

# PHONOLOGICAL IMPAIRMENT IN FRENCH-SPEAKING CHILDREN WITH SLI

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# Potential origins of SLI behaviour

- ⦿ grammatical deficit
- ⦿ memory deficit
- ⦿ limitation of working capacity
- ⦿ phonology – acoustics

# Evidence for phonological deficit

- ① phonological delay when children are compared with age-matched control children (Stoel-Gammon, 1989; Paul & Jennings, 1992 ; Rescorla & Ratner, 1996)
- ① productions are quantitatively different but qualitatively similar
- ① productions are similar to young children's productions

Strongest evidence for phonological deficit comes from comparison with MLU-matched children

- if there are phonological deficits for the same language level, then phonology is a special difficulty for children with SLI

# Previous results

- ⊙ SLI < MLU even taking into account their language delay
- ⊙ this was found for different languages (different phonology, different syntax)
  - the details of the results obtained vary from one language to another
- Bortolini & Leonard (2000)
  - English, Italian
- Owen, Dromi, Leonard (2001)
  - Hebrew
- Aguilar–Medivilla , Sanz-Torrent & Serra-Raventos (2002)
  - Spanish / Catalan

# Goals of the study

- Confirm that children with SLI show specific difficulties in phonology when compared with children with the same language level and confirm that this is a cross-language finding
- Inquire whether there are specific phonological deficit/difficulties in French-speaking children with SLI
- Confirm whether there is or not a developmental trend in the deficit (are errors qualitatively different and more common in older children?)

# Participants

Type	Nb. of participants	Age	MLU	Phonetic inventory
SLI	8	8;6 (1;1)	3.7 (1.5)	23.1 (2.75)
SLI	8	3;11 (0;7)	2.4 (0.3)	17.9 (4.49)
Controls	8	4;0 (0)	3.7 (1.0)	22.5 (3.62)
Controls	8	2;3 (0)	2.7 (0.8)	19.5 (3.50)

- Matched by MLU (language match)
- Age of control children corresponds to mean MLU age of children with SLI

# Task

- ◎ Spontaneous language
  - free play situation for the younger children
  - conversation with adult partner for the older children
- ◎ Children can avoid forms that are difficult for them, so that results tend to be more difficult to obtain, but are also more reliable

# Phonetic transcription

- CHAT format
- At least two persons checked all transcriptions
- Transcriptions were corrected until 100% agreement was reached
- Total utterances: 4158
- Total words: 13312

# Procedure

- ④ Utterance level
- ④ Word level
- ④ Syllable level
- ④ Phoneme level

# Example of transcription

\*CHI: sait pas nager (cannot swim)

%pho: se pa laʒe (child phonology)

%mod: se pa naʒe (adult phonological target)

Phonological errors

# Automatic extension of coding schema

- ⦿ \*CHI:cuisine (..) deux salons . . [% kitchen (.) two saloons]

- ⦿ %pho: kwizEn (..) ty zalô~

- ⦿ %mod: kwizin (..) d2 salô~

- ⦿ %syl: kwizin kwi.zin kwizen kwi.zen

- ⦿ %syl: d2 d2 ty ty

- ⦿ %syl: salô sa.lô zalô za.lô

- ⦿ \*CHI:après la récré de dix heures +... . [% after the ten o'clock break]

- ⦿ %pho: apE a ateeRe t@ ti z9R

- ⦿ %mod: apRE la RekRe d@ di z9R

- ⦿ %syl: apRe a.pRe ape a.pe

- ⦿ %syl: la la a a

- ⦿ %syl: RekRe Re.kRe ateeRe a.te.e.Re

- ⦿ %syl: d2 d2 t2 t2

- ⦿ %syl: di di ti ti

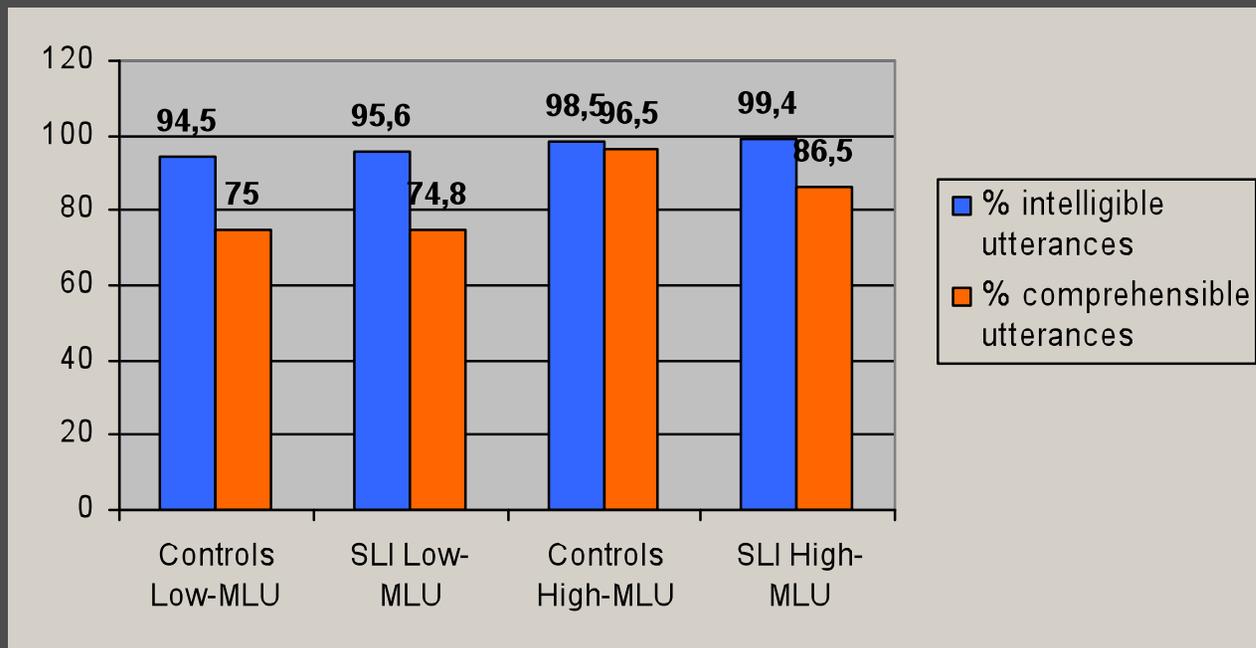
- ⦿ %syl: z2R z2R z2R z2R

- \*CHI: la télé sur l' armoire hein@i . [% the tv on the sideboard]
- %pho: la tele syR | aRmwAR e~
- %mod: la tele syR | aRmwAR e~
- %syl: la la la la
- %syl: tele te.le tele te.le
- %syl: syR syR syR syR
- %syl: | | | |
- %syl: aRmwAR aR.mwAR aRmwAR aR.mwAR
- %syl: ê ê ê ê

- \*CHI: et la radio (.) sur l' armoire . [% and the radio on the sideboard]
- %pho: e la RadjO (.) syR | aR::mwAR
- %mod: e la RadjO (.) syR | aR::mwaR
- %syl: e e e e
- %syl: la la la la
- %syl: Radjo Ra.djo Radjo Ra.djo
- %syl: syR syR syR syR
- %syl: | | | |
- %syl: aRmwaR aR.mwaR aRmwAR aR.mwAR

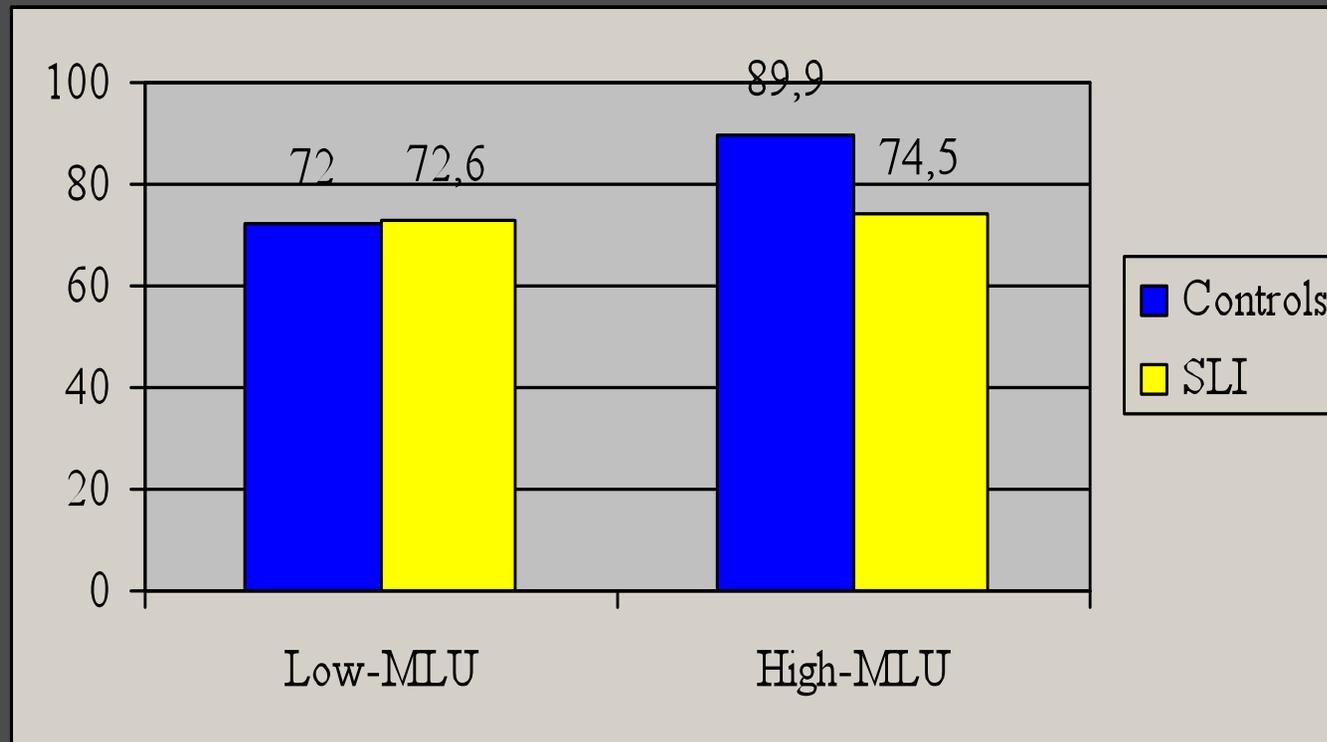
- \*CHI: et la poubelle (.) de table (.) sur l' armoire .  
[% and the trash can (.) of table (.) on the sideboard]
- %pho: e a pubEl (.) d@ tAp (.) syR l amwA
- %mod: e la pubEl (.) d@ tabl (.) syR l aRmwaR
- %syl: e e e e
- %syl: la la a a
- %syl: pubel pu.bel pubel pu.bel
- %syl: d2 d2 d2 d2
- %syl: tabl tabl tAp tAp
- %syl: syR syR syR syR
- %syl: l l l l
- %syl: aRmwaR aR.mwaR amwA a.mwA

# Utterance level



Age effect onky for both measures ( $p < .001$ )

# Word level (correct adult target)



Age effect ( $p = .002$ ), type effect ( $p = .02$ ),  
and interaction age x type ( $p = .009$ )

# Syllable inventory



Type	MLU	CV	V	VC	CCV	CVC	others
SLI	Haut	46 (10)	24 (4)	4 (2)	3 (2)	8 (3)	14 (5)
SLI	Bas	57 (7)	25 (6)	2 (2)	1 (0)	5 (4)	10 (3)
Controls	Haut	52 (3)	16 (3)	3 (1)	2 (1)	11 (2)	15 (2)
Controls	Bas	57 (6)	22 (5)	3 (2)	1 (1)	8 (4)	9 (3)



Green arrows: age effect – Blue arrows: type effect

# % correct syllables



		CV	V	VC	CCV	CVC	others
SLI	High	95,4	98,1	65,7	71,2	74,9	76,8
SLI	Low	91,3	98,8	71,2	50	50,4	61,5
Controls	High	98,4	100	96,1	68,3	94,3	92
Controls	Low	94,1	97,2	65,4	82,4	64,6	57,6



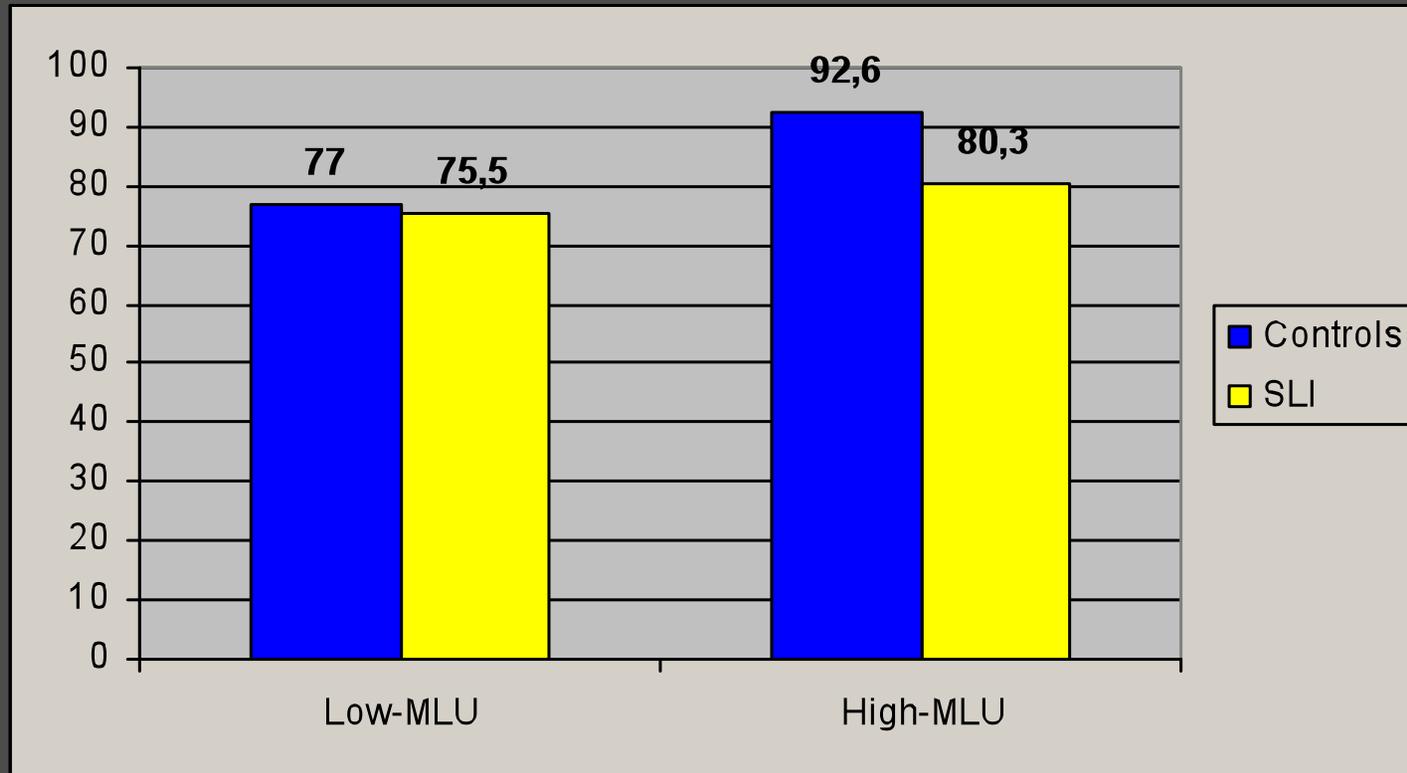
Green arrows: age effect – Blue arrows: type effect

Red circle: interaction age x type

# Percentage of consonant correct

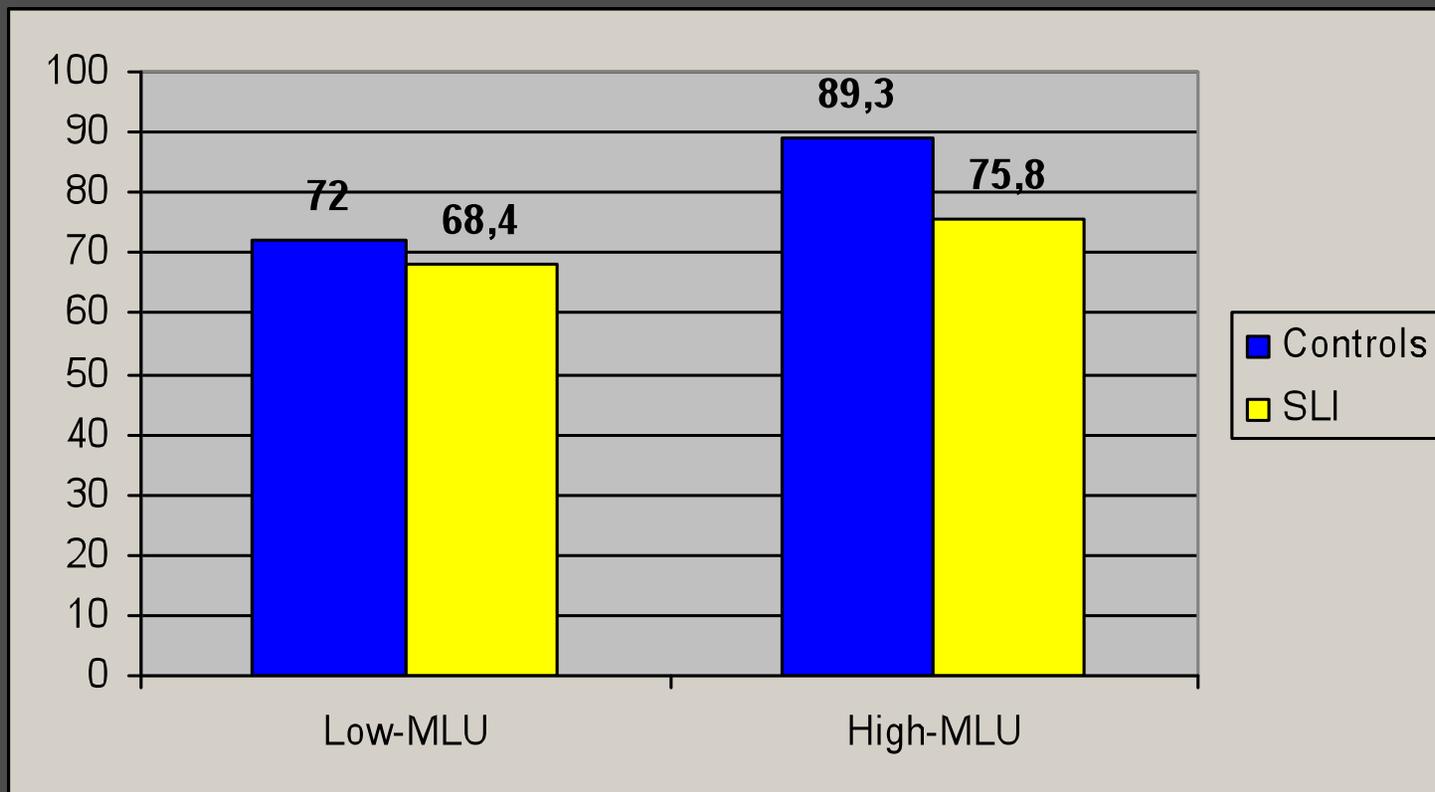
- ⦿ *Automatically computed (starting from syllable structure)*
- ⦿ PPC = number of correct **consonants** / (number of correct target **consonants** + number of omitted **consonants** + number of added **consonants**)

# Percentage phonemes correct (PPC)



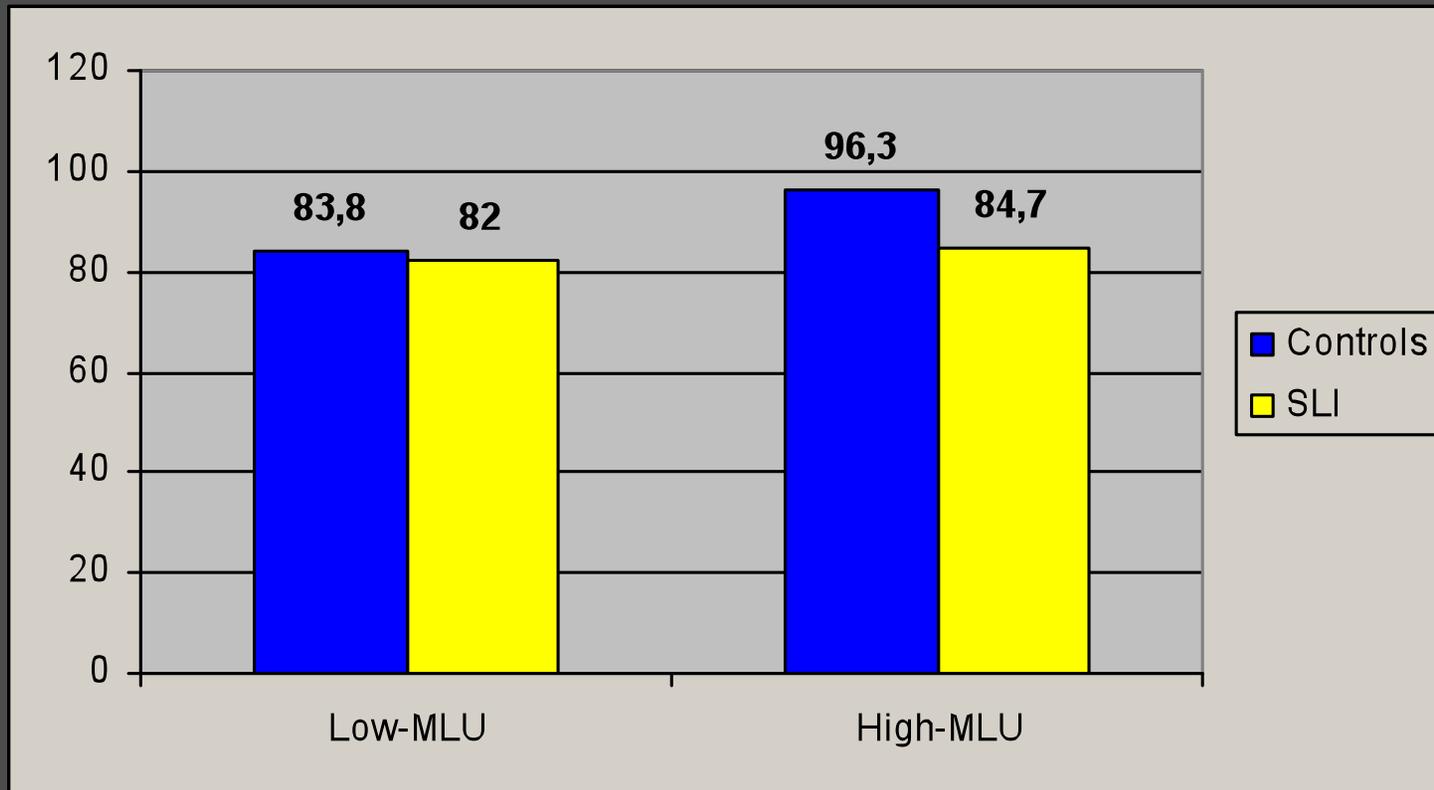
Age effect ( $p = .0001$ ), type effect ( $p < .004$ )  
interaction age x type ( $p = .02$ )

# Percentage consonants correct (PCC)



Age effect ( $p = .0008$ ), type effect ( $p = .02$ ),  
no interaction age x type

# Percentage vowels correct (PVC)



Age effect ( $p < .0001$ ), type effect ( $p < .0001$ ),  
interaction age x type ( $p = .002$ )

# Discussion

- ◉ Utterances → age effect only
- ◉ Words → all effects
- ◉ Syllables → mostly age effect
- ◉ Phonemes → all effects

- ◎ Special difficulties in phonology for children with SLI
- ◎ Results for words were confirmed by measures on phonemes (and on syllables to a smaller extent)
- ◎ Specific result for French children
  - deficit on syllable structure was not important
  - deficit for vowels as well as deficit for consonants

# Developmental effect?

- ◉ There was no difference between the two groups of younger children
- ◉ There was an important difference between the two groups of older children
  - *Note: this was not a developmental study*

- Children with SLI seem to develop phonological competence slower than control children
- They appear as if they are stuck at a low level of phonological competence
- A consequence is that children with SLI may have more problems when it becomes necessary to segment words into syntactic components

# Follow up on the previous study

- To understand the nature of the children's problems and to test phonologically-based theories → it is necessary to test the interplay between phonology and syntax
- not only verbs (most theories – esp. grammatical – are tailored to the difficulties of children with SLI with the verbs)
- → evaluate phonology and syntax for all word categories

# Complexity as a factor

- Does complexity (phonology and syntax) account for children difficulties?
- Organisation of the current student
  - Evaluate (theoretical) complexity for all syntactic categories
  - Measure performances for all categories
  - Compare theoretical complexity and children's performances
  - Check whether results in phonology are correlated with results in syntax

# Phonological complexity

- Data was computed for this study using the database 'Lexique' and work about syllable complexity
- 'Lexique' database was limited to words attested in child directed speech
- Complexity was automatically computed for each word and average complexity was computed for each syntactic category (using Paradis & Beland (2002) work about syllabic complexity)
- 1.21 determiners, 1.21 subject pronouns, 1.92 strong pronouns, 1.99 prepositions, 2.21 auxiliaries, 2.57 adverbs, 2.61 nouns, 2.66 unmarked verbs, 3.03 marked verbs

Four types of syntactic categories for phonological complexity

# Syntactic complexity

	Feature	Number of features	Value
Adverb	None	0	10
Auxiliary verb	Tense, number(1/2), person	2.5	2
Determiner	Gender, number	2	4
Noun	None (number and gender for some nouns)	0.5	8
Preposition	None	0	10
Strong pronoun	Gender, person	2	4
Subject pronoun	Gender, person	2	4
Unmarked verb	Tense (non-pronounced), number (1/2)	1.5	6
Marked verb	Tense (pronounced), number(1/2)	1.5	6

# Complexity for phonology and syntax

	phono cpx	syntactic cpx
adverb	5	10
determiner	10	4
noun	5	8
preposition	7.5	10
strong pronoun	7.5	4
subject pronoun	10	4
marked verb	5	6
auxiliary	7.5	2
unmarked verb	2.5	6

unmarked verb = present tense (1s, 2s, 3s, 3p) + imperative 2s

marked verb = mostly inf. and pp. (+ all other forms)

# Methodology

## ◎ Participants

- 24 French-speaking children
  - 12 children with SLI (mean age: 7;7 ans, MLU: 3.82)
  - 12 control children (mean age: 4;0, MLU: 3.70)

- Task

- spontaneous language production (semi-directed questions and answers)
- phonological transcription (CHAT)
- morphosyntactic tagging (CLAN, MOR & POST)
  - 3052 utterances (1474 SLI ; 1578 Ctrl)
  - 11702 words (5606 SLI ; 6096 Ctrl)

# Example of transcription

\*CHI: sait pas nager (cannot swim)

%pho: se pa laʒe (child phonology)

%mod: se pa naʒe (adult phonological target)

%mds: il se pa naʒe (adult target with syntactic correction)

Phonological errors

Syntactic errors

# Morphosyntactic line was added automatically

- \*CHI: wah@i (.) un (.) grand (.) arbre avec (..) les trucs      comme+ça .
- %mor:            co|wah@i det|un adj|grand n|arbre prep|avec det|les    n|truc adv|  
comme+ça .
- %pho:            wa: (.) 9~ (.) gRa~ (.) da aEk (..) IE Ry gOmza
- %mod:            wa: (.) 9~ (.) gRa~ (.) aRbR avEk (..) IE tRyk komsa
- %mds:            wa: (.) 9~ (.) gRa~ (.) aRbR avEk (..) dE tRyk komsa

## *Target syntactic line was added manually*

- \*CHI: joue des jeux +...
  - %mor:            v|jouer det|des n|jeu +...
  - %pho:            Zu tE Z2j
  - %mod:            Zu dE Z2
  - %mds:            (pro:subj|o~) Zu (prep|a) dE Z2
- 
- \*CHI: elle travaille (.) mais <mon pa(pa)> [//] mon papa il      travaille de la nuit (..) parce+que +...
  - %mor:            pro:subj|elle v|travailler conj|mais det:poss|mon n|papa  
pro:subj|il v|travailler prep|de det|la n|nuit conj|parce+que +...
  - %pho:            E tafa (.) mE <mo~ pa>[//] mo~ papa i tava d@ la myi (..) pat@
  - %mod:            EI tRavaj (.) mE <mo~ pa>[//] mo~ papa il tRavaj d@ la nyi (..) paRsk
  - %mds:            EI tRavaj (.) mE <mo~ pa>[//] mo~ papa il tRavaj {d@} la nyi (..) paRsk

# Phon version

The screenshot displays the Phon software interface with the following components:

- Record List:** A table listing records for speaker 'Andy'. Record 34 is selected.
- Tier Management:** A table showing various tiers for the selected record.
- Record Data:** A panel showing the orthography and IPA for the selected record.
- Syllabification & Alignment:** A panel comparing target and actual syllables.

#	Speaker	Ortho...
1	INV	[Andy l]
2	INV	[done]...
3	Andy	[oui.]
8	Andy	[une] ...
10	Andy	[est] [...
12	Andy	[mon]...
13	Andy	[ma] [...
14	Andy	[Célin...
16	Andy	[Célin...
18	Andy	[ouais.]
20	Andy	[plus] ...
23	Andy	[euhm...
24	Andy	[quato...
27	Andy	[ouais.]
29	Andy	[euhm...
30	Andy	[com...
33	Andy	[euh (t...
34	Andy	[cuisin...
37	Andy	[ouais.]
39	Andy	[trois]...
41	Andy	[{ kkk ...
43	Andy	[un] [...
44	Andy	[trois]...
46	Andy	[kkk.]
48	Andy	[euhm...
49	Andy	[ah] [...
50	Andy	[ah] [...
51	Andy	[armo...

Show Tier	Tier Name	Grouped	Tier Font
<input checked="" type="checkbox"/>	Orthography	Yes	Arial Unicode ...
<input checked="" type="checkbox"/>	IPA Target	Yes	Arial Unicode ...
<input checked="" type="checkbox"/>	IPA Actual	Yes	Arial Unicode ...
<input checked="" type="checkbox"/>	Notes	No	Arial Unicode ...
<input checked="" type="checkbox"/>	Segment	No	Arial Unicode ...
<input checked="" type="checkbox"/>	mds	No	Arial Unicode ...
<input checked="" type="checkbox"/>	time stamp	No	Arial Unicode ...

Speaker	Andy
Orthography	[cuisine (..) [deux] [salons.]
IPA Target	[kwizin] [dø] [salʃ]
IPA Actual	[kwizen] [ty] [zalʃ]
Notes	
Segment	001:06.309 to 001:09.937
mds	(det yn) kwizin dø salʃ
time stamp	

**Syllabification & Alignment**

Target Syllables: k w i z i n d ø s a l ʃ

Actual Syllables: k w i z e n t y z a l ʃ

Alignment:

# Results – Phonological errors

	adv	det	noun	prep	pro	p. subj	verb non.	aux	verb mark
<b>Sli</b>	67%	89%	62%	81%	69%	73%	56%	92%	48%
<b>Ctr</b>	92%	96%	84%	94%	95%	91%	88%	98%	69%
<b>p.=</b>	.0003	.018	.0001	.024	.002	.004	.0001	.15 (NS)	.025
<b>Theory</b>	5	10	5	7.5	7.5	10	5	7.5	2.5

- Large difference between the groups
- At the same MLU level, phonology is weak for children with SLI (confirmed previous results)

# Results – Syntactic errors

	adv	det	nom	prep	pro	p. subj	verb non.	aux	verb mark
<b>Sli</b>	99%	88%	99%	84%	97%	73%	96%	95%	93%
<b>Ctr</b>	99%	95%	100%	94%	96%	81%	97%	99%	95%
<b>p.=</b>	.92 NS	.005	.095 NS	.0012	.94 NS	.27 NS	.46 NS	.18 NS	.20 NS
<b>Theory</b>	10	4	8	10	4	4	6	2	6

- Not much difference between the groups
- With the same MLU, significant differences were found for determiners and prepositions

## Correlations between theoretical complexity and children's results

	phono cpx	syntax cpx
SLI phono	<b>0,79*</b>	<b>-0,34</b>
CTR phono	<b>0,76*</b>	<b>-0,22</b>
SLI syntax	<b>-0,56</b>	<b>0,18</b>
CTR syntax	<b>-0,63</b>	<b>0,25</b>

# Discussion

- ⦿ Negative correlations
  - do syntax and phonology behave differently?
- ⦿ Positive correlations
  - strong link between phonological complexity and phonological errors
- ⦿ Not enough grammatical errors to obtain significant correlation measures?
- ⦿ Task too not sensitive enough to grammatical difficulties?

# Missing elements

- ◎ Some results are not explained by pure phonological theory
  - determiner worse than subject pronouns and verbs worse than nouns (for phonology and syntax) but they have similar phonological complexity
  - errors with prepositions
  - results for adverbs and auxiliaries better than expected
  - results for strong pronouns for SLI worse than expected
- ◎ All syntactic errors do not reflect phonological complexity
  - even if phonological complexity is even better tailored to the specificities of children's productions

# Future developments

- ◎ Phonological complexity appears to be a cornerstone for all (phonological) theories about specific language impairment
  - only phonological complexity predicts correctly the children's errors
  
- ◎ But...

## ... to be improved

- ◎ If complexity works for phonology, why couldn't it be the case for syntax
  - maybe because we have a bad definition of syntactic complexity or of syntax (proposal: base on children's specific productions, not on adult language)
- ◎ Semantic/syntactic seems interesting
  - because it could explain some results with prepositions, nouns/verbs, but needs to be better defined

# Repetition study – different task

## Correct

- *Mathieu et toi, vous allez jouer sur le toboggan* (Matthew and you, you are going to play on the slide).
- 13 (0.82)
- 
- *La confiture de fraise, je la mange sur du pain* (The strawberry jam, I'm eating it on a slice of bread).
- 12 (0.67)

## Including one grammatical error (by substituting one word for another)

- *Marie et moi, vous allons jouer à la balançoire* (number error: Mary and me, you are going to play on a swing)
- 13 (1.15)
- *Le miel du jardin, je la mange sur du pain* (gender error: the honey from the garden, I'm eating her on a slice of bread).
- 12 (1.05)

# Seven grammatical categories

- ⦿ Subject pronoun
- ⦿ Object pronoun
- ⦿ Auxiliary
- ⦿ Determiner
- ⦿ Preposition
- ⦿ Noun
- ⦿ Verb

70 correct utterances, 70 erroneous utterances

Children matched by comprehension level (ECOSSE)

# Comparison between children with SLI and language level controls

- Analysis bears on the correct, incorrect, or absent repetition of the target word in the utterances after the child's repetition

## Examples of incorrect repetition of target

- Target: mes cousines préférées, **elles** apporteront des cadeaux.
- Child: mes cousines préférées, **ils** apportent des cadeaux.
  
- Target: quand j'étais petit, je ne **saurai** pas lacer mes chaussures.
- Child: quand j'étais petit, je ne **sais** pas xx lacer mes chaussures.

		Grammatical target			Ungrammatical target		
Syntactic category	Subjects	No analysis	Target changed	Target reproduced	No analysis	Error corrected	Error reproduced
Subject pronoun	SLI	3.1	3.1	3.8	2.6	6.2	1.1
	Control	1.1	2.5	6.4	1.3	5.3	3.4
Object Pronoun	SLI	2.5	3.2	4.4	4.2	3.9	1.9
	Control	1.1	0.5	8.5	1.0	2.4	6.5
Auxiliary	SLI	4.4	0.9	4.6	2.8	4.8	2.4
	Control	0.8	0.1	9.1	1.5	4.6	3.9
Determiner	SLI	2.2	1.3	6.5	2.8	4.9	2.3
	Control	1.2	0.4	8.4	1.9	3.1	5.0
Preposition	SLI	2.1	2.1	5.8	2.4	5.4	2.2
	Control	0.9	0.8	8.2	1.6	1.9	6.4
Noun	SLI	1.4	0.6	8.1	2.9	2.1	4.9
	Control	0.9	0.0	9.1	2.1	1.0	6.9
Verb	SLI	3.9	2.5	3.6	1.9	5.0	3.1
	Control	1.3	0.6	8.1	1.6	2.2	6.2

# Spontaneous vs non spontaneous production

- ⦿ Is non-spontaneous production just ‘more difficult’?
- ⦿ With spontaneous production children are able to produce memorized (and non decomposed) forms
- ⦿ With non-spontaneous, they have to be creative and to decompose/recompose memorized material
  - This could be where children with SLI have the most severe difficulties

Goal: Using PHON to analyse the cases of incorrect repetition – compare with other material

\*REC: ce garçon n'est pas une menteuse il dit la vérité.

\*CHI: ce garçon il est pas une menteuse il dit la vérité.

%com: Nom féminin erreur

%cod: . . 3 5

\*REC: les camions orange mon frère les prend pour aller jouer.

\*CHI: les camions orange i prend pour aller jouer.

%com: Proobj anaphore immédiate correct

%cod: . 4 . 4

# Phon version

chatxml-xml : coccinelles.KevinA#13 \*

File Edit Record View Media Tools Window Help

Record List

Kevin

#	Spea...	Orth...
3	Kevin	[a] [l...
5	Kevin	[ma...
7	Kevin	[en] ...
9	Kevin	[les] ...
11	Kevin	[qua...
13	Kevin	[les] ...
15	Kevin	[mes...
19	Kevin	[ma]...
21	Kevin	[le] [...
23	Kevin	[les] ...
25	Kevin	[la] [...
27	Kevin	[dem...
29	Kevin	[ma...
31	Kevin	[ma...
33	Kevin	[ma...
35	Kevin	[il] [...
37	Kevin	[il] [...
39	Kevin	[ma]...
41	Kevin	[il] [...
43	Kevin	[ma...
45	Kevin	[ma...
47	Kevin	[hier...
49	Kevin	[le] [...
51	Kevin	[pap...
53	Kevin	[qua...
55	Kevin	[ton]...
57	Kevin	[a] [l...
59	Kevin	[cell...

Tier Management

Show Tier	Tier Name	Grouped	Tier Font
<input checked="" type="checkbox"/>	Orthography	Yes	Arial Unicod...
<input checked="" type="checkbox"/>	IPA Target	Yes	Arial Unicod...
<input checked="" type="checkbox"/>	IPA Actual	Yes	Arial Unicod...
<input checked="" type="checkbox"/>	Notes	No	Arial Unicod...
<input checked="" type="checkbox"/>	Segment	No	Arial Unicod...
<input checked="" type="checkbox"/>	coding	No	Arial Unicod...

Syllabification & Alignment

Target Syllables: l e d ø v o l œ ʁ ä t ʁ e p a ʁ l

Actual Syllables: l e d ø v o l œ ʁ ä k ʁ e p a ʁ l

Alignment: l e d ø v o l œ ʁ ä t ʁ e p a ʁ l

l e d ø v o l œ ʁ ä k ʁ e p a ʁ l

Session Information Tier Management

Record Data

Record: 13 of 73

Speaker: Kevin

Orthography: [les] [deux] [voleurs] [entrés]  
[par] [la] [fenêtre] [de]  
[devant .]

IPA Target: [le] [dø] [volœʁ] [õtʁe] [paʁ]  
[la] [fanstʁ] [də] [dävã]

IPA Actual: [le] [dø] [volœʁ] [õkʁe] [paʁ]  
[la] [fanstʁ] [dada] [dävo]

Notes: Aux etre correct

Segment: 000:58.721 to 001:03.868

coding: . 1 . 4