2,60	0	10	-0,21	-0,20	0,93	-3,49	1,75

Note. [1]Les scores standardisés de la 6e année ne sont pas disponibles dans les normes de la BALE. BALE = Batterie Analytique du Langage Écrit.

pseudomots homologues et non-homologues a ensuite été examinée à l'aide d'un test de différence entre deux corrélations dépendantes avec une variable en commun (Lee et Preacher, 2013 ; Steiger, 1980). Les résultats ont montré que le coefficient de corrélation obtenu entre les deux listes de pseudomots de la BALE et la liste de pseudomots du TELEQ était significativement plus élevé que celui obtenu entre les deux listes de pseudomots de la BALE et la liste de mots irréguliers du TELEQ (z = -2,90, p = 0,003, bilatéral). De la même façon, le coefficient de corrélation obtenu entre la liste de mots irréguliers de la BALE et la liste de mots irréguliers du TELEQ était significativement plus élevé que celui obtenu entre la liste de mots irréguliers de la BALE et la liste de pseudomots du TELEQ (z = 5,94, p < 0,001, bilatéral). Ainsi, les corrélations étaient plus fortes entre les listes homologues qu'entre les listes non-homologues.

Concernant la comparaison des performances au TELEQ et à la BALE, un test t apparié a été effectué sur les scores standardisés de l'échantillon total. Aucune différence significative n'a été trouvée entre les performances à la liste de pseudomots du TELEQ et celles à la liste de non-mots bisyllabiques de la BALE (t(103) = -0,09, p = 0,93), contrairement à ce qui était attendu. Cependant, une différence significative a été observée entre les performances à la liste de pseudomots du TELEQ et celles à la liste de pseudomots trisyllabiques de la BALE (t(103) = 5,41, p < 0,001). En effet, tel qu'attendu, les participants étaient significativement meilleurs au TELEQ (M = 0,00) qu'à la BALE (M = -0,46). Il est toutefois important de noter que la liste de pseudomots du TELEQ n'est pas uniquement constituée de pseudomots bisyllabiques ou trisyllabiques, comme c'est le cas des listes de la BALE. Au contraire, le TELEQ comprend une variété de mots composés d'une à quatre syllabes[6]. Finalement, une différence significative a été relevée entre les performances aux listes de mots irréguliers du TELEQ et celles à la BALE (t(100) = 2,53, p = 0,01). En effet, les participants obtiennent des performances significativement plus élevées au TELEQ (M = 0,00) qu'à la BALE (M = -0,21), tel qu'attendu.

Validité de construit. Les deux listes de mots/pseudomots du TELEQ corrélaient avec le sous-test « Identification de la consonne initiale » de la BALE (voir le **tableau 9**). La corrélation était considérée forte avec la liste de pseudomots et moyenne avec la liste de mots irréguliers (Cohen, 1988). Selon un test de différence entre deux corrélations dépendantes avec une variable en commun (Lee et Preacher, 2013 ; Steiger, 1980), le sous-test « Identification de la consonne initiale » corrélait significativement davantage avec la liste de pseudomots du TELEQ qu'avec la liste de mots irréguliers du TELEQ (z = -3.81, p < 0,001, bilatéral), tel qu'attendu. En ce qui concerne le sous-test « Comparaison de séquences de lettres » de la BALE, le temps de réalisation de cette tâche corrélait négativement avec les scores des deux listes de mots/pseudomots du TELEQ (voir le **tableau 9**). Ainsi, plus les

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[6] Comme il n'existait pas de normes pour le score total (combiné) des deux listes de pseudomots de la BALE, le score total des pseudomots de la BALE n'a pas pu être comparé à celui du TELEQ à l'aide d'un test t apparié.

Tableau 9

Corrélations entre les mesures du TELEQ et de la BALE

BALE	TELEQ	
	Pseudomots	Mots irréguliers
Liste de pseudomots (total)	0,77**	0,60**
Liste de mots irréguliers	0,60**	0,88^{**1}
Identification de la consonne initiale	0,56**	0,29*
Comparaison de séquences de lettres (vitesse)	-0,45**	-0,63**

Note. TELEQ = Test d'évaluation du langage écrit québécois; BALE = Batterie Analytique du Langage Écrit. [1]Le seuil critique a été corrigé avec la correction de Bonferroni. Le seuil critique corrigé est de 0,00625.
$^{*}p = 0{,}002$. $^{**}p < 0{,}001$.

scores de précision du TELEQ étaient élevés, plus le temps de réalisation du sous-test «Comparaison de séquences de lettres» était court. La corrélation était jugée forte avec les mots irréguliers et moyenne avec les pseudomots (Cohen, 1988). De plus, tel qu'attendu, le coefficient de corrélation obtenu entre le score de vitesse du sous-test «Comparaison de séquences de lettres» de la BALE et le score de la liste de mots irréguliers du TELEQ était significativement plus grand que celui obtenu entre le score de vitesse du sous-test «Comparaison de séquences de lettres» de la BALE et le score de la liste de pseudomots du TELEQ ($z = -2{,}53$, $p < 0{,}01$, bilatéral).

Validité critériée concomitante. Tel qu'attendu, une corrélation moyenne a été observée entre le score obtenu à la liste de pseudomots du TELEQ et la note obtenue en écriture, dans la discipline du français (rapportée dans le plus récent bulletin) ($r = 0{,}33$, $p = 0{,}001$). Une faible corrélation significative a également été observée entre le score obtenu à la liste de mots irréguliers et la note obtenue en écriture, dans la discipline du français ($r = 0{,}23$, $p = 0{,}02$; Cohen, 1988).

Discussion

Cette étude visait à effectuer une pré-validation du sous-test «Dictée de mots et de pseudomots» du TELEQ auprès d'un échantillon d'enfants québécois du primaire. Le TELEQ a été développé afin de répondre à un manque d'outils cliniques pouvant être utilisés pour l'évaluation du langage écrit, possédant de bonnes qualités psychométriques et étant adaptés à la culture franco-québécoise (Bouchard et al., 2009; Monetta et al., 2016). Le sous-test «Dictée de mots et de pseudomots» du TELEQ est composé à la fois d'une liste de pseudomots (qui ont été classés selon leur longueur, leur complexité orthographique et la progression des apprentissages des enfants québécois du primaire) et d'une liste de mots irréguliers (qui est basée sur la liste orthographique du MELS (2014)). Les deux listes ont été administrées à 117 enfants québécois francophones de la 2^{e} à la 6^{e} année du primaire ne présentant pas de difficultés en langage écrit.

Performances au TELEQ

Les performances des enfants du présent échantillon à la liste de pseudomots suivent une progression logarithmique en fonction du niveau scolaire. En effet, une différence significative est observée entre les scores des enfants de 2^{e} année du primaire et ceux des niveaux supérieurs, mais pas entre les scores des enfants des niveaux supérieurs. Le ralentissement de l'augmentation de performance à partir de la 3^{e} année du primaire pour l'écriture de pseudomots peut s'expliquer par l'utilisation de la procédure de correspondance entre les phonèmes et les graphèmes qui débute très tôt au primaire. En effet, l'écriture selon les règles de correspondance phonographémique constitue la première étape de l'apprentissage de l'orthographe des mots (Bézu, 2009; Caravolas, Hulme et Snowling, 2001; Sprenger-Charolles, Siegel et Bonnet, 1998). Ainsi, il est possible que les habiletés à utiliser les règles de correspondance phonographémique augmentent de façon abrupte en début d'apprentissage (lors de leur acquisition), puis qu'elles se stabilisent par la suite. De plus, l'apprentissage des graphies contextuelles et acontextuelles (décrites dans la section «Mesures») commence dès le 2^{e} cycle du primaire, soit autour de la 3^{e} année (MELS, 2009). Cela pourrait expliquer pourquoi une différence significative est observée entre les scores des enfants de 2^e année et ceux des niveaux supérieurs, mais pas entre les scores des enfants de 3^e année et ceux de 4^e, 5^e et 6^e année. Quoique non statistiquement significative, nous observons tout de même une augmentation de la moyenne entre ces niveaux scolaires, indiquant une progression de la performance entre les enfants de 3^e et 6^e année. Ajoutons qu'un effet plafond observé auprès d'enfants de 3^e année normolecteurs (comme c'est le cas dans la présente étude) est encourageant pour d'éventuelles études qui auraient un groupe clinique composé d'enfants présentant une dysorthographie. En effet, les résultats des enfants dysorthographiques devraient se situer sous la norme de leur niveau scolaire. Cela laisse donc présager que les performances des enfants dysorthographiques se distribueront de façon variable (en évitant un effet plancher). Si tel est le cas, le TELEQ pourrait alors permettre d'évaluer l'ampleur des déficits en écriture.

En ce qui concerne les performances des enfants à la liste de mots irréguliers du TELEQ, celles-ci montrent une progression ascendante significative entre les différents cycles du primaire, mais pas entre les niveaux scolaires faisant partie d'un même cycle. Cela peut s'expliquer par le fait que la progression des apprentissages des enfants au Québec se fait par tranche de deux ans (par cycle), l'orthographe des mots étant graduellement enseignée aux enfants au cours d'un cycle et étant révisée en fin de cycle (Conseil supérieur de l'éducation, 2002; MELS, 2009). La liste orthographique du MELS (2014), sur laquelle est basée la construction de la liste de mots irréguliers, classe d'ailleurs les mots selon le niveau scolaire dans lequel ils devraient être enseignés et selon les différents cycles pendant lesquels ces mots devraient être à l'étude. Ajoutons que les moyennes des performances de l'échantillon augmentent progressivement de la 2^e à la 6^e année, ce qui laisse supposer une amélioration des performances à l'intérieur des niveaux scolaires d'un même cycle, même si celle-ci n'est pas statistiquement significative.

Fidélité et validité

En ce qui concerne les qualités psychométriques du sous-test « Dictée de mots et de pseudomots » du TELEQ, la présente étude indique qu'il semble présenter des propriétés psychométriques satisfaisantes. En effet, les corrélations très fortes et significatives entre les passations test et retest des listes du TELEQ suggèrent une bonne fidélité test-retest de l'outil (Cohen, 1988). Ces résultats signifient que les performances d'un même enfant à deux moments rapprochés dans le temps sont stables. Les résultats au test *t* apparié montrent toutefois que les enfants ont obtenu de meilleures performances au retest qu'au test, ce qui peut s'expliquer par un effet de pratique (Bernaud, 2007), plusieurs participants ayant d'ailleurs mentionné lors du retest se rappeler avoir orthographié les mêmes mots quelques semaines auparavant. Le passage du temps pourrait également en partie expliquer ces résultats (surtout pour les enfants ayant eu le retest un mois après le test) étant donné que les apprentissages scolaires des enfants se poursuivent entre le moment des passations test et retest (Bernaud, 2007). Ainsi, l'orthographe de certains mots pourrait ne pas avoir été enseignée à l'enfant avant la passation du test, mais l'avoir été avant la passation du retest. Il en est de même pour l'apprentissage des graphies contextuelles et acontextuelles qui peut avoir progressé entre le moment des passations test et retest.

L'alpha de Cronbach de chacune des deux listes du sous-test « Dictée de mots et de pseudomots » du TELEQ dépasse largement le seuil minimal d'acceptabilité de 0,70 (Nunnally et Bernstein, 1994), ce qui laisse entrevoir la présence d'une bonne cohérence interne. Ce résultat révèle que les items appartenant à une même liste de mots du TELEQ corrèlent bien entre eux et qu'ils semblent donc mesurer un même construit (c.-à-d. l'intégrité de la voie d'assemblage pour la liste de pseudomots et l'intégrité de la voie d'adressage pour la liste de mots irréguliers). Toutefois, un alpha de Cronbach plus élevé que 0,90, comme celui obtenu pour la liste de mots irréguliers, pourrait être le signe d'une redondance entre les items (Streiner, 2003; Tavakol et Dennick, 2011). Comme notre objectif est de développer un outil qui permettrait d'identifier le plus efficacement possible les enfants présentant des difficultés en orthographe, il serait peut-être possible de rendre l'outil plus efficace en réduisant le nombre d'items, et donc, la durée de passation. Toutefois, le nombre d'items requis pour que l'outil soit à la fois sensible et spécifique reste à déterminer avec une future étude qui inclura un groupe clinique. Cette future étude pourra évaluer la pertinence et les effets d'une diminution du nombre d'items de la liste de mots irréguliers du sous-test « Dicté de mots et de pseudomots » du TELEQ.

Pour ce qui est de la validité concordante, comme les plus fortes corrélations se situent entre les listes homologues de pseudomots et de mots irréguliers du TELEQ et de la BALE, ces deux outils semblent évaluer les mêmes construits, soit les voies d'assemblage (par les listes de pseudomots) et d'adressage (par les listes de mots irréguliers). Les performances des enfants au TELEQ sont également significativement plus élevées que celles à la BALE, tant pour les pseudomots trisyllabiques que pour les mots irréguliers. La construction des deux listes de mots/pseudomots du sous-test « Dictée de mots et de pseudomots » du TELEQ a été réalisée selon la structure d'enseignement de l'école québécoise et la progression des apprentissages des enfants québécois. Elle pourrait donc amener un plus grand taux de réussite au test chez les enfants franco-québécois, ce qui permettrait une évaluation plus juste des habiletés d'orthographe phonologique et lexicale et supporterait l'utilité de ce sous-test du TELEQ. Toutefois, les performances plus élevées au TELEQ qu'à la BALE pourraient également résulter d'un artéfact statistique. En effet, les normes du TELEQ ont été créées à partir du présent échantillon, ce qui fait en sorte que la moyenne de l'échantillon est nécessairement un score z de 0. Cette analyse devra être réalisée de nouveau auprès d'un autre échantillon d'enfants en les comparant aux présentes normes. Par ailleurs, les fortes corrélations entre les listes de mots irréguliers et de pseudomots du TELEQ et les sous-tests de la BALE évaluant les prérequis à la lecture et à l'écriture (c.-à-d. les mêmes facteurs cognitifs) viennent également appuyer l'idée que les deux listes du TELEQ permettent d'évaluer les deux voies de l'orthographe et pointent vers la présence d'une excellente validité de construit. En effet, la corrélation forte entre la liste de pseudomots du TELEQ et le sous-test « Identification de la consonne initiale » de la BALE soutient l'idée que ces deux tâches recrutent le même processus cognitif, soit la discrimination phonémique qui permet la conversion phonème-graphème et qui est à l'origine de la voie d'assemblage. De plus, la corrélation forte et significative entre la liste de mots irréguliers du TELEQ et le sous-test « Comparaison de séquences de lettres » de la BALE (évaluant la perception visuelle des séquences de lettres) suggère que la liste de mots irréguliers du TELEQ mesure la représentation visuelle de l'orthographe des mots, soit la composante principale de la voie d'adressage.

La corrélation positive modérée obtenue entre la liste de pseudomots du TELEQ et la note obtenue en écriture, dans la discipline du français, suggère quant à elle une bonne validité critériée concomitante. La corrélation faible obtenue entre la liste de mots irréguliers du TELEQ et la note obtenue en écriture, dans la discipline du français, va également dans le même sens. Une explication potentielle de la faible taille des corrélations est le fait que la note obtenue en écriture, dans la discipline du français, n'est pas une mesure pure des habiletés d'orthographe lexicale. En effet, cette note reflète également les habiletés d'orthographe grammaticale (conjugaisons et accords), de syntaxe, de ponctuation et d'organisation et de cohérence du texte (MELS, 2009). De futures études, incluant des participants ayant des difficultés d'orthographe et d'autres mesures prédictives, devraient être réalisées afin de déterminer si l'outil prédit la performance scolaire des enfants en écriture (discipline du français).

Limitations

Certaines limitations méthodologiques doivent être considérées dans cette étude. Tout d'abord, la taille de l'échantillon a pu être un facteur ayant affecté la puissance des analyses. En effet, selon Cohen (1988), chacun des cinq groupes (niveaux scolaires) aurait dû être composé d'au moins 39 participants afin d'obtenir 80% de chance de détecter un effet « moyen » dans les analyses de variance lorsqu'il y en avait un. Or, le nombre de participants dans chaque niveau scolaire variait de 13 à 33 participants. De plus, la répartition des enfants selon les différents niveaux scolaires n'était pas homogène puisque la majorité des participants se retrouvaient en 2^e, 3^e,4^e et 5^e année. Donc, bien que plusieurs résultats significatifs aient été observés et que ceux-ci étaient très encourageants en ce qui concerne la fidélité et la validité du sous-test « Dictée de mots et de pseudomots » du TELEQ, il serait important que les présents résultats soient répliqués avec un plus grand échantillon ayant une meilleure distribution entre les différents niveaux scolaires.

Des auteurs suggèrent également que le genre peut avoir une influence sur les habiletés de lecture et d'orthographe (Allred, 1990 ; Logan et Johnston, 2010). Il serait donc intéressant de vérifier, dans de prochaines études, si ce facteur a une influence sur les performances au TELEQ, et ce, à l'intérieur de chaque niveau scolaire. Un autre facteur qui, selon les résultats de la présente étude, aurait une influence sur les scores obtenus à la liste de pseudomots (mais pas à ceux de la liste de mots irréguliers) du TELEQ est le revenu familial. Il faut cependant noter que la majorité des enfants de l'échantillon provenaient de familles avec un revenu annuel supérieur ou égal à 100 000$. Il serait intéressant de refaire les analyses rapportées dans le présent article avec un échantillon comprenant davantage de participants ayant un revenu inférieur à 100 000$, ou encore, étant sous le seuil de faible revenu afin de voir si le revenu familial a un effet sur les performances à la liste de mots irréguliers. En effet, un statut socioéconomique peu élevé est associé à une plus faible stimulation du langage, à une moins grande exposition à des mots écrits à la maison et à de moins bonnes performances en orthographe (Leseman et De Jong, 1998). Ainsi, il se pourrait que des analyses auprès d'un échantillon d'enfants mieux réparti entre les différents statuts socioéconomiques mettent en évidence des différences de performances pour la liste de mots irréguliers, en plus de celles déjà observées pour la liste de pseudomots.

Notons également que l'échantillon utilisé dans la présente étude n'était pas représentatif de la population des enfants fréquentant les écoles francophones du

Québec aux plans linguistiques et culturels. Un échantillon d'enfants dont le français est une des langues parlées à la maison a été privilégié pour la présence étude de pré-validation, afin d'éliminer les facteurs linguistiques pouvant influencer la performance des enfants au sous-test « Dictée de mots et de pseudomots » du TELEQ. Toutefois, selon les données de 2015, 17,5% des élèves fréquentant une école francophone n'avaient pas le français comme langue maternelle (Olivier, 2017). Les études subséquentes de validation et de normalisation de l'outil devront inclure davantage d'enfants bilingues ou pour qui le français n'est pas une des langues parlées à la maison. Finalement, l'absence d'un groupe clinique composé d'enfants ayant une dysorthographie dans la présente étude n'a permis d'examiner ni la sensibilité diagnostique du sous-test « Dictée de mots et de pseudomots » du TELEQ ni son utilité clinique.

Conclusion

La présente étude met de l'avant des qualités psychométriques très satisfaisantes pour le sous-test « Dictée de mots et de pseudomots » du TELEQ, tant en termes de fidélité que de validité. Cet outil semble bien évaluer les deux voies de l'orthographe, ce qui peut s'avérer particulièrement utile dans l'établissement du profil des habiletés orthographiques des enfants du primaire. De plus, le TELEQ a été conçu dans l'objectif d'évaluer plus adéquatement les habiletés en orthographe des enfants québécois que ses équivalents européens. En effet, sa construction ayant été effectuée à partir des mots enseignés dans les écoles québécoises et selon la progression des apprentissages des enfants québécois, il est possible que le sous-test « Dictée de mots et de pseudomots » du TELEQ présente moins de biais culturels et linguistiques que ceux des outils européens. Les résultats de la présente étude soulignent également l'importance de prendre en compte les facteurs linguistiques et culturels dans l'interprétation des résultats des tests évaluant le langage écrit en clinique. Une étude future, basée sur un échantillon plus grand et plus représentatif de la population, pourra non seulement confirmer les résultats de la présente étude, mais également permettre d'établir des normes québécoises pour le sous-test « Dictée de mots et de pseudomots » du TELEQ. La comparaison des performances des enfants québécois du primaire vus en clinique à des normes permettra ainsi aux cliniciens de quantifier le niveau d'orthographe de ces enfants, en plus de détecter plus aisément la présence de difficultés dans cette population et d'élaborer des interventions adéquates. Finalement, la passation du sous-test de cet outil auprès d'une population clinique présentant une dysorthographie permettra de vérifier sa sensibilité et sa spécificité et d'établir son utilité clinique pour l'évaluation de ce trouble d'apprentissage.

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Note des auteurs

Les résultats présentés dans cet article sont aussi rapportés dans l'essai doctoral de Marie-Ève Beaudry.

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