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Rapport de recherche

PROGRAMME ACTIONS CONCERTÉES

Développement d'un outil de dépistage de la dysorthographie basé sur des compétences multiples du langage oral : un nouvel outil normalisé et validé pour le français québécois

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Développement d'un outil de dépistage de la dysorthographie basé sur des compétences multiples du langage oral : un nouvel outil normalisé et validé pour le français québécois

Part A: Research context

This project is concerned with Axe 2.2 as stated in the "Appel de propositions: Programme de recherche sur l'écriture". Specifically, the research is concerned with the link between children's oral language abilities and their capacity to acquire written language skills, especially in the domain of spelling. In addition to theoretical examinations of the oral language foundations of spelling abilities, the goal of this project was to develop a tablet based application for screening children at school entry in order to identify those children who may be at risk for delayed acquisition of spelling skills unless they obtain additional supports during the primary grades. The screening tool that we developed as part of this project is uniquely validated for francophone children attending school in Québec, including those children who speak French as their first language and those who are learning French as their second language. Before describing the methods and outcomes of this study, the background literature related to the oral language foundations of spelling development will be summarized briefly.

Four aspects of oral language development are known to support the acquisition of spelling skills: speech production accuracy, speech perception skills, phonological awareness and knowledge of aspects of grammar. Beginning with speech production, errors in the pronunciation of words are very common in young children but there is much variability so that within

the same kindergarten classroom there may be children with perfect speech and others with many speech errors (MacLeod, Sutton, Trudeau, & Thordardottir, 2011; Smit, 1993). The child may misarticulate an individual sound (e.g., « chapeau » = [sapo]), or have difficulty with the structure of the word as a whole (e.g., « jambon » = [bõ]). In fact, we have shown that in French, errors of word structure are particularly common (e.g., « hélicoptère » = [ikɔtɛʁ]) because French words tend to be very long (Brosseau-Lapré & Rvachew, 2013; Rvachew, Leroux, & Brosseau-Lapré, 2014; Rvachew et al., 2013). Many studies have shown that children who have speech sound disorders as preschoolers have more difficulty learning to spell than their peers once they are in school (Bird, Bishop, & Freeman, 1995; Lewis, Freebairn, & Taylor, 2002). A related problem is the ability to perceive speech sounds accurately: children who misarticulate speech sounds often do not hear differences between correctly and incorrectly pronounced words clearly and it is easy to understand how these perceptual difficulties might contribute to spelling errors, for example « télévision » = télévition or délévision, and « casserole » = carsol or castrole.

Phonological awareness is the knowledge that words are made up of smaller phonological constituents – syllables, onsets, rimes, and phonemes. In young children it is commonly tested by asking children to match words that share a common constituent (e.g., given pictures of 'chapeau', 'hibou' and 'ciseau', the child should identify the first and third as sharing the final rime [o]). Phonological awareness is essential for accurate spelling – first the word must be divided into smaller parts, i.e., 'morceau' = /m/+/ɔʀ /+/s/+/o/

and then the smaller parts must be associated with the correct letters, i.e., /m/='m', /ɔʀ /='or', /s/='c', /o/ ='eau'. The child might be able to learn to associate sounds with letters but be unable to apply this knowledge because he does not know how to divide up the words that he hears into the smaller constituents. Children with speech disorders, language disorders, and dyslexia are likely to have a phonological awareness deficit that impairs their reading and spelling abilities (Raitano, Pennington, Tunick, Boada, & Shriberg, 2004; Rvachew, 2007). The correlation between phonological awareness and spelling is well established in descriptive studies (Holm, Farrier, & Dodd, 2007; Savage et al., 2005). Phonological awareness intervention in kindergarten has been shown in randomized control trials to have a positive impact on spelling acquisition in later grades (e.g., Schneider, Roth, & Ennemoser, 2000).

Morphological awareness also involves the ability to segment words into smaller parts but in this case the constituents are smaller units of meaning rather than sound-based phonological units (Levin et al., 2001; Sénéchal, 2000; Sénéchal, Basque, & Leclaire, 2006). In this case, the child is expected to recognize the shared meanings that link families of words such as 'morceler' and 'morceau'. The child is also expected to recognize suffixes that alter the grammatical class of a word (e.g., 'morcellement', 'fermement') or change the verb tense (e.g., 'morcelerons', 'fermerons') as well as prefixes that change the meaning of the root morpheme (e.g., 'refermer', 'recoller', 'remonter', etc.). This kind of knowledge helps a writer choose among plausible alternative spellings of a given word, for example, 'morcelable'

rather than '*morselable', 'fermement' rather than '*fermemant' and 'nous fermerons' rather than '*nous fermeront'. In a review of the research, Pacton and Deacon (2008) concluded that explicit ability to use this kind of morphological knowledge in spelling emerges at the age of 8 years in French and English speaking children; however, implicit morphological awareness skills are measurable in children as young as 5 years of age. In fact, recent research has suggested that morphological skills may emerge earlier in French compared with English speaking children (Duncan, Colé, & Casalis, 2009). Morphological awareness at school entry predicts both reading and spelling at the end of first grade after controlling for phonological awareness abilities (Wolter, Wood, & D'zatko, 2009). Children with dyslexia, language and spelling disorders have poorer morphological awareness than their age-matched peers although these children use morphological strategies when spelling as well as peers matched for spelling age (Bourassa, Treiman, & Kessler, 2006; David & Wei, 2008; Rubin, Patterson, & Kantor, 1991). Children with speech sound disorders have significant difficulty with productive morphology (Haskill & Tyler, 2007; Mortimer & Rvachew, 2008, 2010; Rvachew, Gaines, Cloutier, & Blanchet, 2005); more study is need to determine whether these difficulties explain the spelling disorder that is so common among this group. There is some evidence that interventions that target morphological awareness lead to improved spelling ability (Arnbak & Elbro, 2000; Kirk & Gillon, 2009).

Hypothesis and Objectives

We proposed that children's performance on measures of speech production accuracy, speech perception skills, phonological awareness and knowledge of grammatical morphemes, when tested in first grade, would predict the children's spelling abilities when measured at the end of second grade. Our ultimate objective is to develop a screening tool that can be administered at the beginning of the first year of school to identify those children who are most at risk for spelling disorder at the end of the second year.

Part B: Potential Solutions, Results, Impacts, Implications

The report by Jalbert (2007) on the written language performance of Quebec primary school students raised the issue of spelling and grammar errors in particular: the report noted a decrease in the rate of success for this aspect of writing performance between 2000 and 2005. The report further noted considerable variability in performance for this aspect of writing with many students writing flawlessly while others produced a great many errors in their writing. The author recommended further reflection as well as experimental studies to identify the most effective teaching methods to improve spelling and grammar in the children's writing. Given the extreme variability in skill levels for this aspect of writing however we feel that it may be fruitful to identify those children most at risk of having particular problems in this domain and to address underlying difficulties with phonological and morphological processing that may slow acquisition of these orthographic

skills. Therefore we have developed a screening tool that, with little training and less than 20 minutes of time (including testing, data acquisition, scoring and analysis), can be used to identify first grade children who are likely to need extra help in order to achieve a satisfactory level of spelling abilities at the end of second grade. The screening tool is mean to be implemented on a digital tablet and used by teachers or paraprofessionals in the school environment. The research that we have conducted in the context of developing this tool is also of use to teachers and specialist school staff (such as orthophonistes/speech-language pathologists) because it high-lights the importance of attending to the children's weakness in the oral language domain as a means of providing a better foundation for the acquisition of written language skills. The use of the screening tool may help principles and specialist school personnel to distribute specialized services more effectively or efficiently. Our findings and the screening tool can also be used to support the implementation of a "response-to-intervention" program to prevent delayed acquisition of literacy skills rather than waiting for children to fail before implementing specialized programs. For example, during the course of our research we became aware of a first grade child who was forced to repeat the grade without being referred for specialist testing; however our research assessment revealed the child to be dyslexic. The screening tool that we have developed could be used by teachers in the first year of school to identify children with oral language difficulties that put them at risk for failure in the written language domain.

The key messages of the research that we have conducted can be stated as follows:

(1) *Kindergarten teachers*. Be sure to implement a language rich classroom because oral language skills are the foundation of written language acquisition.

(2) *Primary school teachers*. Refer children who produce unclear speech when they are talking to the speech-language pathologist for an assessment and therapy if necessary. French-speaking children can be expected to produce all the consonants correctly during the kindergarten year. This is true for children who are speaking French as their first or second language.

(3) *Primary school teachers*. Refer children who produce many grammatical errors when they are talking to the speech-language pathologist for an assessment and therapy if necessary. French-speaking kindergarten children can be expected to produce complete sentences with appropriate word order and use conjunctions (*et, après, parce que*). They should also master plural and gender marking on articles and adjectives (ex. *la grande maison verte* vs. *le grand bateu vert* vs. *les grandes maisons vertes*), and have acquired knowledge in basic verb inflection such as the difference between past present and future and use inflected verbs (in the imperative, *passé composé, futur proche,* present tense and *imparfait*) rather than infinitives (e.g., *boire*). This is true for children who are speaking French as their first or second language (for at least two years).

(4) *Principals and first grade teachers*. Our screening tool, the PHOPHLO, can be used to screen children at the beginning of first grade to determine which

children continue to be at risk even after experiencing a strong oral language experience during the kindergarten year. Children who perform poorly on this screening instrument can be offered additional support in small groups to strengthen their foundational skills for the acquisition of literacy. These supportive programs may be designed and supervised by a speech-language pathologist but they can be effectively provided by paraprofessional support personnel.

(5) *Speech-language pathologists and psycho-educators*. Special programs to promote emergent literacy skills should have an oral language component as well as strengthening the children's phonological awareness and knowledge of grapheme-phoneme correspondence rules.

(6) *Primary school teachers*. Children who present with delayed acquisition of literacy skills in second grade, including deficits of written language accuracy, should be referred to the speech-language pathologist for an assessment of their oral-language abilities and for remediation of deficits in oral language domains if necessary. **Using the Phophlo could give teachers an objective measure of potential for writing disorders.**

(7) *Primary school teachers*. In our study, children were assessed with the BELO at the end of grade two. The children whose second language was French scored at least as well as the children whose first language was French for the spelling of nonwords, words and phrases. Therefore, second grade children who spell significantly worse than average should be referred for specialist assessments even when their home language is not French.

(8) *Speech*-Language Pathologists. Response-to-intervention is an evidence based approach to ensuring that the whole school population achieves expectations with respect to literacy acquisition and successful RTI programs have always included the speech-language pathologists as a key team member who advises and educates school personnel. PHOPHLO supports RTI by highlighting the foundational aspects of oral language – phonology, morphology, speech perception and phonological awareness and providing a tool for screening children at the beginning of first grade.

Part C – Methodology

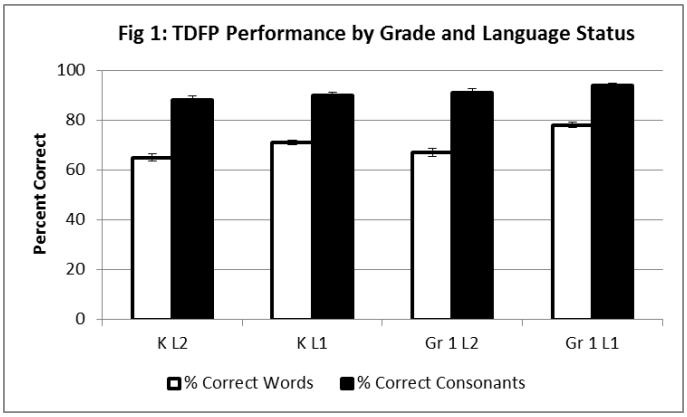
This study proceeded in three parts. During the Pilot phase diagnostic versions of four tests were administered to kindergarten age and first grade children. The tests were the *Test de Dépistage Francophone de Phonologie* (30 items; TDFP; Brosseau-Lapré, Paul & Rvachew, 2012), *Speech Assessment and Interactive Learning System* (60 items; SAILS; Rvachew, 2009; adapted by Brosseau-Lapré for Quebec French), Test de Conscience Phonologique (34 items; TCP; Brosseau-Lapré & Rvachew, 2009); and Jeu de Verbes (24 items; JdV Marquis et al., 2012). An item analysis of the children's responses allowed us to identify those items that best differentiated (for each test) high scoring from low scoring children as well as kindergarten from first grade children and children who were rated at-risk by their teachers in comparison to those not deemed to at-risk by their teachers. These item-specific data were used to create a 44-item screening test, covering all 4 domains, to be used in Phase II of the research project

(the screening test is described in greater detail; see Annex A: PHOPHLO). In Phase II PHOPHLO was administered to first grade children. Approximately 24 months later, in Phase III of the project, these same children completed the primary outcome measure – the BELO test of spelling ability.

Description of Children who were Tested by Project Phase

	N	Age (yrs;mos)	# L1 French	#boys
Pilot - Kindergarten	43	6;01	24	21
Pilot – Gr1	18	7;02	12	11
Phase I – Gr 1	91	6;09	53	35
Phase II – Gr 2	78	8;02	45	30

Part D – Results – Pilot Phase

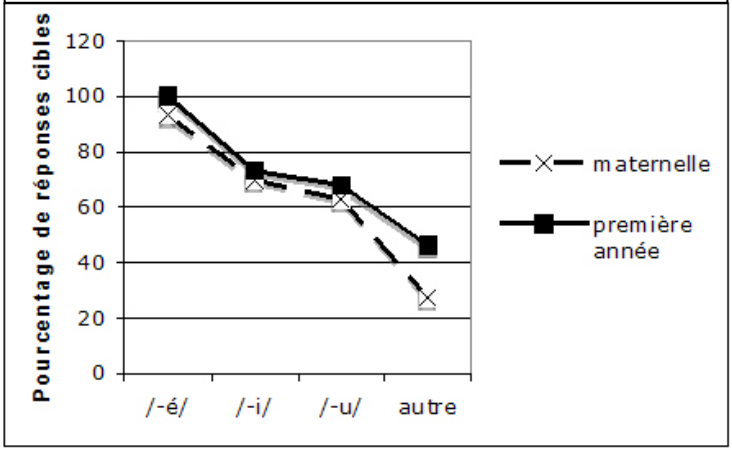


The results of the Pilot Phase have been published in two papers that are attached as Annex B and Annex C. The key findings of this phase describe the speech production and expressive morphology skills of francophone preschoolers, specifically comparing those Quebec school children who began school speaking French as their first language (L1) to those children whose home language is not French (L2). The analysis of the results of the speech production test (TDFP) revealed very few differences between the children on the basis of grade or language status as shown in Figure 1. Children in second grade tended to produce

fewer syllable structure errors than children in kindergarten; this means that unusual productions of difficult words were relatively common in kindergarten (e.g., “hélicoptère” = [ekipɔtɛʁ]) but significantly less common in first grade. Children who were second language learners of French sometimes produced voicing errors (e.g., “nuage” = [nyas] or [nyaʃ]), more often than the L1 children, but this difference was not statistically significant. Although percent correct consonants was very good, the children did not achieve a high percentage of correct words because this test is deliberately loaded with fairly difficult words so that ceiling effects are avoided in the school age population. The children’s performance shows that francophone children acquire knowledge of the individual sounds of French at an early age but have difficulty organizing them into the longer words of French until they are older.

Similarly, regarding the children’s ability to produce the *passé composé*, no significant differences were observed as a function of grade although the rate of success varied significantly with verb group as illustrated in Figure 2. Specifically, the children produced more correct responses for the verbs requiring the morpheme “é” in the passé composé form in comparison to all other verb groups. Unlike the findings for speech production however, further analyses revealed that L1 French-speaking

Fig 2: % Correct responses by verb group and grade



children produced these grammatical morphemes significantly more accurately than L2 children who were learning French in school.

Part D – Results – Phase I

The PHOPHLO screening tool was administered to 91 first grade children in Phase I as a prelude to assessing the predictive validity of this instrument in relation to second grade spelling abilities. The mean and standard deviation for each subtest is shown in the table below.

Phase I PHOPHLO Performance by Subtest

Subtest	Measure	Min	Max	Mean	S.D.
Speech Perception	% correct	50	100	91.10	13.94
Speech Production	% consonants correct	78	100	96.94	3.97
Phonological Awareness	# correct items	5	14	11.95	2.14
Verb Production	# correct items	0	10	7.00	2.99

In addition to screening the children's performance in these four domains, the children's teachers were asked to rate the children's risk for difficulties in the future by responding to the following question: "A quel degré l'enfant est-il à risque de developper des difficultés d'écriture?", with 5 response alternatives on an ordinal scale provided. Correlations between the children's performance on these four subtests of the PHOPHLO and teacher predictions of future academic performance were calculated. These correlations are shown in the table below with significant correlations indicated with bolded text ($p < .01$).

Correlation of PHOPHLO Subtest Scores with Teacher Predictions of Risk

	Perception	Production	Phon. Aw.	Morphology	Teacher Pred.
Perception	1.00	0.18	0.15	0.12	-0.19
Production		1.00	0.20	0.19	**-0.49**
Phon. Aw.			1.00	**0.39**	**-0.43**
Morphology				1.00	**-0.39**
Teacher Pred.					1.00

Further analyses indicated that 94% of the children deemed to be at no or low risk by the teachers passed 3 or 4 subtests on the PHOPHLO; on the other hand 56% of children judged by the teachers to be at high risk passed fewer than 3 subtests on the PHOPHLO. These analyses show that teacher perceptions of the child's risk for future difficulties with the acquisition of spelling skills are related to PHOPHLO performance but the validity of the screening instrument can only be determined with objective evidence of the children's spelling ability. We now turn to the Phase II data.

Part D – Results – Phase II

Phase II testing occurred when the children were approaching the end of second grade. The BELO test of spelling abilities was administered in small groups to 78 of the children who participated in the Phase I testing. The table below shows the mean and standard deviation of the children's performance for each subtest of the BELO (nonwords, single words and sentences).

Phase II Performance on the BELO by Subtest

	Minimum	Maximum	Mean	S.D.
Nonwords	30.00	100.00	86.15	12.61
Words	2.00	15.00	10.88	3.07
Sentences	9.00	35.00	28.05	4.68
Total Score	14.00	59.00	47.55	8.23

Next, mean Total BELO score was examined as a function of whether the child passed or failed the PHOPHLO screening and its subtests two years prior. In other words, the next table shows the average PHOPHLO performance in grade 1 for those children who passed the BELO spelling test in grade 2 and for those children who failed the BELO spelling test in grade 2. The average PHOPHLO scores are shown for each subtest first and then the total screening test score is shown. It can be seen that PHOPHLO subtest scores and total scores are lower on average for children who failed the spelling test in grade 2 in comparison to children who passed the spelling test in grade 2.

Phase II Performance on BELO (mean) by Phase I PHOPHLO Performance

	Pass PHOPHLO	Fail PHOPHLO
Speech Perception	48.17	42.13
Speech Production	48.40	41.80
Phonological Awareness	48.35	43.54
Verb Production	48.97	41.6
Complete PHOPHLO*	49.01	37.6

*Pass criterion is at least z = -1.00 on 3 or 4 subtests

Finally, the sensitivity and specificity of the PHOPHLO as a screening measure was determined by considering the numbers of children who failed the PHOPHLO at the Phase I testing interval in relation to their Phase II BELO performance. A total score of at least 36 was considered to be a pass on the BELO.

Sensitivity and Specificity of the PHOPHLO in Relation to BELO Total Score

	Fail BELO	Pass BELO	
Fail PHOPHLO	4	6	10
Pass PHOPHLO	2	66	68
	6	72	78

The data in this table indicate that the sensitivity of the PHOPHLO (i.e., proportion of true positives identified) is 66% while the specificity (i.e., proportion of true negatives identified) is 92%. These findings suggest that the PHOPHLO could be a useful screening tool in the Quebec school context although it is necessary to cross-validate this result with larger samples of children from diverse school boards. Furthermore, it would be wise to investigate whether there is any marginal utility to testing speech perception with words that are longer and more complex in comparison to the short word currently included in the screener.

In addition to testing the children's spelling at Time 2, the children's written usage of grammatical morphemes was also tested. These data are still undergoing detailed analyses. However, some preliminary analyses have

been presented at conferences and one such conference poster is appended as Annex D.

Part E – Research Approaches

This project has led to the development of a screening tool that is promising in terms of its usefulness for the identification of French-speaking children attending school in Québec who are at risk for delayed acquisition of spelling skills. We have shown that the screening tool - Prédiction des Habiletés Orthographiques Par des Habiletés Langage Oral (PHOPHLO) - can be easily administered to children early in first grade and that it predicts spelling abilities at the end of second grade with reasonable sensitivity and specificity. In order to firmly establish the validity and utility of this tool there are three remaining tasks:

(1) Recoding of the software with an updated software interface to ensure that the PHOPHLO can be administered using a variety of hardware tools (e.g., desktop computers, Android tablets, iPads etc.). We are currently working with a small Québec company (iLanguageLab) to accomplish this task.

(2) Cross-validate the tool by administering it to a larger sample of first grade children who are attending school in diverse regions of Québec and testing predictive validity with these new samples of children against second grade spelling abilities.

(3) Broaden the scope of the project to explore whether the screening tool might be effective to identify children who are at risk for other forms of literacy deficits (e.g., decoding skills, reading comprehension).

(4) Assess the usefulness of the tool in the context of an intervention program such as broad based response-to-intervention program to reduce literacy deficits within a given school or school board.

Part F – References and Bibliography

During the course of this project, we and our collaborators and colleagues have published research that illuminates the links between oral language and literacy generally and describes oral language and literacy development in Québec French specifically. We list some of these publications here:

Brosseau-Lapré, F., & Rvachew, S. (2013). Cross-linguistic comparison of speech errors produced by English- and French-speaking preschool age children witih developmental phonological disorders. *International Journal of Speech-Language Pathology, Early Online, 1-11*.

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ANNEXE A: PHOPHLO

PRÉDICTION DES HABILETÉS ORTHOGRAPHIQUES PAR LES HABILETÉS DE LANGAGE ORAL

Tâche 1 : Perception de la parole

On présente à l'enfant 10 enregistrements naturels du mot "gris" énoncé par des enfants et des adultes. L'enfant doit identifier les bonnes productions de "gris" ainsi que les productions erronées ("gis", "ris", "gwis") en touchant les images appropriées sur l'écran de la tablette. Une animation de renforcement (une souris qui mangue du fromage) donne de l'information sur le nombre d'essais restant. Les réponses sont notées comme étant correctes ou incorrectes par l'application. La note de passage est établie à partir d'approximativement un écart type en dessous de la moyenne du groupe témoin de la Phase I de l'étude, c'est à dire 8 réponses cibles ou plus.

Tâche 2: Production de la parole

Les enfants nomment 10 images, présentées une à la fois, qui dénotent des objets et qui ont pour but d'induire la production des mots suivants : niche, tournevis, serpent, clown, araignée, enveloppe, garde-robe, parapluie, hélicoptère, et camion. Chaque item est induit avec une phrase amorce, par exemple "La maison du chien, c'est sa…". Une animation de renforcement (des pétales qui apparaissent sur une marguerite) donne de l'information sur le nombre d'essais terminés et restants. Au cours de l'administration du test, l'administrateur peut indiquer si l'enfant a correctement produit le mot ou non, en touchant l'icône approprié. Les réponses sont enregistrées par l'application. Après l'administration du test, l'administrateur écoute les productions incorrectes de l'enfant et note chaque consonne comme étant produite correctement ou non sur une grille d'évaluation. La note de passage est établie à partir d'approximativement un écart type en dessous de la moyenne du groupe témoin de la Phase I de l'étude, c'est à dire un score de 93% ou plus de production de consonnes correctes.

Tâche 3: Conscience phonologique

On présente aux enfants l'image d'un animal ainsi qu'une piste audio qui nomme l'animal et demande à l'enfant de trouver les items que l'animal aimera, par exemple "Le nom de cet animal est Lou. Lou aime les choses qui sonnent comme son nom. Écoute, laquelle de ces choses est celle que Lou aime?" Par la suite, on montre à l'enfant, en les nommant, des images de quatre items, un seul qui rime avec le nom de l'animal (par ex., "vent", "fée", "main", "chou"). Ce test contient 5 items de pratique et 14 items test comprenant 6 rimes différentes. L'enfant répond en touchant l'image que l'animal va aimer. L'application calcule automatiquement la valeur (correcte ou incorrecte) de la réponse. Une animation de renforcement (des chenilles qui se transforment en papillons) donne de l'information sur le nombre d'essais terminés et restants. La note de passage est établie à partir d'approximativement un écart type en dessous de la moyenne du groupe témoin de la Phase I de l'étude, c'est à dire un score de 10 items cibles ou plus.

Tâche 4: Morphologie verbale

L'application présente une image à l'enfant en parallèle avec une courte histoire et, en finale, une question qui induit la production du passé composé. Par exemple "*Marie va cacher ses poupées. Marie cache toujours ses poupées. Qu'est-ce qu'elle a fait hier Marie?*" La réponse attendue pour cet item de pratique est *"Marie a caché ses poupées*". Les 10 items utilisés pour la tâche sont les verbes *rire*, *sentir*, *défaire*, *perdre*, *remplir*, *boire*, *mordre*, *ouvrir*, *conduire*, et *battre*. Une animation de renforcement (tourner les pages du livre pour passer à la prochaine "histoire") encourage l'enfant à avancer. Au cours du test l'administrateur peut indiquer en touchant l'icône approprié si l'enfant a correctement produit le verbe ou non. Les réponses de l'enfant sont enregistrées par l'application. Après l'administration du test, l'administrateur peut écouter les productions incorrectes de l'enfant et noter des détails supplémentaires sur la réponse de l'enfant sur une grille d'évaluation. La note de passage est établie à partir d'approximativement un écart type en dessous

de la moyenne du groupe témoin de la Phase I de l'étude, c'est à dire un score de 4 items cibles ou plus.

Score du test de dépistage

Les enfants qui ne passent pas au moins deux des quatre tâches sont considérés comme étant à risque de présenter des difficultés dans l'apprentissage du langage écrit. Ils devraient faire l'objet d'un suivi par des spécialistes en développement du langage oral et écrit, et pourraient avoir besoin d'aide supplémentaire dans les domaines de faiblesse identifiés. Ceux-ci pourraient être des domaines des habiletés en langue orale ainsi que la langue écrite.

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Speech articulation performance of francophone children in the early school years: Norming of the *Test de Dépistage Francophone de Phonologie*

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Abstract
Good quality normative data are essential for clinical practice in speech-language pathology but are largely lacking for French-speaking children. We investigated speech production accuracy by French-speaking children attending kindergarten (*maternelle*) and first grade (*première année*). The study aimed to provide normative data for a new screening test – the *Test de Dépistage Francophone de Phonologie*. Sixty-one children named 30 pictures depicting words selected to be representative of the distribution of phonemes, syllable shapes and word lengths characteristic of Québec French. Percent consonants' correct was approximately 90% and did not change significantly with age although younger children produced significantly more syllable structure errors than older children. Given that the word set reflects the segmental and prosodic characteristics of spoken Québec French, and that ceiling effects were not observed, these results further indicate that phonological development is not complete by the age of seven years in French-speaking children.

Keywords: Articulation, assessment, French, phonology, screening

Introduction

Good quality normative data are essential for clinical practice in speech-language pathology. When managing cases with developmental phonological disorders, developmental norms for the acquisition of speech sounds are of particular importance. Such data allow the speech-language therapist (SLT) to determine if an individual child's developmental trajectory is delayed relative to his or her peers, such that a therapeutic intervention is required. Examination of the pattern of speech errors produced by a given child relative to normative data may influence the choice of treatment approach. Knowledge of the typical order and age of acquisition of speech sounds in the language informs the selection of therapy goals.

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When treating English-speaking children with developmental phonological disorders, a rich scientific basis for clinical practice exists in the published literature. Expectations for the development of English phonology in the monolingual learning context have been established using a variety of descriptive metrics across a broad age range. For example, studies have presented data about the phonetic repertoire for two-year-olds (Stoel-Gammon, 1987), acquisition ages for consonants and vowels have been suggested on the basis of numerous studies conducted with children aged two to eight years (Dodd, Holm, Hua, & Crosbie, 2003; Pollock & Berni, 2003; Sander, 1972; Smit, 1993), and common phonological processes have been described for toddlers and preschool-aged children (Cahill Haelsig & Madison, 1986; Dodd et al., 2003; Porter & Hodson, 2001; Preisser, Hodson, & Paden, 1988). Interpretation of these data can be complex due to apparent conflicts among studies and the need to attend to varying units of analysis depending upon the characteristics of the child and the goals of the assessment. Clinical decision-making is enhanced by the wealth of data available although the SLT must integrate across multiple perspectives on phonological development and resolve inconsistencies within this literature on developmental trajectories in English (for summary and further discussion, see Rvachew & Brosseau-Lapré, 2012).

For those SLTs treating French-speaking children with a developmental phonological disorder, the evidentiary base is much smaller, although growing. Most studies that have been published on French phonological development have been relatively small sample investigations involving very young children. These studies have made it clear that the SLT cannot make assumptions about typical developmental patterns by extrapolating from the English-based literature to the French context. Despite a significant degree of overlap in the segmental inventories of English and French, there are many differences in the phonological systems of these two languages which may account for observed differences in the phonological patterns among French and English language learners.

For a comprehensive overview of the characteristics of French phonology, and in particular the Québec dialect that is the focus of this paper, we refer the reader to MacLeod, Sutton, Trudeau, and Thordardottir (2011) and to Rose and Wauquier-Gravelines (2007). Here, we will highlight particular characteristics that differ from the English pattern of phonological development and may influence clinical decision-making. First, the prosodic structure of French results in a speech rhythm that gives prominence to word final syllables such as the syllable [po] in ''chapeau'' (hat) → [ʃa'po] and the syllable [bɔ̃] in ''jambon'' (ham) → [ʒɑ̃'bɔ̃]. This rhythm may arise from right-headed feet, and Rose (2000) argues for an iambic bias in early French phonological development to explain survival of unstressed syllables in the production of these words (in contrast to English) and truncation patterns in longer words (e.g. ''hélicoptère'' (helicopter) /elikɔptɛʁ/ → [kɔ'tɛʁ], a pronunciation that we see often in children with speech delay). On the other hand, Wauquier and Yamaguchi (in press) argue that prosody in French is organized at the level of the phonological phrase with primary stress occurring on the last syllable and a counter stress occurring on the first syllable; the intervening syllables are unstressed and the whole unit forms an ''accentual arc''. From this perspective, and especially given that inputs to French children rarely involve a single lexical word, an iambic lexical stress pattern cannot be assigned to individual words because syllable stress assignment depends upon the location of the word in the phrase, as illustrated in these examples: ''un chapeau'' (a hat) → [ˌœ̃ ʃa'po]; ''un chapeau rouge'' (a red hat) → [ˌœ̃ ʃapo 'ʁuʒ]; ''cherche un chapeau rouge'' (look/search for a red hat) → [ˌʃɛʁʃ œ̃ ʃapo 'ʁuʒ]. In the study that we report here, however, the children are asked to produce single lexical words and therefore the stress is expected to fall predictably on the last syllable of the target word.

French is said to be a syllable-timed language (theoretically syllables are produced with roughly equal duration) whereas English is stress-timed (theoretically intervals between stressed syllables are of roughly equal duration). This distinction is often questioned on empirical grounds

because the theoretical differences in durational attributes are not strictly upheld (Roach, 1982). The perception of syllable timing has been attributed to a reduced prominence of stressed versus unstressed syllables in French, in which vowel reduction does not occur, but vowel deletion is common (Adda-Decker, Boula de Mareüil, Adda, & Lamel, 2005); in contrast, the perception of stress timing in English has been attributed to the dominance and regularity of heavy syllables (Fant, Kruckenberg, & Nord, 1991). Syllables may be as heavy in French as in English (i.e. two and three consonant sequences are permitted in onset and coda in both languages). However, stressed syllables in French have fewer segments than in English on average: approximately 80% of syllables in French are open and overall there are fewer consonants per vowel (Adda-Decker et al., 2005). Word shapes are also distinctive in French with a high proportion of multisyllabic words. Although the objective data are derived from text rather than oral language, it is clear that word lengths overall are longer in French compared with English; specifically, in children's texts the proportions of words made up of 1, 2, 3 or 4 syllables are 0.13, 0.42, 0.34 and 0.09, respectively (NOVLEX database, Lambert & Chesnet, 2001); in adult texts the proportions are 0.07, 0.33, 0.41 and 0.15 for 1, 2, 3 and 4 syllable words, respectively (LEXIQUE 3.45, New, Pallier, & Ferrand, 2005). In comparison, Greenberg (1998) reported proportion of types in the English ''switchboard corpus'' to be approximately 0.22, 0.40, 0.24 and 0.10 for 1, 2, 3 and 4 syllable words, with 81% of tokens being monosyllabic.

These prosodic characteristics of French may account for some production patterns that have been observed in early French phonology. Vihman (2006) reported that consonant harmony and no-onset word templates are particularly common in the early word forms produced by children learning languages that include many multisyllabic words, including French. Vihman speculates that lengthening of the second syllable vowel in iambic words deflects children's attention from the consonant in the first syllable of the onset, thus accounting for deletion of word initial consonants in French (see also Wauquier & Yamaguchi, in press, for a discussion of the influence of the accentual arc on the evolution of children's templates with development in French-learning toddlers). Brosseau-Lapré and Rvachew (2013) studied preschool-aged children speaking Québec French with speech delay in comparison with English-speaking children with speech delay, matched for percent consonants correct (PCC) in conversation, age and vocabulary skills; in single word picture naming responses, syllable structure errors were observed to be approximately twice as frequent as segment errors in the speech of the French-speaking children; in contrast, a much greater frequency of segment errors relative to syllable structure errors was observed in the speech of English-speaking children with speech delay.

French-speaking toddlers have difficulty with consonant sequences as is common in other languages. Describing two toddlers learning European French, Demuth and McCullough (2009) reported that they acquired onset sequences such as ''bras'' (arm) → [bʁa]) before coda sequences such as ''parc'' (park) → [paʁk] and ''autre'' (other) → [otʁ]), whereas the opposite pattern is more typically observed in English (McLeod, Van Doorn, & Reed, 2001). Kehoe, Hilaire-Debove, Demuth, and Lleó (2008) also described consonant sequence production by toddlers learning European French; they observed a variety of errors for liquid, rhotic and glide clusters, including reduction via deletion or coalescence as well as epenthesis. However, Leroux, Brosseau-Lapré, and Rvachew (2011) did not observe any epenthesis among preschoolers with speech delay speaking Québec French. Within this sample, the children achieved 46% accuracy for the clusters overall, reflecting relatively good accuracy for the individual segments, including /l/ and /ʁ/ despite frequent segment omission and coalescence errors.

Segment acquisition was described by MacLeod et al. (2011) for 156 children aged 20–53 months speaking Québec French. In this study, a picture-naming task was used to target all 20 consonants in the language, specifically, the nasals /m, n, ɲ/; the voiceless unaspirated stops /p, t, k/; the pre-voiced stops /b, d, g/; the voiceless and voiced fricatives /f, s, ʃ, v, z, ʒ/; the

liquid /l/; the uvular fricative rhotic /ʁ/ and the glides /w, j, ɥ/. These consonants were targeted in initial, medial and final position of 40 words (40% one-syllable, 53% two-syllable and 8% three-syllable words). The authors suggested that there may be differences in acquisition order relative to English due to differences in prosody, as we detailed with respect to stress and syllable structure, differences in phonetic implementation, as noted for the voicing contrast and for the rhotic phoneme, and differences in frequency of usage. In particular, the /ʒ/ occurs with much greater frequency in French than in English. Mastery age for each phoneme was reported as the age at which a given consonant was produced accurately by 90% or more of the children in all three word positions. The resulting mastery ages were summarized as follows: prior to approximately 36 months for /p, t, m, n, f, z, ɲ/; most other consonants were mastered between 36 and 53 months, specifically /b, d, k, g, v, l, w, ʁ, ɥ/. Four consonants were not mastered by the preschool sample in this study – /s, ʃ, ʒ, j/ – although customary production (i.e. produced correctly by 50% of the children) was achieved for these late developing phonemes before 53 months of age. Overall, the results of this study indicate that French-speaking preschoolers achieve customary production for all consonants and master most consonants before the end of the fifth year.

There are three reasons to continue study of consonant acquisition by French-speaking children beyond the preschool period. First, it is necessary to establish the mastery age for the four late developing phonemes, /s, ʃ, ʒ, j/. Second, for clinical purposes, it is important to have a standard against which to compare the performance of children with developmental phonological disorder at later ages, when some of these children may receive their first formal speech therapy assessments, that is at school entry. Third, it is desirable to investigate consonant accuracy in words that more adequately reflect the prosodic characteristics of French. The purpose of the study reported here was to describe consonant acquisition by French-speaking children using a picture naming test, the *Test de Dépistage Francophone de Phonologie (TDFP).* The TDFP is a screening test that we are developing to identify children who produce significantly more articulation errors than their age peers when producing words that approximate the syllable structure characteristics of spoken French; therefore, it samples 30 words of which 20% are one-syllable, 50% are two-syllable, 23% are three-syllable and 7% are four-syllable words. In the first study, the participants were children attending kindergarten (*maternelle*) and first grade (*première année*) in a suburban French school district that includes a high proportion of second language (L2) learners of French, in addition to native (L1) French speakers. The presentation of these normative data is followed by the description of a single case that demonstrates the potential of the TDFP as a screening tool for school-age children. The child described in this case study was recruited from a hospital speech therapy program.

Experiment 1

Method

Participants

Sixty-one children were recruited from a suburb of Montréal in the province of Québec (Canada) for participation in this study. The particular area from which the children were recruited, according to the most recent census, is an area of high immigration with 61% of the total population speaking French as the ‘‘mother tongue’’ and 28% speaking neither English nor French as the mother tongue. Less than 13% of the population speaks English regularly at home. By law immigrant children must be educated in French in Québec. The children who participated in this study were recruited from the French public school system and were grouped as described below as being first language (L1) or second language (L2) speakers of French.

All participants were part of a larger study aimed at developing an early detection tool for spelling disorders in French. Testing protocols were approved by the internal review boards from both McGill University and Université de Montréal Faculties of Medicine. Parents signed the consent form allowing children to participate in the study. Children and parents could withdraw from the study at any time.

The children were recruited from the school by sending letters home and asking parents to return a signed consent for their child if they agreed to their child's participation. After receiving this written consent, a telephone interview was conducted to obtain demographic, literacy, health and language information via standard questionnaires. Language status was based on parental reports of their own language use with and around their child, siblings' language use, other caregivers' language use, and radio and television exposure. A 90% criterion of French exposure from birth was used to determine monolingual status of children placed in the L1 group. Native languages of the remaining children, placed in the L2 group, were diverse and included English, Arabic, Spanish, Haitian Creole, Italian, Greek, Lao, Polish, Romanian, Asu and Khmer.

The 61 participants were divided into two age groups according to class enrollment (either *maternelle* or *première année*) as well as the two language backgrounds (monolingual French L1 or bilingual French L2). The characteristics of these groups are described in Table 1. There was indication of developmental concerns from the school professionals for two kindergarten children who had not already been evaluated at the time of the study: one male who was suspected of suffering from an autism spectrum disorder and one female who was suspected of suffering from an intellectual impairment.

Stimuli

The TDFP comprises 30 items selected from the *Test Francophone de Phonologie* (TFP; Paul & Rvachew, 2009), as described in Paul (2009). The TFP was designed to assess accuracy of consonant and vowel production for the purpose of determining the nature of a child's speech disorder and choosing speech therapy targets. It contains 54 target words selected to be representative of the distribution of phonemes, syllable shapes and word lengths characteristic of Québec French. This diagnostic instrument is not normed but we have administered it to more than 70 preschool-aged francophone children with speech delay, and these data were used to

Table 1. Participant characteristics by group.

	Maternelle	Première Année
Total N	43	18
Number L1	24	12
L1 boys	11	9
L1 girls	13	3
Number L2	19	6
L2 boys	10	2
L2 girls	9	4
Developmental concerns	2	0
Age of first word	11.93 (6.6)	11.00 (3.71)
Child age, mean (SD)	6;1 (3.7)	7;2 (3.88)
Maternal education, mean (SD)	14.28 (1.83)	15.00 (2.09)
Paternal education, mean (SD)	14.19 (1.97)	14.89 (1.94)

Developmental concerns refer to the number of children reported by the parent or teacher to present with a significant developmental concern. Maternal age is recorded as the highest level of education attained by the mother according to self-report, in years (i.e. a bachelor's degree would be recorded as 16 years of education).

design the TDFP. The first criterion for word selection was acceptability of the words to children and parents, since we found from prior experience that certain picture stimuli on the TFP elicited either null or negative responses (e.g. it was very difficult to elicit the word *oui* ''yes'', children were embarrassed to say the word *amoureux* ''in love/lover'' and parents were divided on whether *graffigner* ''to scratch'' was a real, or standard, French word). After eliminating words of this type, selection proceeded so as to result in a 30-item screener that had roughly similar properties to the original 54-word version with respect to the distribution of features, syllable shapes and word lengths. The final 30 words are described in Table 2. The information about age of acquisition was drawn from four sources (Bonin, Boyer, Méot, Fayol, & Droit, 2004; Cannard et al., 2006; Chalard, Bonin, Méot, Boyer, & Fayol, 2003; Hazard, De Cara, & Chanquoy, 2007) and indicates that most of the words are known to be acquired between the ages of two and eight years. Word frequencies were derived from the NOVLEX database (Lambert & Chesnet, 2001), which provides information for a corpus derived from books intended for children aged eight to nine years of age, reported in this case for the base words (i.e. frequencies for singular and plural forms are aggregated). Table 3 also indicates the number of syllables and the syllable structure for each word. The average length of the words in syllables is 2.16, very similar to the word lengths reported in the printed input to French school children according to the MANULEX database (Lété, Sprenger-Charolles, & Colé, 2004). Finally, the consonants targeted by each item are shown according to syllable position. Consonants appear in four syllable positions: singleton syllable onset (e.g. first consonant in *niche* /niʃ/ ''dog house''), branching onsets (e.g. the two consonants at the beginning of the word *clown* /klun/), glide in the nucleus (e.g. glide following the /v/ in avion /avjɔ̃/ ''plane'') and the coda (e.g. the /ʁ/ in the words *serpent* /sɛʁpɑ̃/ ''snake'' and *hélicoptère* /elikoptɛʁ/ ''helicopter'').

Procedure

Children were evaluated individually by a research assistant in a quiet room inside the school. The larger study included four different language assessment tasks in French, divided into two separate session pairings, (a) phonological awareness and (b) speech perception, and (c) morphological production and (d) phonological production (TDFP). Language assessments were counterbalanced within session and across participants. Evaluation sessions occurred within a maximum of two weeks from each other. The phonological production (TDFP) task elicited word production of all French phonemes. Only the results of the TDFP will be described in this report. The speech production screener was a basic picture naming task. The children's responses were recorded using a Zoom1 stereo digital recorder at a sampling frequency of 44 kHz and a quantization rate of 24 bits. Each response was transcribed by a French-speaking student in speech-language pathology with graduate-level training in clinical phonetics and phonology. Test items were elicited by presenting children with full color photographs in Powerpoint slides depicting two to four items per plate, organized thematically (e.g. one plate depicts a child playing with toy vehicles, specifically a truck, helicopter, airplane and train). The research assistant was provided with three levels of verbal prompts to elicit the corresponding words, to be applied in a specific order beginning with a prompt for a spontaneous production, progressing to a delayed imitation of the target word if the child did not know it, and finally providing a direct imitation prompt if required to obtain the correct label. These prompts were written on the TDFP administration sheet to ensure that they were standardized for all children.

Transcription

A French-speaking research assistant (master's student in speech-language pathology) completed narrow phonetic transcriptions of the participants' responses on the TDFP from the audio recordings. The research assistant reviewed each file at least three times. If a child produced the

Table 2. Description of TDFP by item listed in order of presentation.

#	Item (French)	Item (English)	Target	AoA	Freq	#Syl	Syl Str	Onset	BrOnset	GN	Coda
1	Niche	Kennel	niʃ	6;0 – 6;11	1000–9999	1	cvc	n			ʃ
2	Nuage	Cloud	nyaʒ	6;0 – 6;11	10 000–49 999	2	cv.vc	n			ʒ
3	Soleil	Sun	sɔlɛj	3;0 – 3;11	10 000–49 999	2	cv.cvc	s, l			j
4	Château	Castle	ʃɑto	4;0 – 4;11	10 000–49 999	2	cv.cv	ʃ, t			
5	Escalier	Staircase	ɛskalje	2;0 – 2;11	1000–9999	3	vc.cv.cgv	k, l		j	s
6	Glissade	Slide	glisad	Unknown	1000–9999	2	ccv.cvc	s	gl		d
7	Vaisselle	Dishes	vɛsɛl	Unknown	1000–9999	2	cv.cvc	v, s			l
8	Cochon	Pig	kɔʃɔ̃	3;0 – 3;11	10 000–49 999	2	cv.cv	k, ʃ			
9	Tournevis	Screwdriver	tuʁnəvis	5;0 – 5;11	Unknown	3	cvc.cv.cvc	t, n, v			ʁ,s
10	Serpent	Snake	sɛʁpɑ̃	3;0 – 3;11	10 000–49 999	2	cvc.cv	s, p			ʁ
11	Clown	Clown	klun	2;0 – 2;11	1000–9999	1	ccvc		kl		n
12	Chapeau	Hat	ʃapo	2;0 – 2;11	10 000–49 999	2	cv.cv	ʃ, p			
13	Araignée	Spider	aʁɛɲe	4;0 – 4;11	1000–9999	3	v.cv.cv	ʁ, ɲ			
14	Framboises	Strawberries	fʁɑ̃bwaz	Unknown	Less than 1000	2	ccv.cgvc	b	fʁ	w	z
15	Bibliothèque	Bookshelf	bibliɔtɛk	7;0 – 7;11	1000–9999	4	cv.ccv.v.cvc	b, t	bl		k
16	Girafe	Giraffe	ʒiʁaf	2;0 – 2;11	1000–9999	2	cv.cvc	ʒ, ʁ			f
17	Langue	Tongue	lɑ̃g	Unknown	10 000–49 999	1	cvc	l			g
18	Enveloppe	Envelope	ɑ̃vlɔp	6;0 – 6;11	1000–9999	2	v.ccvc		vl		p
19	Garde-robe	Wardrobe	gaʁdəʁɔb	Unknown	Less than 1000	3	cvc.cv.cvc	g, d, ʁ			ʁ, b
20	Parapluie	Umbrella	paʁaplɥi	3;0 – 3;11	1000–9999	3	cv.cv.ccgv	p, ʁ	pl	ɥ	
21	Marionnettes	Puppets	maʁjɔnɛt	5;0 – 5;11	Less than 1000	3	cv.cgv.cvc	m, ʁ, n		j	t
22	Géant	Giant	ʒeɑ̃	Unknown	10 000–49 999	2	cv.v	ʒ			
23	Singe	Monkey	sɛ̃ʒ	3;0 – 3;11	10 000–49 999	1	cvc	s			ʒ
24	Aquarium	Aquarium	akwaʁjɔm	7;0 – 7;11	Less than 1000	3	v.cgv.cgvc	k, ʁ		w, j	m
25	Beigne	Donut	bɛɲ	Unknown	1000–9999	1	cvc	b			ɲ
26	Manger	To eat	mɑ̃ʒe	2;0 – 2;11	50 000 more than	2	cv.cv	m, ʒ			
27	Train	Train	tʁɛ̃	4;0 – 4;11	10 000–49999	1	ccv		tʁ		
28	Avion	Airplane	avjɔ̃	2;0 – 2;11	Unknown	2	v.cgv	v		j	
29	Hélicoptère	Helicopter	elikɔptɛʁ	4;0 – 4;11	1000–9999	4	v.cv.cvc.cvc	l, k, t			p, ʁ
30	Camion	Truck	kamjɔ̃	2;0 – 2;11	1000–9999	2	cv.cgv	k, m		j	

Target column shows target transcription as produced by an adult; AoA indicates estimated age of acquisition for the word as derived from multiple sources as described in the text; Freq indicates approximate frequency of occurrence of the word as derived from the NOVLEX database; Syl indicates the number of syllables in the word; Syl St refers to syllable structure with c, v and g referring to consonant, vowel and glide, respectively; BrOnset refers to branching onset and GN refers to glide in the nucleus.

same target more than once, the first recording or the clearer recording was transcribed. The third author, a native francophone, independently completed narrow phonetic transcriptions of 10 randomly selected recordings (16% of the samples) using the same procedures. Transcription agreement for narrow transcription for target consonants was 95.9% and for vowels 99.1%.

Coding

Following transcription of the recorded responses to the test items, each consonant production was coded as belonging to one of four different categories: correct production, segment error, syllable structure error or distortion. Segment errors involved substitution of one phoneme for another such as ''niche'' [niʃ] → [nis]. Syllable structure errors were of three types: most common were deletion (i.e. omission) of a consonant, e.g. ''soleil'' [sɔlɛj] → [sɔlɛ:]; sometimes an addition of a consonant also altered the syllable structure of the word, e.g. ''bibliothèque'' [bibliɔtɛk] → [blibliɔtɛk]; occasionally these errors involved transposition of consonants within a word, e.g. ''glissade'' [glisad] → [gilsad]. Distortion errors included segments that did or did not match the target; therefore [s̪] in the onset position of the words ''singe'' and ''chapeau'' were both counted as a distortions. For the purpose of calculating PCC, consonants were coded as correct or incorrect with substitutions, omissions, distortions and additions all coded as errors. For the purpose of calculating percent vowels correct (PVC), vowels were coded as correct or incorrect with errors, including substitutions, omissions, distortions and additions. Additions of a consonant to a vowel were coded as a vowel error (e.g. ''escalier'' [ɛskalje] → [dɛskalje]). Subsequent to item transcription and segment coding some summary statistics were derived for each sample, specifically number of words correctly produced, PCC, PVC and number of consonant omissions, in each case aggregated across all 30 words.

The third author recoded 16% of the samples to determine reliability of the coding procedure. Agreement for number of correctly articulated words and number of omitted consonants was 100%. Agreement for consonant codes was 99.3%: disagreements involved seven consonants coded as correct by the research assistant but coded as distortions (five) or syllable structure errors (two) by the third author. Agreement for vowel codes was 100%.

Results

Articulation accuracy by group

Initial analyses involved calculation of a number of different summary statistics reflecting articulation accuracy, aggregated across words but separately for each group. These summary statistics are shown in Table 3 by group. The effect of grade and of language background on each outcome measure was assessed via 2 × 2 ANOVA (analysis of variance) and then followed up with a *t*-test to compare the means for kindergarten versus first grade children. A parallel *t*-test to assess the impact of language group was not conducted because, as is revealed below, the ANOVAs did not reveal any statistically significant main effects of language background. Two measures focused on correct articulations, specifically, number of correctly articulated words and percent consonants correct. As shown in Table 3, there were no significant differences between groups for number of correctly articulated words as a function of grade [$F(1,61) = 0.77$, $p = 0.385$] or language [$F(1,61) = 2.66$, $p = 0.108$] and no significant interaction [$F(1,61) = 0.20$, $p = 0.659$]. Although percent consonants correct was about 4% points higher in first grade than in kindergarten, the ANOVA revealed no significant effect for grade [$F(1,61) = 3.31$, $p = 0.074$], language [$F(1,61) = 1.99$, $p = 0.164$], or the interaction [$F(1,61) = 0.04$, $p = 0.840$].

Additional measures focused on misarticulations and provide a picture of the profile of errors that can be expected in children of this age. The summary statistics describing misarticulations

Table 3. Mean (standard deviation) for each outcome measure by group with associated *t*-test to compare change with grade.

	Maternelle			Première Année						
	L2 $n=19$	L1 $n=24$	Both $n=43$	L2 $n=6$	L1 $n=12$	Both $n=18$	t	df	p	Hedge's g
Correct articulations										
Correct words	19.53 (6.36)	21.29 (4.64)	20.51 (5.47)	20.17 (4.07)	23.25 (3.74)	22.22 (4.02)	0.24	59.00	0.237	0.54
Percent consonants correct	88.11 (7.94)	90.37 (6.34)	89.37 (7.09)	91.13 (4.13)	94.15 (3.44)	93.14 (4.13)	2.59	52.48	0.012	0.75
Counts of misarticulations										
Words with a vowel error	1.90 (2.64)	1.63 (1.64)	1.74 (2.17)	2.33 (1.50)	1.33 (1.23)	1.67 (1.37)	−0.14	59.00	0.870	−0.21
Omitted consonants	2.95 (3.05)	3.00 (3.51)	2.97 (3.28)	2.17 (1.72)	1.75 (1.37)	1.89 (1.45)	−1.78	58.73	0.078	−0.42
Segment error	4.95 (3.78)	2.96 (2.94)	3.84 (3.44)	3.83 (2.14)	2.42 (1.51)	2.89 (1.81)	−1.40	55.72	0.167	−0.47
Syllable structure error	3.74 (2.77)	3.67 (3.47)	3.70 (3.47)	2.00 (1.41)	1.59 (1.50)	1.72 (1.45)	−3.56	58.34	0.001*	−0.93
Distortions	2.47 (3.34)	2.42 (3.28)	2.44 (3.28)	2.50 (2.74)	1.50 (2.34)	1.83 (2.38)	−0.61	59.00	0.480	−0.31

*p value is less than 0.007 indicating statistical significance after Bonferroni correction.

were number of words containing a vowel error and the total number of omitted consonants, segment errors, syllable structure errors and consonant distortions. Vowel errors were relatively rare with fewer than two words per child containing a vowel error. No significant effects were observed for grade [$F(1,61) = 0.02$, $p = 0.898$], language [$F(1,61) = 1.24$, $p = 0.270$] or the interaction [$F(1,61) = 0.41$, $p = 0.525$]. Consonant omissions were also infrequent and, although numerically higher in kindergarten than first grade, no significant effects were observed for grade [$F(1,61) = 1.41$, $p = 0.214$], language [$F(1,61) = 0.05$, $p = 0.833$] or the interaction [$F(1,61) = 0.08$, $p = 0.785$]. For numbers of segment errors, the small differences between groups are masked by large standard deviations within groups and therefore no significant effects were observed for grade [$F(1,61) = 0.90$, $p = 0.346$], language [$F(1,61) = 3.81$, $p = 0.056$] or the interaction [$F(1,61) = 0.11$, $p = 0.744$]. In contrast, syllable structure errors are clearly more frequent among kindergarten children than first graders, with a significant effect of grade [$F(1,61) = 5.37$, $p = 0.024$], but no effect of language [$F(1,61) = 0.09$, $p = 0.769$] and no significant interaction [$F(1,61) = 0.04$, $p = 0.834$]. Finally, the decline in distortion errors with advancing grade was not statistically significant [$F(1,61) = 0.24$, $p = 0.626$], and there was no effect of language [$F(1,61) = 0.34$, $p = 0.563$], and no significant interaction [$F(1,61) = 0.27$, $p = 0.605$].

Articulation accuracy by word

Table 4 presents accuracy data for each word aggregated across all children within each group, with the summary statistic indicating percent whole-word accuracy (i.e. percentage of children in the group who articulated the word completely correctly). The data in Table 4 show that some words were clearly more difficult than others although there were no words that were articulated correctly by all children. In general, longer words such as *bibliothèque* ''bookshelf'' and *aquarium* ''aquarium'' were more likely to be misarticulated although this was not always the case given that *parapluie* ''umbrella'' was relatively easy whereas *singe* ''monkey'' was relatively difficult. Misarticulated tokens are shown in the appendix.

Articulation accuracy by phoneme

Accuracy of production for each consonant is shown in Table 5, aggregated across words and participants, shown separately for each group. On average, accuracy is greater than 90% for the phonemes [m n ɲ p t d k f v ʁ ɥ j]. Accuracy fell below the cut-off for mastery for the phonemes [(b) ɡ s z ʃ ʒ (l) (w)] with the parentheses indicating borderline cases.

Phoneme accuracy by syllable position

Syllable structure is known to influence consonant accuracy with consonant sequences in particular predicted to be more difficult than singleton consonants. Table 6 presents consonant accuracy information for four syllable positions: singleton onset (e.g. *langue* → [l̲ɑ̃ɡ] ''tongue''), branching onset (e.g. *clown* → [k̲lun] ''clown'' with both the [k] and the [l] coded as a branching onset), glide in the nucleus (e.g. *avion* → [avj̲ɔ̃] ''plane'') and coda (e.g. *niche* → [niʃ̲] ''dog house''). Responses fell below 90% accuracy for singleton coda position only.

Phoneme accuracy by syllable

Finally, accuracy may be influenced by the syllable in which the consonant occurs. Syllables with less stress and syllables within longer words may be more vulnerable to errors. Table 7 presents

Table 4. Percent whole-word accuracy by word and group.

	Maternelle		Première Année		
Item	L2 (%)	L1 (%)	L2 (%)	L1 (%)	Mean (%)
27 train	94.74	91.67	83.33	100.00	92.43
30 camion	89.47	87.50	83.33	100.00	90.08
28 avion	84.21	100.00	83.33	91.70	89.81
18 enveloppe	68.42	87.50	100.00	83.33	84.81
11 clown	78.95	91.67	66.67	92.00	82.32
8 cochon	78.95	83.33	66.67	100.00	82.24
20 paraplui	78.95	66.67	100.00	83.30	82.23
25 beigne	83.33	75.00	83.33	83.30	81.24
3 soleil	81.25	58.33	83.33	100.00	80.73
4 château	68.42	79.17	83.33	91.70	80.66
1 niche	68.42	79.17	83.33	91.70	80.66
10 serpent	68.42	70.83	100.00	83.33	80.65
22 geant	63.16	83.33	83.33	83.33	78.29
26 manger	57.89	87.50	100.00	58.00	75.85
13 araignée	73.68	87.50	50.00	91.70	75.72
12 chapeau	68.42	83.33	66.67	83.00	75.36
7 vaisselle	84.21	75.00	66.67	75.00	75.22
19 garde-robe	93.33	75.00	50.00	75.00	73.33
21 marionnettes	84.21	79.17	50.00	75.00	72.09
16 girafe	57.89	54.17	100.00	75.00	71.77
17 langue	68.42	83.33	66.67	66.70	71.28
6 glissade	47.37	70.83	66.67	75.00	64.97
2 nuage	52.63	75.00	50.00	75.00	63.16
29 hélicoptère	68.42	54.17	66.67	50.00	59.81
8 escalier	57.89	54.17	33.33	83.30	57.17
9 tournevis	52.63	45.83	50.00	75.00	55.87
23 singe	36.84	20.83	83.33	58.30	49.83
24 aquarium	10.53	37.50	66.67	83.33	49.51
14 framboise	47.37	50.00	33.33	66.70	49.35
15 bibliothèque	36.84	20.83	50.00	50.00	39.42

See Table 2 for the target transcriptions and semantic referents that correspond to each item. In this table, items are listed in rank order by difficulty as indexed by mean percent correct. From Table 2, the items are listed in order of presentation to the children. Misarticulated tokens are shown in the appendix.

accuracy for consonants as a function of syllable position, organized according to single syllable words, final stressed syllables of multisyllable words and then the unstressed syllables in multisyllable words. Syllables are annotated by position in the word and word length (i.e. 1.2 is the first syllable in a two-syllable word). The results shown in Table 7 suggest a small effect of syllable stress and word length in that accuracy is approximately 6% higher for stressed syllables compared with unstressed syllables in multisyllable words and the lowest accuracy rates overall were observed for the first and second syllables within four-syllable words. These effects are small however and may be masked by the overall high rate of consonant accuracy within these samples of children.

Discussion

In this study, 61 French-speaking children attending kindergarten (*maternelle*) and first grade (*première année*) named 30 pictures representing 1, 2, 3 and 4 syllable words. The first

Table 5. Articulation accuracy by phoneme.

	Maternelle		Première Année		
Phoneme	L2	L1	L2	L1	Mean
m	94.74	96.88	91.67	95.83	94.78
n	96.84	96.64	100.00	100.00	98.37
ɲ	94.59	93.75	91.67	100.00	95.00
p	95.61	98.60	100.00	97.22	97.86
b	91.49	91.67	80.00	93.33	89.12
t	97.37	98.61	97.22	100.00	98.30
d	94.74	97.92	91.67	95.83	95.04
k	88.72	92.22	97.62	98.81	94.34
g	78.95	90.28	88.89	83.33	85.36
f	92.11	100.00	91.67	95.83	94.90
v	84.21	93.75	91.67	91.67	90.32
s	81.20	80.95	92.86	92.86	86.97
z	63.16	58.33	50.00	75.00	61.62
ʃ	73.68	81.25	83.33	93.75	83.00
ʒ	63.16	75.83	73.33	71.67	71.00
ʁ	89.04	90.63	90.28	97.92	91.96
l	89.47	87.87	91.67	90.83	89.96
ɥ	89.47	91.67	100.00	100.00	95.29
w	84.21	83.33	91.67	95.83	88.76
j	97.37	92.36	94.44	98.61	95.70

Table 6. Articulation accuracy by syllable Position.

	Maternelle		Première Année		
Syllable position	L2	L1	L2	L1	Mean
Singleton onset	88.60	90.98	94.22	95.41	92.30
Branching onset	88.72	91.94	90.48	93.45	91.15
Glide in the nucleus	93.42	90.58	93.75	97.92	93.92
Singleton coda	84.86	88.00	84.06	90.58	86.88

observation is that 65% (L2, *maternelle*) to 78% (L1, *première année*) of the words were articulated correctly, indicating that the word set was difficult enough to avoid ceiling effects and to provide useful data when screening the articulation accuracy of school-aged children. Given that the word set reflects the segmental and prosodic characteristics of spoken Québec French, these results further indicate that phonological development is not complete by the age of seven years.

Although the number of vowel errors, consonant omissions, substitutions and distortions declined with age, these changes were not statistically significant due to their overall low frequency and large within group variance. Syllable structure errors were not especially frequent either but declined by almost half between the two years ($M = 3.7$, *maternelle*; $M = 1.72$, *première année*), a decline that was statistically significant. None of these error types distinguished first from second-language learners of French.

Overall, the performance of the L1 and L2 groups was similar with no significant differences across language groups for percent correct production of words or consonants. This finding was not surprising given prior findings in the literature. For example, Burrows and Goldstein (2010) reported no difference between monolingual and bilingual speakers of Spanish with respect to

Table 7. Accuracy by syllable stress.

	Maternelle		Première Année			
Syllable	L2	L1	L2	L1	Mean by Syllable	Mean by Category
Stressed syllable in single syllable words						89.33
1.1	86.16	91.03	88.46	91.67	89.33	
Stressed syllable in multisyllable words						93.94
2.2	87.56	92.59	93.94	96.21	92.75	
3.3	90.98	89.29	88.10	97.62	91.50	
4.4	93.42	96.84	100.00	100.00	97.57	
Unstressed syllables in multisyllable words						88.25
1.2	84.80	89.10	91.67	92.13	89.43	
1.3	90.79	93.75	87.50	93.75	91.45	
1.4	94.74	75.00	83.33	91.67	86.19	
2.3	87.72	89.35	94.44	96.30	91.37	
2.4	77.19	73.61	77.78	75.00	75.90	
3.4	97.37	91.67	100.00	91.67	95.18	

production accuracy for segments or whole-words. Examining a larger sample of four-to-seven-year-old children, Goldstein, Bunta, Lange, Rodriguez, and Burrows (2010) found that relative amount of exposure to Spanish or English did not result in significant differences in consonant accuracy; direct measures of language proficiency were predictive of segment accuracy for this same sample of older children. In contrast, Gildersleeve-Neumann, Kester, Davis and Peña (2008) showed that Spanish–English bilingual children with more English exposure had greater consonant accuracy than balanced bilinguals; however, this study involved younger children, aged three and four years. In the study reported here, some consonants appeared to be more difficult for the L2 maternelle group compared with the L1 maternelle group: /k, ɡ, ʃ, ɥ/. Large differences between the L2 and L1 groups in *première année* were observed for /b, z, ʃ, ʁ/. Voicing errors and fronting of palatals were quite common among the L2 children. Therefore, there are some indications that the L1 group was further advanced toward the acquisition of adult-like phonology than the L2 group despite global similarities in performance.

At the level of individual consonants, improvements in scores from the younger to the older children were also small, but in some cases crossed the threshold from below to above 90% correct. Specifically, /s, ʃ, l, w/ were still problematic for some children in *maternelle*, but were clearly mastered by the children in *première année*. Accuracy levels remained at or below 75% for /z, ʒ/ for all four groups. The finding for /z/ is anomalous with the findings reported by MacLeod et al. (2011), in which this phoneme was reported as mastered by three years of age. This probably reflects the poor sampling of /z/ in the TDFP as it occurred only once at the end of a difficult word, specifically *framboise* (Table 2), in contrast to MacLeod et al. who sampled this phoneme in the words *oiseau* ''bird'' → /wazo/ and *zèbre* ''zebra'' → /zɛbʁ/ in addition to ''framboise''.

As noted above, the most remarkable developmental improvement was the reduction in syllable structure errors. This can be attributed to a small improvement in accuracy for the production of branching onsets and larger improvements in accuracy for the production of unstressed syllables in three and four syllables words. The coda in the first and second syllables in words such as *garderobe* /ɡaʁdəʁɔb/ ''wardrobe'', *hélicoptère* /elikɔptɛʁ/ ''helicopter'', *escalier* /ɛskalje/ ''stairs'', and *tournevis* /tuʁnəvis/ ''screw driver'' was particularly vulnerable to deletion. On the other hand, the most difficult words on the screening test did not contain word internal codas. The most frequently misarticulated word, *bibliothèque* /bibliɔtɛk/ ''bookshelf'', contained a complex onset in a difficult context. Common misarticulations of this word included reduction of the

cluster, [bibiɔtɛk], and reduplication of the cluster, [blibliɔtɛk], although weak syllable deletion, [pliɔtɛk], and voicing errors, [pipliɔtɛk], also occurred. Two other words that were frequently misarticulated were *framboise* ''raspberry'' and *aquarium*; although reduction of the consonant sequences was the most common errors, interesting resyllabifications of *aquarium* were notable (e.g. [aʁkwajɔm]).

In summary, French-speaking children attending *maternelle* and *première année* can be expected to articulate at least two-thirds of the words on the TDFP correctly, both at the level of the vowel and the consonant. Overall, the children articulated at least 90% of the consonants correctly on average. In the next section, we explore the usefulness of this information for clinical purposes, describing a child who was enrolled in a clinical trial of interventions for the treatment of speech delay in francophone children.

Case study

Method

Participant

A 72-month-old boy whose first and only language was French, was assessed to document his ongoing progress after receiving a 12-week speech therapy program one year earlier. His mother reported that there were no complications during the pregnancy or birth but there were concerns about gastric reflux, food intake and growth after birth. Otherwise his developmental history was unremarkable. He received speech therapy for the first time at the age of 59 months due to concerns regarding speech intelligibility. Prior to receiving speech therapy, percent consonants' correct was 56% while naming the 54 items on the TFP and 73% in conversation. Treatment targets during the therapy program that was provided during the year prior to enrollment in *maternelle* were /s/, word onset clusters, and word internal codas with /ʁ/ in particular targeted in this position.

Procedure

During a one hour assessment, standardized and unstandardized assessment procedures were conducted, including: the *Échelles de Vocabulaire en Images de Peabody* (EVIP; Dunn, Theriault-Whalen, & Dunn, 1993), a normed Canadian-French measure of receptive vocabulary; the TFP (Paul & Rvachew, 2009) and the *Test d'analyse auditive en français* (TAAF; Cormier, MacDonald, Grandmaison, & Ouellette-Lebel, 1995), a test of phonological awareness that requires deletion of syllables and phonemes from words.

Results

This child achieved a standard score of 136 on the EVIP indicating receptive vocabulary abilities that were above average, even according to local expectations (Thordardottir, Keheyia, Lessard, Sutton, & Trudeau, 2010). His score on the TAAF was within normal limits ($z = -0.38$). His production of the 30 words probed by the TDFP is shown in Table 8. It can be seen that inconsistent distortion of /s/ remains as a concern in his speech; in addition, he continues to delete /ʁ/ in the word internal coda position despite correct production of this phoneme in onsets and clusters; persistent fronting (with distortion) of /ʃ,ʒ/ accounts for a third of the errors. The errors observed in these productions are summarized in Table 9 in relation to the normative expectations shown in Table 3 for the L1 Maternelle group. This child's performance for the number of correct words, percent consonants correct and number of distortions all fall more than two standard deviations below the mean. The number of segment errors is greater than one standard deviation below the mean. Although this child has mastered the phonemes that are expected for his age, and

Table 8. Production of TDFP items by child with history of speech delay.

Target	Production	Target	Production
niche	nis	Giraffe	ʒ̟iʁaf
nuage	nyaz	Langue	lɑ̃g
Soleil	sɔlɛj	Enveloppe	ɑ̃vjɔp
château	s̟ɑto	Garderobe	gadəʁɔb
escalier	ɛs̟kalje	Parapluie	paʁapɥi
glissade	glis̟ad	Marionette	majɔnɛt
vaiselle	vɛs̟ɛl	Géant	ʒ̟eɑ̃
cochon	kɔs̟ɔ̃	Singe	s̟ɛ̃ʒ̟
tournevis	tunəvis	Aquarium	nakwajɔm
serpent	sɛpɑ̃	Beigne	bɛɲ
clown	klun	Manger	mɑ̃ʒ̟e
chapeau	sapo	Train	tʁɛ̃
araignée	aɛɲe	Avion	avjɔ̃
framboise	fʁɑ̃bwaz̟	hélicoptère	elikɔptɛʁ
bibliothèque	biblɪɔtɛk	Camion	kamjɔ̃

See Table 2 for target transcriptions and semantic referents.

Table 9. TDFP performance for a child who received speech therapy one year earlier.

Relative to normative data from the L1 Maternelle Group	Raw Score	*z*	L1 Maternelle
Correct articulations			
Correct words	10.00	–2.43	21.29 (4.64)
Percent consonants correct	76.60	−2.17	90.37 (6.34)
Counts of misarticulations			
Words with a vowel error	1.00	0.38	1.63 (1.64)
Omitted consonants	6.00	−0.67	3.00 (3.51)
Segment errors	7.00	−1.37	2.96 (2.94)
Syllable structure errors	6.00	−0.67	3.67 (3.47)
Distortions	9.00	−2.01	2.42 (3.28)

the errors that occur all involve late developing phonemes, the frequency of errors in the sample place the child well below normal limits and suggests that the child would benefit from additional speech therapy.

Discussion and conclusions

This case study highlights the importance of quantitative normative data on the development of French phonology for clinical decision-making. If the SLT were to assess the adequacy of the child's speech development by attending to consonant acquisition norms alone, the child's speech development would appear to be falling within acceptable limits. All the errors involve late developing phonemes (s, z, ʃ, ʒ, ʁ) for which mastery is not expected in the kindergarten-aged child (with the possible exception of /z/). However, the large frequency of errors overall clearly indicates that the child's speech performance is not within normal limits and warrants some form of intervention or at least continued monitoring on the part of the SLT.

The TDFP serves as a useful screening tool for school-aged francophone children. The probe words include enough 2, 3 and 4 syllable words to approximate the average word length of spoken

French while targeting a full range of consonants in varied syllable positions and thus provides a representative sample of speech performance. The test provides information about the child's performance in the segmental and prosodic domains. The test scores for children in *maternelle* and *première année* do not show floor or ceiling effects and thus the test is sensitive to a broad range of performance levels at school entry, and with continued data collection for older children, could be useful for screening children in the later grades. Further research is required to demonstrate concurrent validity with other measures of speech accuracy (such as percent consonants correct in conversation) and sensitivity to change in articulation over time. Research to establish the predictive validity of this screening tool is also ongoing.

Some of our work to establish the validity of this screening test involves examining the relationship between performance on the screening test (i.e. TDFP) and the larger diagnostic test from which the words were drawn (i.e. TFP). We caution, however, that the distinction between the screening test and the diagnostic test must be maintained in the clinical context. The screening test is intended as a time-efficient procedure for identifying children who may have an unusually large number of speech errors relative to their age peers and who may be at risk for delayed acquisition of literacy skills such as spelling and decoding. Children who fail the test should then receive comprehensive assessments of their abilities in these other areas. For example, treatment planning in the area of phonology cannot be based on the results of the TDFP. A larger sample of the child's speech, including systematic sampling of segments and prosodic structures as is provided by the TFP is required. Additionally, a connected speech sample is required, especially in French, because the child's phonological output can be impacted by the ''accentual arc'' of the phonological phrase in which words are produced (Wauquier & Yamaguchi, in press). Nonetheless, the shorter screening test is a useful tool for identifying those children most at risk on the basis of a high frequency of errors relative to their peers; this screening tool may also provide a starting point for planning the data collection strategy for the diagnostic assessment.

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Appendix

Inventory of misarticulated tokens by TDFP item, in order by frequency of occurrence.

Target		Misarticulated tokens
Niche	niʃ	[nis], [niʃ^{D}], [liʃ]*, [nliʃ]*
Nuage	nyaʒ	[nyaʃ], [nyaz], [ny^{D}aʒ], [nyaʒ^{D}], [nuaʒ]*,[nywaʒ]*,[yaʒ]*
Soleil	sɔlɛj	[s^{D}ɔlɛj], [ʃɔlɛj], [sɔlɛ]
Château	ʃɑto	[sato], [ʃ^{D}ɑto], [ʃlɑto]*, [tsɑto]*, [ʃɑtɔ]*
Escalier	ɛskalje	[ɛskaje], [iskalje],[ɛs^{D}kalje], [diskalje], [ɛskalj^{D}e]*, [ɛskalji]*, [ɛstalje]*, [ɛsk^{D}alje]*, [ɛskɑlje]*
Glissade	glisad	[glis^{D}ad], [klisad], [glisat], [g^{D}lisad], [gl^{D}is^{D}ad]*, [glisado]*, [glisap]*, [lisad]*, [gisad]*,[ɹisad]*, [gils^{D}ad]*
Vaisselle	vɛsɛl	[vɛs^{D}ɛl], [vis^{D}ɛl], [bɛsɛl], [fɛsɛl], [βɛsɛl]*
Cochon	kɔʃɔ̃	[kɔsɔ̃], [kɔs^{D}ɔ̃], [pəs^{D}ɔ̃]*
Tournevis	tuʁnəvis	[tunəvis], [tuʁnəvis^{D}], [tunəvis^{D}], [tuʁnəfis], [tuʁdəvis], [tɔʁnəvis]*, [tuʁnəhis]*, [tuʁ^{D}nəvis]*
Serpent	sɛʁpɑ̃	[s^{D}ɛʁpɑ̃], [sɛpɑ̃], [sɛʔpɑ̃]*, [s^{D}ɛwpɑ̃]*, [sabaj]*
Clown	klun	[klyn], [ʃɬun]*
Chapeau	ʃapo	[sapo], [s^{D}apo], [ʃəpo]
Araignée	aʁɛɲe	[aʁiɲe], [aʁɛɲ^{D}e], [aɛɲe], [aʁɲe]*,[naʁɛɲe]*, [aʁɛɲi]*
Framboises	fʁɑ̃bwaz	[fʁɑ̃bwas], [fʁɑ̃bwaz^{D}], [fɑ̃bwaz]*, [fɑ̃bwa]*, [ʁɑ̃baz]*, [fʁɑ̃bwɔ]*,[fʁɑ̃bwoz]*, [fʁɑ̃bʁaz]*, [ʁɑ̃bʁaz]*, [fʁɑ̃vwaz]*,
Bibliothèque	bliblioɪtek	[bibioɪtɛk], [bliblioɪtɛk], [bibliɔɪtɛ], (plus 12 single token variants)
Girafe	ʒiʁaf	[ʤiʁaf], [ʃiʁaf], [ziʁaf], [z^{D}iʁaf], [ʒ^{D}iʁaf], [ʧiʁaf]*, [ʃ^{D}iʁaf]*, [ʒiʁas]*, [ʤihaf]*, [kliʁaf]*, [iʁaf]*, [liaf]*
Langue	lɑ̃g	[lɑ̃k], [lɑ̃]*, [lɑ̃g^{D}]*, [lɑ̃w]*
Enveloppe	ɑ̃vlɔp	[ɑ̃wlɔp], [ɑ̃vəp], [ɑ̃vjɔp]*, [ɑ̃vlɔk]*, [ɑ̃vlɔp]*, [ɑ̃flɔp]*, [ɑ̃vlɔ]*, [ɑ̃ʁblɔp]*, [ɑ̃pə]*
Garde-robe	gaʁdəʁɔb	[gadəʁɔb], [dɑ̃dəʁɔp]*, [kaʁdəʁɔb]*, [kadəʁɔp]*, [gaʁdəʁɔp]*, [gaʁbəʁɔb]*, [jaʁdəʁɔb]*, [gadəɔb]*, [gaʔdəʁɔb]*, [gɛʔdəʁɔː]*
Parapluie	paʁaplɥi	[paʁapɥi], [pɔʁapɥi]*, [paʁɔpɥi]*, [paʁapwi]*, [paʁapsi]*, [pahapji]*, [papji]*
Marionnettes	maʁjɔnɛt	[aʁjɔnɛt], [majɔnit]*, [maj^{D}ɔnɛt]*, [maʁjɔnɛts]*, [maʁkəʁit]*, [mamənəʁɛtk]*, [majɔnɛt]*, [manɔnjɛt]*, [baʁjɔnɛt]*, [maʁjenɛt]*, [maʁjɔnɛ]*
Géant	ʒeɑ̃	[ʃeɑ̃], [ʒ^{D}eɑ̃], [zeɑ̃] [ziɑ̃]*, [sɑjɑ̃]*
Singe	sɛ̃ʒ	[sɛ̃ʃ], [s^{D}ɛ̃ʒ], [ʃɛ̃ʒ], [sɛ̃z],[sɛ̃ʒ^{D}], [s^{D}ɛ̃z^{D}], [sɛ̃z^{D}], [sɛ̃]*, [sɛ̃s]*, [ʃɛ̃ʃ]*, [s^{D}eɛ̃s]*, [sɛ̃h]*, [seis]*

(*continued*)

Target		Misarticulated tokens
Aquarium	akwaʁjɔm	[aʁkwaʁjɔm], [aʁkwajɔm] [akʁaʁjɔm], [akwaʁjɔm], [nakwaʁjɔm], [akaʁjɔm] (plus 13 similar single token variants)
Beigne	bɛɲ	[bɛ̃ɲ], [baɲ], [pɛɲ]*, [bɛɲɛ]*, [bɛ̃g]*, [bɛ̃]*, [bɛːn]*, [b^{D}ɛ̃ɲ]*
Manger	mɑ̃ʒe	[mɑ̃ʃe], [mɑ̃ʒ^{D}e], [mɑ̃ze], [mɑ̃ʒi]*, [mɑ̃zi]*, [mɑze]*
Train	tʁɛ̃	[tʁɛ], [kʁɛ̃]*, [tʁ^{D}ɛ̃]*
Avion	avjɔ̃	[afjɔ̃], [navjɔ̃]*
Hélicoptère	elikɔptɛʁ	[ikɔptɛʁ],[enikɔptɛʁ], [alikɔptɛʁ], [lilikɔptɛʁ], (plus 12 similar single token variants)
Camion	kamjɔ̃	[kanɔ̃]*, [kajɔ̃]*, [kamɔ̃]*, [kanjɔ̃]*, [tamjɔ̃]*, [k^{D}amjɔ̃]*

All types of distortion are represented with a superscript 'D' to reduce the numbers of unique variants in the table. The asterisk indicates single token variants (i.e. pronunciations that occurred only once across all four groups of participants).

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1. Cadre théorique

1.1 Acquisition

1 L'acquisition productive du langage nécessite la maîtrise de plusieurs phénomènes linguistiques, dont l'identification des structures et des éléments morphologiques du mot (ex. racine+flexion). Cette identification morphologique est particulièrement importante dans la conjugaison des verbes, qui occupent un point central dans la structure de la phrase (Bassano, 2010). Les enfants francophones sont sensibles à la productivité morphologique, mais sont également sensibles à la régularité et à la fréquence d'apparition des schèmes verbaux français (Royle *et al.* 2012). Chez le nourrisson, la reconnaissance de la racine d'un verbe survient entre huit et onze mois (Marquis & Shi, 2008) tout comme la capacité de relier la racine d'un verbe à une de ses formes conjuguées (Marquis & Shi, 2009). Dès l'âge de trois ans, les enfants démontrent l'utilisation de principes morphologiques qui distinguent les groupes de conjugaison lors de la production des verbes (ex. Royle, 2007). La recherche sur l'acquisition des verbes en langage spontané nous indique que les enfants francophones (entre 21 et 47 mois) produisent des formes conjuguées à l'impératif, au futur proche, à l'imparfait et au passé composé (Thordardottir, 2005). De plus, les formes produites par les enfants francophones sont généralement grammaticales : les verbes sont conjugués selon la personne, le nombre et le temps.

1.2 Modèles théoriques

2 Il existe des modèles psycholinguistiques (basés sur l'anglais) dans lesquels les verbes sont décrits de façon dichotomique, réguliers *versus* irréguliers (voir par ex. Pinker, 1999). Les verbes réguliers se conjuguent en suivant un schème morphologique régulier (ex. *call, call +ing, call+ed*) et productif qui peut être recruté pour leur production (ou compréhension), tandis que les verbes irréguliers semblent se conjuguer sans concaténation morphologique (ex. *sing, sang, sung*) et doivent être mémorisés et emmagasinés pour leur production adéquate. Pour les langues latines (ex. l'espagnol, l'italien ou le français), la conjugaison des verbes est mieux décrite en termes de distinction tripartite des groupes du verbe (voir par ex. Clahsen *et al.*, 2002, pour l'espagnol ; Royle *et al.*, 2012, pour le français ; Say & Clahsen, 2002, pour l'italien). En français par exemple, les verbes sont traditionnellement divisés en trois groupes principaux : les verbes du premier groupe (se terminant en *-er* à l'infinitif), les verbes du second groupe (se terminant en *-ir* à l'infinitif) et les verbes irréguliers[1]. Cependant, des sous-groupes de régularité se manifestent parmi les trois groupes. Certains de ces sous-groupes semblent emprunter, notamment pour le passé composé, des schèmes de conjugaison chez les verbes réguliers (ex. les irréguliers en *-é*, *aller – allé* /ale/) et sous-réguliers (ex. les irréguliers en *-i*, *prendre – pris* /pʁi/), tandis que d'autres se conjuguent de façon irrégulière (ex., *ouvrir – ouvert* /uvɛʁ/). Parmi les verbes du troisième groupe, un sous-groupe particulier émerge : les verbes dont le participe passé se termine en *-u* (ex. *voir – vu*). Ce sous-groupe renferme des verbes parmi les plus fréquents de la langue tels que *voir*, *boire* et *vouloir*. Étant donné que la fréquence d'occurrence d'un verbe peut influencer sa maîtrise chez l'enfant (voir par ex. Royle, 2007), il s'avère important d'étudier aussi la connaissance des schèmes réguliers et sous-réguliers qui apparaissent fréquemment dans la langue. Or, le manque de distinction de ces verbes sous-réguliers et irréguliers peut mener à une compréhension superficielle des capacités à conjuguer les verbes chez les enfants.

1.3 Effets de fréquence

3 Même si les verbes du premier groupe composent la majorité des verbes français (de 85 % à 90 % de tous les verbes, Bescherelle, 2006), les effets de fréquence de type et d'occurrence (en anglais *type* et *token frequency*) affectent l'exposition à tous les groupes de conjugaison. Selon le corpus de langage spontané de deux enfants francophones de deux ans de Guillaume (1927 [1973]), les verbes du premier groupe représentent 76 % des types de verbes, alors qu'ils ne constituent que 36 % des occurrences. Les verbes du second groupe (verbes réguliers et irréguliers) incluent 6 % des types et 11 % des occurrences, tandis que les verbes du troisième groupe (tous irréguliers) comptent 18 % des types et 58 % des occurrences. Les verbes irréguliers semblent donc être très présents dans la langue de l'enfant. Nicoladis *et al.* (2007) ont vérifié l'importance de la fréquence des formes du passé composé pour l'acquisition des verbes, en analysant des corpus de littérature enfantine et de discours dirigé vers l'enfant. Leur investigation dévoile que 63 % des types de verbes au passé composé et 51 % des occurrences sont du premier groupe. Royle *et al.* (2012) ont confirmé les données de Guillaume (1927[1973]) avec un corpus plus récent (2005-2008) de 12 enfants québécois âgés de 36 à 45 mois. De plus, une analyse des formes au passé composé démontre la prédominance des schèmes du premier groupe (61 % des types et 47 % des occurrences) pour cette conjugaison, avec une représentativité mitigée du second groupe (17 % des types et 27 % des occurrences, si on y inclut les verbes irréguliers ayant un participe passé en *-i*) comparativement aux verbes dont le participe passé se termine en *-u* (9 % des types 5 % des occurrences), et aux verbes avec une forme non morphologique tel *mourir-mort* (11 % des types et 19 % des occurrences). Ces analyses démontrent que les formes du passé composé incluent une grande variété de formes, avec une prédominance du premier groupe. Une étude vérifiant les capacités de production des enfants de ces quatre groupes de verbes permettrait de dévoiler la sensibilité des enfants à la fréquence des schèmes morphologiques des verbes français.

1.4 Trouble spécifique du langage (TSL)

4 L'enseignement du français en milieu scolaire requiert, outre la compétence à écrire, l'enseignement de la conjugaison des verbes. Afin de faciliter cet enseignement, il est nécessaire de bien connaître les principes grammaticaux (c'est-à-dire, la grammaire implicite) présents chez l'enfant avant l'entrée à l'école, les difficultés rencontrées par les enfants, et les moyens qu'ils utilisent pour surmonter leurs difficultés de conjugaison. De plus, un certain nombre d'enfants présente des troubles du langage qui auront des impacts directs sur leur réussite scolaire. En particulier, les enfants présentant un trouble spécifique du langage (TSL), une dyslexie ou une dysorthographie peuvent être en difficulté en milieu scolaire. L'un des principaux problèmes rencontrés par les enfants avec un TSL est la conjugaison des verbes (ex. Jakubowicz & Nash, 2001 ; Paradis & Crago, 2001 ; Royle & Thordardottir, 2008). Or, même pour les enfants sans trouble de langage, trop peu d'études traitent de la nature des processus impliqués dans l'encodage des paradigmes verbaux. Il apparaît que les enfants sans trouble établissent précocement une sensibilité aux schèmes morphologiques des verbes français. Jakubowicz & Nash (2001), Paradis & Crago, (2001), et Royle & Thordardottir (2008) ont démontré que les enfants avec TSL éprouvent des difficultés avec les flexions verbales du français comparativement aux groupes contrôles. Lorsque l'on compare la production de verbes induits, les enfants âgés de 3-4 ans avec TSL produisent significativement moins le passé composé contrairement aux enfants sans trouble de langage (Royle & Thordardottir, 2008). Dans une étude précédente de Royle (2007), portant sur la conjugaison chez quinze enfants à développement typique et âgés de 3 à 4 ans et demi, environ 10 % des erreurs commises étaient des erreurs de surgénéralisation, où la forme cible était fléchie en empruntant un schéma régulier (ex. **il a voulé*) ou sous-régulier (ex. **il a ouvri*), phénomène rare chez les enfants TSL. Les erreurs de surgénéralisation indiquent que les enfants ne font pas que copier ce que les adultes produisent, mais qu'ils génèrent des schèmes de conjugaison permettant de produire les formes peu fréquentes ou irrégulières. Par contre, l'étude de Royle (2007) ne contrôle pas spécifiquement les stimuli verbaux selon la classification tripartite présentée ci-

dessus, et n'étudie pas non plus la sensibilité à la régularité phonologique présente dans les formes se terminant en *-u*.

1.5 Productivité

5 L'indice de productivité du passé composé peut s'avérer essentiel afin de déterminer les effets de la fréquence et de la régularité sur l'acquisition de la conjugaison des verbes français. Le participe passé est très fréquent dans le langage chez l'enfant et représente pour les verbes d'action environ 16 % des formes verbales produites spontanément entre 14 et 36 mois (corpus de Pauline, Bassano, 2010). Hiriarteborde (1973) a développé une tâche de production induite du passé composé où la production induite des verbes réguliers fréquents et moins fréquents était comparée au discours spontané des mêmes enfants. À trois ans et demi, les petits Français produisaient correctement le passé composé, mais seulement si l'on retrouvait au moins quatre différents types de passé composé dans leur discours spontané. Les enfants québécois démontrent la même capacité de produire le passé composé de verbes connus vers trois ans et demi et de verbes inconnus vers quatre ans (Royle, 2007). Kresh (2008) a étudié le traitement du participe passé en français à l'aide d'une tâche de production induite chez des enfants de six et huit ans. Dans cette étude, en plus des traditionnels groupes de verbes dont le participe se termine en *-é*, en *-i* et les irréguliers (ex. *souffrir-souffert*), Kresh a évalué le sous-groupe des verbes irréguliers dont le participe se termine en *-u* (ex. *paraître-paru*). Les résultats de cette étude indiquent des effets de fréquence pour tous les items sauf ceux en *-u*, et des effets paradoxaux pour les formes irrégulières : en effet, on observe un renversement de l'effet de fréquence pour les verbes les moins fréquents qui sont mieux produits que ceux de fréquence moyenne. Cependant, seuls des items de moyenne ou basse fréquence ont été testés dans cette étude. On peut aussi se questionner sur la représentativité des mesures de fréquence utilisées (fréquence du Lemme en texte écrit dans MANULEX, Lété *et al.*, 2004), étant donné les résultats rapportés pour les formes irrégulières. En prenant pour acquis que les enfants sont sensibles aux effets de fréquence du type, une étude plus approfondie de ces effets sur les verbes de haute fréquence, tout en contrôlant pour les sous-groupes de conjugaison des verbes français apparaît nécessaire, afin de mieux comprendre le traitement des différentes formes verbales. Dans la présente étude, nous reprendrons les groupes de verbes en *-é*, en *-i*, en *-u* et irréguliers (IR) étudiés par Kresh (2008), mais en n'utilisant que des formes de fréquence relativement haute.

1.6 Problématique

6 Afin de réussir l'acquisition adéquate des paradigmes verbaux, les enfants doivent dans un premier temps déterminer l'existence des différents groupes de conjugaison, malgré la haute représentativité d'un seul schéma (les verbes en *-er*) dans le corpus. En parallèle, ils devront développer des règles d'application de ces schèmes (c'est-à-dire connaître la classe verbale à laquelle une forme appartient). Dans la présente étude, nous voulons évaluer la maîtrise du passé composé chez les enfants de 6 et 7 ans, en utilisant des verbes avec les terminaisons du participe passé suivants ; soit en *-é* (ex. *cacher-caché*), en *-i* (ex. *finir-fini*), en *-u* (ex. *mordre-mordu*) et les irréguliers *autres* (ex. *ouvrir-ouvert*). Selon le Programme de formation de l'école québécoise du Ministère de l'enseignement, des loisirs et du sport du Québec (le MELS), les enfants n'ont pas encore appris à distinguer ni à écrire ces formes[2]. Nous pouvons donc étudier les compétences linguistiques de ces enfants sans grande interférence avec la scolarisation. Ceci nous permettra de développer un modèle de la représentation du verbe chez l'enfant en début de scolarisation.

2. Hypothèses

7 Dans un premier temps, on s'attend à obtenir un effet d'âge qui distinguerait les enfants plus âgés des enfants plus jeunes. On prévoit également d'obtenir un meilleur taux de réussite selon la régularité et la fréquence du paradigme : les verbes réguliers en *-é* seront mieux réussis que les verbes en *-i*, qui, eux, seront mieux réussis que les verbes en *-u*, qui à leur tour seront mieux réussis que les verbes irréguliers *autres*. Étant donné les résultats de Royle (2007) démontrant

des sur-régularisations en *-i* chez des enfants de 4 ans – les verbes en *-i* devraient être bien maîtrisés – Il est probable que cela se retrouve au niveau des verbes du premier groupe. Les verbes irréguliers, en *-u* et *autres*, seront moins bien réussis que les verbes réguliers et sous-réguliers dû à leur manque de productivité. Les verbes en *-u* seront mieux réussis que les verbes irréguliers *autres*, malgré leur absence de productivité, en raison de la présence d'une régularité morphophonologique en fin de mot (*-u*) (voir Albright, 2002 pour une discussion de la fiabilité (*reliability*) morphologique, c'est-à-dire le potentiel qu'une marque morphologique donnée puisse être utilisée dans un environnement phonologique déterminé), et de la fréquence d'item de ces formes. Finalement, pour les verbes irréguliers *autres,* aussi improductifs, et étant des types uniques, nous pensons qu'aucun effet de fréquence de type ne peut favoriser leur apprentissage : ils devraient, par conséquent, être les plus difficiles à produire malgré leur grande fréquence d'item.

3. Expérience

3.1 Méthodologie

3.1.1 Participants

8 Vingt-deux enfants de maternelle (13 garçons et 9 filles) âgés de 6 ans (M = 6 ;1, ET = 0,31) et treize enfants de première année (9 garçons et 4 filles) âgés de 7 ans (M = 7 ;8 ET = 0,32) tous unilingues francophones de la grande région de Laval, Québec ont participé à cette étude.[3] La collecte de données s'est déroulée aux mois de mai et juin. Les enfants étaient donc tous en fin d'année scolaire. Les enfants de 6 ans terminaient la maternelle et les enfants de 7 ans terminaient, quant à eux, la première année. Les enfants participaient à une étude plus large visant à développer un outil de dépistage de la dysorthographie en français (Rvachew *et al.*, 2011-2013), le protocole a été approuvé par les comités d'éthique à la recherche des facultés de médecine des Universités de McGill et de Montréal. Les parents ou tuteurs des enfants ont signé un formulaire de consentement permettant à l'enfant de participer à l'étude. Les enfants pouvaient se retirer de l'étude à tout moment. Nous avons également amassé des informations démographiques, d'exposition à l'écrit, de santé et de langage par le biais d'une entrevue téléphonique avec les parents. Selon les informations obtenues, aucun des enfants de notre groupe n'avait de signes de troubles neuronaux, cognitifs ou autres pouvant affecter le développement de son langage.

3.1.2 Procédure

9 Nous avons créé une tâche de production induite de verbes sur tablette interactive[4] à plate-forme Android. Une application en code source libre (*Open Source*) développée pour la tâche permettait de présenter des images créées par une artiste professionnelle et illustrant les verbes induits. L'application, consiste à simuler un livre d'histoires imagées avec lequel l'enfant est amené à compléter de courtes histoires en répondant à des questions posées par l'évaluateur. L'application enregistrait toutes les réponses verbales des enfants en plus d'une série d'informations telles que la date et l'heure de l'expérimentation ainsi que le temps écoulé pour le visionnement de chacune des images.

10 Les enfants ont tous été testés individuellement à l'école durant les heures de classe dans un local de l'établissement scolaire réservé pour l'étude, pour une durée approximative de 30 à 45 minutes. Durant l'expérimentation, l'enfant avait en main la tablette présentant les images et pouvait observer les images à sa guise. L'expérimentatrice lisait les phrases avec les verbes cibles visant à induire la production du passé composé en français. Cette méthode a été adaptée à partir de celle utilisée avec des enfants francophones beaucoup plus jeunes par Royle (2007) et Royle & Thordardottir (2008) et d'enfants plus âgés par Kresh (2008) (voir aussi Berko, 1958 pour son travail séminal sur l'utilisation de la méthodologie de production induite avec des enfants anglophones). L'expérimentatrice passait à l'image suivante si l'enfant ne répondait pas (c'est-à-dire jusqu'à ce que le silence devienne inconfortable, soit après environ 20 secondes) suivant la lecture du script. Peu importe sa production, l'enfant était encouragé pour ses efforts avant de passer à l'image suivante. Un exemple du script est donné en (1).

11 (1) Image : Une fille cachant ses poupées sous une boîte

- *Marie va cacher ses poupées.*
- *Marie cache toujours ses poupées.*
- *Qu'est-ce qu'elle a fait hier Marie ?*

12 L'expérience débutait avec les quatre stimuli d'entraînement, un pour chaque groupe de verbes étudié. Pour les stimuli d'entraînement seulement, la bonne réponse était donnée à l'enfant s'il ne pouvait produire la réponse. Le script donnait des indices sur le paradigme de conjugaison en fournissant la forme du verbe au présent (ex. *cache*) et à l'infinitif, soit dans une forme avec un auxiliaire (ex. *va cacher*) ou avec un verbe demandant un complément à l'infinitif (ex. *aime cacher*).

3.2 Stimuli

13 Nous avons utilisé quatre groupes de sept verbes chacun ($N = 28$) : 7 verbes avec un participe passé en *-é* (ex. *cacher-caché*), 7 verbes avec un participe passé en *-i* (ex. *finir-fini*), 7 verbes avec un participe passé en *-u* (ex. *mordre-mordu*) et 7 verbes avec un participe passé *autre* ou non paradigmatique (ex. *ouvrir-ouvert*). Les groupes de verbes étaient équilibrés sur des mesures de fréquence (d'après les bases de données LEXIQUE et MANULEX pour les 6-7 ans), voir les Annexes 1 et 2. Les fréquences de forme et de lemme ne diffèrent pas statistiquement (tous les $p > .1$). Les groupes de verbes ont également été appariés pour le nombre de phonèmes, le nombre de syllabes, le nombre de voisins orthographiques et le nombre de voisins phonologiques (tous les $p > .1$). Avant la collecte des données, nous avons fait évaluer la plausibilité des phrases porteuses par des adultes locuteurs natifs du français ($N = 7$). Toutes les phrases ont été jugées plausibles en français à 96 % ($ET = 1.07$).

14 L'ordre de présentation des stimuli était le même pour tous les enfants. La présentation des images a préalablement été pseudo-randomisée pour qu'au maximum deux verbes d'un même groupe soient présentés de façon contiguë, afin de réduire les stratégies de production d'analogies selon le modèle des stimuli précédents. Un point était accordé pour la production du passé composé complet (le groupe sujet-auxiliaire-participe, ex. (*Marie*), *elle a caché*). Toutes les réponses ont été enregistrées et les types d'erreurs ont par la suite été compilés et analysés. De plus, une analyse d'erreurs a permis de vérifier plus à fond les stratégies utilisées par les enfants. Les types d'erreurs observés sont a) le participe produit seul (ex. *bu* pour *il a bu* : ce type d'erreur est ambigu entre l'infinitif et le participe passé pour les verbes en *-é*), b) l'infinitif produit seul (ex. *boire* pour *il a bu*), c) le verbe au présent (ex. *il boit* pour *il a bu*), et d) *autre production* (la substitution d'un autre verbe ou la production mixte du passé composé avec la forme infinitive, ex. *il a terminé* pour *il a fini* ou encore **il a ouvrir* pour *il a ouvert*).

4. Résultats

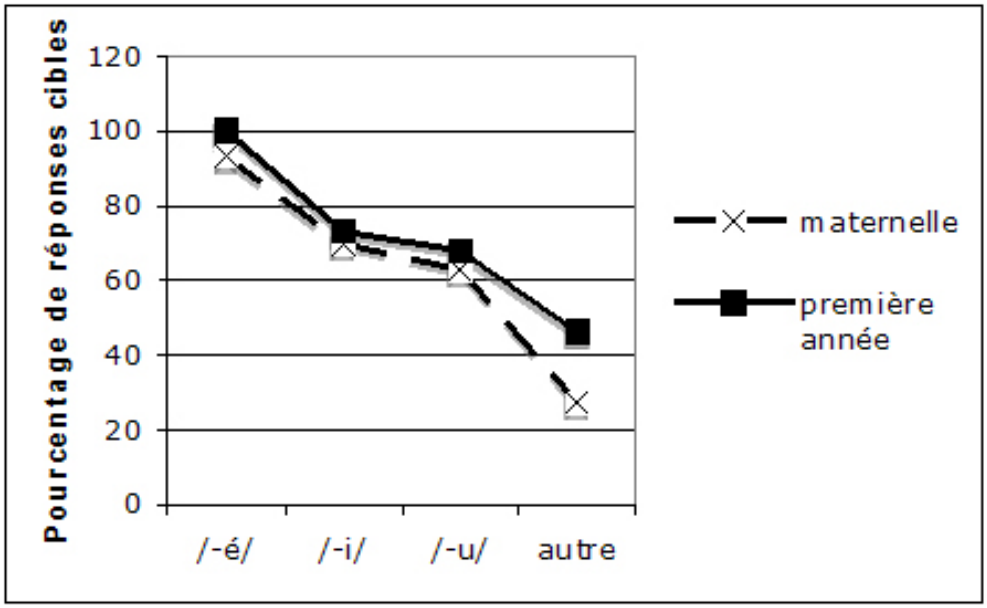
15 Dans toutes les analyses, la valeur d'alpha de 0,05 a été utilisée comme seuil de signification. Des analyses à mesures répétées (ANOVA) ont été faites sur les scores moyens de réponses cibles des enfants, avec le groupe de verbes comme facteur intrasujets (*-é, -i, -u* et *autres*) et le groupe d'âge comme facteur intersujets (maternelle et première année). Nous avons trouvé un effet principal de groupe de verbes ($F(3, 31) = 63.3$, $p < .001$), mais aucun effet principal de groupe d'âge ($F(1, 33) = 1.13$, $p = .295$), ni interaction de groupe de verbes et groupe d'âge ($F(3, 31) = 1.26$, $p = .305$), suggérant que les résultats ne diffèrent pas selon l'âge des enfants. Ces résultats sont rapportés au Tableau 1 et dans la Figure 1. Compte tenu des résultats de l'ANOVA, nous avons comparé les résultats des quatre groupes de verbes au moyen de tests *post-hoc*. Les verbes en *-é* sont significativement mieux produits que les trois autres groupes de verbes : *-é* contre *-i* $t(34) = 4.35$, $p < .001$; *-é* contre *-u* $t(34) = 5.41$, $p < .001$; *-é* contre *autres* $t(34) = 4.35$, $p < .001$. Les verbes *autres* sont significativement moins bien produits que les autres groupes de verbes : *autres* contre *-i* $t(34) = 7.76$, $p < .001$; *autres* contre *-u* $t(34) = 6.54$, $p < .001$. Finalement, les scores moyens pour les verbes des groupes *-i* et *-u* ne diffèrent pas entre eux $t(34) = 1.58$, $p = .124$.

Tab. 1. Pourcentage d'énoncés réussis et écarts-types pour chacun des groupes de verbes

	Maternelle		Première année		Tous les enfants	
	M	*ET*	*M*	*ET*	*M*	*ET*

-é	93,18	21,61	100	0	95,71	17,31
-i	69,70	38,36	73,08	31,58	70,95	35,55
-u	62,88	34,09	67,95	38,16	64,76	35,19
autre	27,27	20,28	46,15	25,60	34,29	23,89
Moyenne	63,26		71,79		66,43	

Fig. 1. Pourcentage de réponses cibles par groupe de verbes pour chaque groupe d'âge



16 Puisque différents types d'erreurs ont été relevés dans les productions des enfants, nous avons vérifié si les erreurs se retrouvaient de façon similaire à travers les quatre groupes de verbes. Nous avons regroupé ici la production de l'infinitif, la production d'un autre verbe, la production mixte du passé composé avec la forme infinitive ou la production d'une forme surgénéralisée, car ces erreurs étaient trop peu fréquentes pour les intégrer dans des cellules individuelles dans nos analyses statistiques non paramétriques.

17 Des analyses Chi-carrés à deux niveaux, avec comme facteurs le groupe de verbes (quatre niveaux) et le type d'erreurs (cible, participe passé, présent de l'indicatif et autres) sur les fréquences des stratégies de réponses non-cibles, ont révélé une relation significative entre les groupes de verbes et le type d'erreurs, $X^2(9, N = 810) = 235.13$, $p < .001$, voir le Tableau 2 pour les détails de la répartition des erreurs réelles et attendues. Nous observons une différence dans la distribution des erreurs entre le groupe des verbes en *-é* et les trois autres groupes de verbes. Pour les verbes en *-é*, les erreurs consistent presque exclusivement en la production de la forme ambiguë du participe passé ou de l'infinitif [radical+e] à 25,2 %. Pour les trois autres groupes de verbes, les erreurs se situent au niveau du groupement autres (23,6 % pour les verbes en *-i* ; 29,2 % pour les verbes en *-u* ; 58,4 % pour les verbes *autres*).

Tab. 2. Fréquence des types d'erreurs par groupes de verbes (-é, -i, -u et autres) pour tous les enfants

	Production				
Type de participe	Cible	Participe[a]	Présent	Autre	Total
-é					
Observé	148 (70,5 %)	53(25,2 %)	7 (3,3 %)	2 (1 %)	210
Attendu	126,3	18,4	8,0	57,3	
-i					
Observé	140 (67,3 %)	9 (4,3 %)	10 (4,8 %)	49 (23,6 %)	208
Attendu	125,1	18,2	8,0	56,8	
-u					

Observé	129 (63,9 %)	7 (3,5 %)	7 (3,5 %)	59 (29,2 %)	202
Attendu	121,4	17,7	7,7	55,1	
Autre					
Observé	70 (36,8 %)	2 (1,1 %)	7 (3,7 %)	111 (58,4 %)	190
Attendu	114,2	16,7	7,3	51,8	

[a] Le participe passé et l'infinitif étant homophones à l'oral pour ce groupe de verbes, nous avons groupé ces deux types d'erreurs

18 Nous avons voulu vérifier plus avant la répartition des erreurs dans les groupes de verbes n'étant pas du premier groupe, entre autres la production de l'infinitif et le participe passé. Nous avons donc comparé les groupes de verbes *-i*, *-u* et *autres* avec les types d'erreurs (cible, participe passé, infinitif, présent de l'indicatif et autre production[5]). L'analyse Chi-carré révèle encore une fois une relation significative entre les groupes de verbes et le type d'erreurs $X^2(8, N = 610) = 114.34, p < .001$, voir le Tableau 3. Cette dernière analyse indique que la production de l'infinitif constitue entre 16,5 et 19,3 % des erreurs de production pour tous les verbes (à l'exclusion du premier groupe) tandis que la production du participe seul est peu présente. Nous pouvons également voir que les enfants produisent 44 % d'autres productions pour les verbes à schème non paradigmatique. En résumé, pour toutes les analyses, nous pouvons remarquer l'absence de différence entre les verbes du groupe *-i* et les verbes du groupe *-u*. Nous remarquons également une maîtrise significativement plus élevée pour les verbes du groupe *-é*.

Tab. 3. Fréquence des types d'erreurs par groupes de verbes (-i, -u et autres) pour tous les enfants

	Production					
	Cible	Participe	Infinitif	Présent	Autre	Total
-i						
Observé	140 (67,3 %)	9 (4,3 %)	35 (16,8 %)	10 (4,8 %)	14 (6,7 %)	208
Attendu	115,6	6,1	36,5	8,2	41,6	
-u						
Observé	129 (63,9 %)	7 (3,5 %)	39 (19,3 %)	7 (3,5 %)	20 (9,9 %)	202
Attendu	112,3	6,0	35,4	7,9	40,4	
Autre						
Observé	70 (35,0 %)	2 (1,0 %)	33 (16,5 %)	7 (3,5 %)	88 (44,0 %)	200
Attendu	111,1	5,9	35,1	7,9	40	

5. Discussion

19 La maîtrise productive des processus morphologiques de la langue permet entre autres de pouvoir reconnaître des mots nouvellement rencontrés. Cette capacité est nécessaire aux enfants qui sont en train de bâtir le lexique de leur langue. La présente étude a tenté de démontrer la pertinence d'étudier les effets de fréquence des groupes et sous-groupes de régularité des verbes français. Nous avons testé la capacité des enfants à produire des verbes réguliers, sous-réguliers et irréguliers en vérifiant aussi la maîtrise de verbes qui sont généralement considérés comme irréguliers : les verbes dont le participe passé se termine en *-u* (ex. *voir-vu*). Nous avions émis comme hypothèse que les enfants plus jeunes éprouveraient plus de difficultés à produire le passé composé que les enfants plus âgés. Cette hypothèse est infirmée, les plus jeunes comme les plus vieux ont réussi à produire avec un succès similaire les formes induites. Il y a deux interprétations possibles de ce résultat. La première est que notre mesure n'est pas assez sensible pour révéler un changement des capacités linguistiques dans ces groupes d'âge (une autre étude pourrait par exemple vérifier la capacité des enfants à produire le participe passé sans égard à la syntaxe), et la seconde est qu'il n'y a pas de différences entre les enfants âgés de 6 et 7 ans dans la représentation de la morphologie verbale. Des études futures pourront répondre à ces questions. Nous avions également prévu d'obtenir un effet gradient de réussite selon la régularité et la fréquence du paradigme (*-é* > *-i* > *-u* > *autres*). Cette hypothèse est en partie confirmée puisque les verbes réguliers en *-é* ont été significativement mieux réussis que les verbes des trois autres groupes, et les

verbes irréguliers *autres* significativement moins bien réussis en général. Cependant, il était surprenant de constater qu'il n'y avait aucune différence entre les verbes en *-i* et en *-u*. Ces derniers sont traditionnellement considérés comme irréguliers et tardivement maîtrisés. Les présentes données suggèrent que ces verbes peuvent être relativement bien appris par les enfants, peut-être dû à la présence d'une sous-régularité au niveau de la flexion (voyelle finale / i/ ou /y/). Nos données diffèrent des résultats obtenus par Kresh (2008), qui n'avait pas obtenu d'effets de fréquence pour les verbes en *-u*, et a montré un effet gradient de réussite sur les différents groupes de verbes peu fréquents et de fréquence moyenne.

20 La présente étude évoque plutôt une distinction tripartite des schèmes réguliers, sous-réguliers et irréguliers des verbes fréquents en français, ce qui est différent de l'approche dichotomique de schèmes réguliers *versus* irréguliers proposée par Kresh (2008) et Nicoladis *et al.* (2007). Les verbes sous-réguliers en *-i* et en *-u* (ces derniers généralement catégorisés comme étant irréguliers) sont produits avec un succès similaire chez les enfants de 6 et 7 ans. Les enfants vus dans cette étude n'ont pas encore reçu d'enseignement explicite des règles de conjugaison des verbes. Ils nous informent donc des schèmes de conjugaison établis en majorité par exposition implicite.

21 Notre analyse révèle que non seulement les enfants réussissent à produire correctement ces verbes, mais qu'il est impossible de distinguer statistiquement les capacités des enfants à produire les sous-groupes du groupe des verbes en -i et en -u. Nous estimons que c'est l'interaction entre la fréquence d'occurrence et la fiabilité morpho-phonologique qui a permis aux enfants de maîtriser ces conjugaisons (qui sont peu représentatives en termes de types selon les données de Royle *et al.* 2012). Ces résultats devraient servir de point d'ancrage aux modèles psycholinguistiques de l'acquisition des conjugaisons des verbes français.

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Annexe

Annexe A : Propriétés des quatre types de verbes utilisés et écarts-types

Groupe de verbe	Fréquence de forme[a]	Fréquence de lemme[a]	Nombre de Phonèmes[a]	Nombre de Syllabes[b]	Voisins ortho.[a]	Voisins phono.[a]
-é	110,4 (141,40)	535,6 (572,65)	4,17 (0,41)	2 (0)	4,83 (1,72)	17,67 (8,33)
-i	74,50 (104,85)	255,95 (218,04)	3,86 (1,07)	1,71 (0,49)	5,43 (4,96)	8,86 (9,30)
-u	98,04 (109,11)	393,95 (248,92)	4,17 (1,17)	2 (0,63)	5,33 (5,28)	10,33 (7,23)
autre	61,72 (114,73)	231,52 (330,99)	3,71 (1,11)	1,71 (0,49)	4,17 (4,67)	13,5 (9,59)

[a] Tiré de LEXIQUE (New *et al.*, 2001)
[b] Structures syllabiques du français québécois
Analyses univariées par type de verbe, tous F(3, 23), p > .1

Annexe B : Fréquences écrites de lemme et de forme et écarts-types dans la littérature enfantine

Groupe de verbe	Lemme CP[a]	Lemme CE1[a]	Lemme CP-CM2[a]	Forme CP[a]	Forme CE1[a]	Forme CP-CM2[a]
-é	678,83	780,82	652,04	84,95	70,64	70,44

	(485,00)	(773,74)	(673,42)	(76,84)	(74,27)	(75,79)
-i	290,63 (208,00)	446,92 (567,95)	407,56 (478,28)	57,72 (57,48)	71,54 111,12)	63,35 (85,47)
-u	333,94 (232,32)	390,16 (394,22)	358,06 (254,40)	69,82 (108,88)	40,33 (52,52)	52,70 (60,72)
autre	157,03 (230,96)	128,97 (163,33)	156,68 (164,71)	21,22 (25,73)	17,18 (9,20)	23,22 (14,12)

[a] Tiré de MANULEX (Lété *et al.*, 2004)
CP = cours préparatoire ou maternelle (6 ans)
CE1 = cours élémentaire 1 (7 ans)
CM2 = cours moyen 2 (11 ans)
Analyses univariées par type de verbe, tous p > .1

Annexe C : Un exemple d'image utilisée durant la procédure (pour le verbe cacher)

Notes

1 Certains soutiennent par contre qu'il n'existe que deux groupes de verbes en français similairement aux modèles anglais : réguliers et irréguliers (ex. Kresh, 2008 ; Nicoladis *et al.*, 2007).

2 Sur le site Web du MELS, il est indiqué que l'enfant de 1ère et 2ème année (premier cycle) apprend, en conjugaison, à « Mémoriser, sans découverte du système de la conjugaison, les formes verbales fréquentes à l'écrit des verbes *aimer, aller*, *avoir*, *dire*, *être*, *faire* à l'indicatif présent accompagnées de leur pronom de conjugaison (ex. : *tu aimes ; je suis ; il a ; vous faites ; ils vont*) » (MELS, 2008c). Aucun de ces verbes ne fait partie de nos stimuli.

3 Dans le système d'éducation québécois, le niveau primaire compte six années de scolarité (l'âge d'admission en première année est fixé à six ans, MELS, 2008a) et la maternelle est une année facultative (l'âge d'admission en maternelle est de cinq ans, MELS, 2008b). La maternelle permet à l'enfant de socialiser : on utilise le jeu comme principale méthode d'enseignement.

4 Dans son utilisation, la tablette interactive présente plusieurs avantages : notamment elle est légère, portable, visuelle et interactive. De plus, les enfants sont friands des nouvelles technologies, ce qui assure un plus grand intérêt durant la tâche.

5 Regroupant la production d'un autre verbe, la production mixte du passé composé avec la forme infinitive ou la production d'une forme surgénéralisée.

Pour citer cet article

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Résumés

Nous avons évalué 35 enfants français québécois sur la conjugaison de verbes français réguliers, sous-réguliers et irréguliers au passé composé (en *-é*, *-i*, *-u* ou *autres*). Une tâche de production induite a été administrée à des enfants fréquentant la maternelle ou la première année d'école. Les verbes ont été présentés, avec des images les représentant, dans des contextes à l'infinitif (ex. *Marie va cacher ses poupées*) et au présent (ex. *Marie cache toujours ses poupées*), afin d'amorcer leur paradigme de conjugaison. Les enfants devaient produire la forme cible du verbe au passé composé en répondant à la question 'Qu'est-ce qu'il/elle a fait hier ?'. Les résultats n'indiquent aucun changement dans le type et le nombre d'erreurs commises avec l'âge. Les réponses des enfants démontrent un effet de la fréquence, mais aussi de la productivité et de la prévisibilité, des différents schèmes morphologiques sur la maîtrise de la conjugaison. Les données ont des conséquences sur les modèles psycholinguistiques du traitement et de l'acquisition de la morphologie régulière et irrégulière.

We evaluated 35 Québec French children on their ability to produce regular, sub-regular, and irregular passé composé verb forms (ending in *-é*, *-i*, *-u* or *other*). An elicitation task was administered to children attending preschool or first grade. Target verbs were presented, along with images representing them, in infinitive (e.g., *Marie va cacher ses poupées* 'Mary aux.pres. hide-inf. her dolls'= 'Mary will hide her dolls') and present tense (ex. *Marie cache toujours ses poupées* 'Mary hide-3s. always her dolls'= 'Mary always hides her dolls') contexts, in order to prime the appropriate inflectional ending. Children were asked to produce target verb forms in the *passé composé* (perfect past) by answering the question 'What did he/she do yesterday?'. Results show no reduction of erroneous productions or error types with age. Response patterns highlight morphological pattern frequency effects, in addition to productivity and reliability effects, on children's mastery of French conjugation. These data have consequences for psycholinguistic models of regular and irregular morphology processing and acquisition.

Entrées d'index

Mots-clés : verbes, groupe de conjugaison, production induite, français, tablette Android
Keywords : verbs, conjugation group, elicitation, French, Android tablet

ANNEXE D: COMPARING ORAL AND WRITTEN MORPHOSYNTAX IN MONOLINGUAL AND MULTILINGUAL CHILDREN : A LONGITUDINAL STUDY

Comparing Oral and Written Morphosyntax in Monolingual and Multilingual Children: A Longitudinal Study

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Abstract

We present a study evaluating data from French oral morphosyntax (past tense production) at year one (first grade) and written morphosyntax (multiple choice task) at year two. We compared multilingual children (MUL) learning French as a second or third language and French-speaking monolingual children (ML). Data from the oral and the written tasks were correlated to measure whether oral abilities in first grade can be predictive of those mastered by in the writing system by second grade.

Materials and methods

Participants:

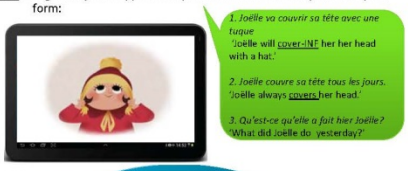
- 71 children 6.2 to 9.1 years old (*M* = 7.4, *SD* = 0.79)
  - 1st grade: 6.2 to 7.3 years old (*M* = 6.7, *SD* = 0.29)
  - 2nd grade: 7.6 to 9.1 years old (*M* = 8.1, *SD* = 0.32)
- **38 French-speaking children (ML)** (6.2 to 9.1 years old, *M* = 7.5, *SD* = 0.8)
- **33 Multilingual children (MUL)** (6.2 to 9.0 years old, *M* = 7.4, *SD* = .77)

Tasks:

Oral: Production of the past tense in 1st grade (2012)

Materials: 10 frequent verbs
3 with *-i* past participle (e.g. *ri* 'laughed')
4 with *-u* past participle (e.g. *perdu* 'lost')
3 *other* past participle forms (e.g. *ouvert* 'opened')

Script: Using a storybook app. The experimenter elicited the *passé composé* form:



1. *Joëlle va couvrir sa tête avec une fugue*
'Joëlle will cover-INF her her head with a hat.'

2. *Joëlle couvre sa tête tous les jours.*
'Joëlle always covers her head.'

3. *Qu'est-ce qu'elle a fait hier Joëlle?*
'What did Joelle do yesterday?'

Target: *Elle **a couvert** sa tête.*
'She AUX cover-pp her head.'
passé composé

Written: Multiple choice task in 2nd grade (2013)

Materials: 10 sentences with 3 items, mostly homophones, bearing grammatical morphology

Example: a has
*Paul *as [a] une amie* 'Paul *have a friend'
**à* *at

Hypotheses

Based on previous research, we expected:

1. A significant difference between ML and MUL children for the oral task (David & Wei, 2008);
2. No differences between ML and MUL children for the written task (De Temple, Wu, & Snow, 1991) and;
3. To observe positive correlations between the results on the two tasks (Bourassa, Treiman, & Kessler, 2006).

Results

In the oral task, ML children produced verbs more accurately than MUL children,
ML (83,9%) > MUL (65,5%) $F(1,70) = 10.2$, $p = .01$.
For the written task, no significant difference was found between groups
ML (86.4%) = MUL (86.1%) $F(1,70) = 0.02$, p = n.s.
A significant correlation between the oral and written tasks was observed.
($r = 0.24$, $p = .05$).

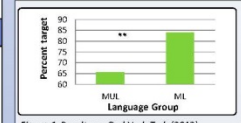


Figure 1: Results on Oral Verb Task (2012)

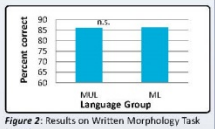


Figure 2: Results on Written Morphology Task (2013)

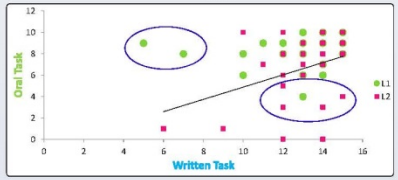


Figure 3: Correlation Between Oral and Written Task

Discussion

Results in the oral task suggest that French-speaking monolingual children benefit from their exposure to French since birth. In the case of written language, **both groups benefit similarly from equal amounts of exposure to explicit teaching**, as De Temple et al (1991) observed in their study on English. This confronts received wisdom that bilingualism delays learning complex aspects of language such as morphosyntax and writing skills.

However, it is difficult to determine whether the MUL children's results and apparent improvement are a corollary of the fact that the tasks were different each year.

Nonetheless, the correlation observed between the two tasks mirrors positive correlations that are frequently found between phonological awareness and writing abilities. **The link between oral and written morphosyntactic abilities found in the present study is innovative** (but see Levin, Ravid,& Rapaport, 2001, for Hebrew).

This study helps us better understand children's acquisition of French as a second language and highlights the importance of evaluating both oral and written skills with tests that are standardized for multilingual children in addition to monolingual ones.

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