Liaison acquisition and word-formation in French: a specific influence of phonotactics?

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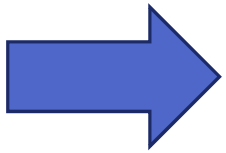
Task for the child : segmenting the speech input into linguistic units matching forms and functions

This task extends beyond the age of 2

Children early memorize sequences which correspond to multiple words in adults

Bannard & Matthews, 2012; Peters, 1985; Tomasello, 2003

Finding word in continuous speech is challenging when word edges are variable due to phonological processes.



Segmentation errors resulting from liaison are frequent until the age of 4.

Dugua, 2006; Chevrot et al., 2007; 2011

Summary

1 – Functioning of French liaison and the consequences for the segmentation of new words in the child.

2 – The cues guiding the segmentation of words in very young children

3 – The usage-based model of liaison acquisition

4 - Two sets of data addressing the role of phonotactics

- A corpus of child-directed speech
- An experiment involving the segmentation of pseudowords in liaison context.

Liaison in French: functioning and consequences for word segmentation

1/ Liaison consonant is produced in a two-word sequence

ex: /t/ in *petit écureuil* [pti**t**ekyRoej] 'small squirrel'

- Word1: /pti/

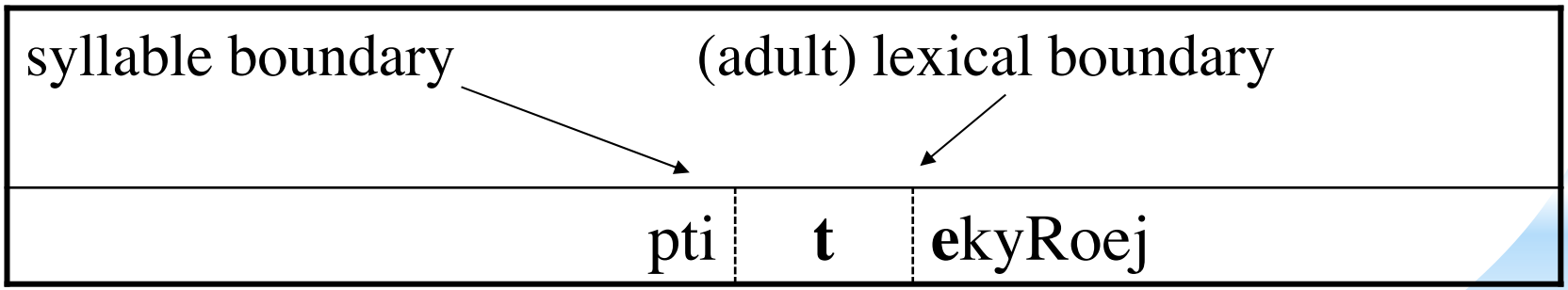
- Word2 (initial vowel in isolation): /ekuRoej/

- Liaison Consonant: / t /

2/ Laison consonant forms a syllable with the following vowell

ex: /pti.**te**.ky.Roej/ - *petit écureuil*

The syllable boundary no longer corresponds to the lexical boundary



3/ Production and phonetic content of the liaison consonant depend on Word1

Word1s *joli*, *vrai*... => **no liaison**

[ʒɔliekyRoej] ‘pretty squirrel’

Word1s *un*, *aucun*… => **/n/ liaison**

[œ̃**n**ekyRoej] ‘a/one squirrel’

Word1s *deux*, *les*, *gros*… => **/z/ liaison**

[dø**z**ekyRoej] ‘two squirrels’

In brief

1/ The liaison consonant forms a CV sequence with the initial vowel of the word2

2/ Its phonetic content varies as a function of the word1

3/ The lexical boundary is located between the C and the V in adult.

Liaison drives the mechanisms responsible for word segmentation and word formation in opposite directions

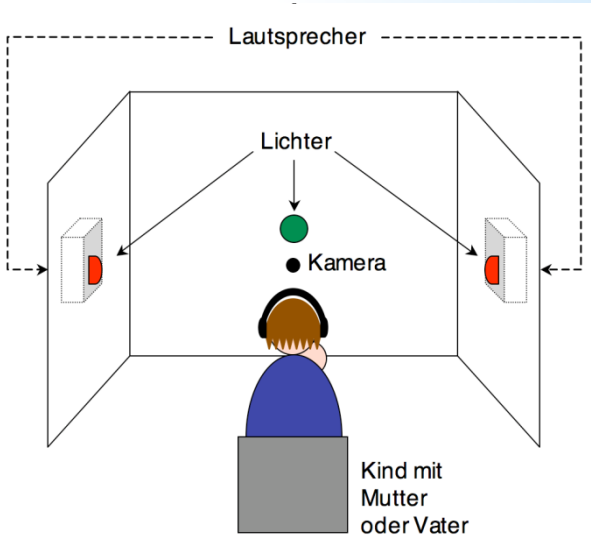
word1 ← phonetic content of the liaison

syllabic linkage →

word2

Cues to word segmentation in the child

Most of the studies are based on the Head Turn Preference method



http://ling.uni-konstanz.de/pages/home/grijzenhout/bsl/index.php?cont=method

Phonological cues
Lexical cues

Phonological cues to word segmentation in the child (1)

Cues	Strategy for segmentation	Languages	Age
Syllabic cues Goyet et al., 2013	One CV(C)) syllable, one word	French	From the age of 8 months
Rhythmic cues Höhle, 2012; Morgan & Saffran, 1995; Nazzi et al., 2006 inter alia	Strong syllables are word-initial and the following weak syllables are attached to them (stress-timed languages)	English, Dutch, German	From the age of 9-10 months
Allophonic cues Johnson & Jusczyk, 2001; Jusczyk et al., 1999 ; Mattys & Jusczyk, 2001	- Greater coarticulation within words than across boundaries - Certain allophones of the same consonant are typical of the final/initial position in the word	English	From the age of 8-9 months

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Phonological cues to word segmentation in the child (2)

Cues	Strategy for segmentation	Languages	Age
Transitional probabilities between syllables **Saffran, Aslin, and Newport, 1996, 1998**	More frequently the syllable S2 occurs after the syllable S1, more likely S1S2 is a word.	English	From the age of 8 months
Phonotactic cues **Mattys & Jusczyk, 2001; Friederici & Wessels, 1993; Jusczyk et al., 1993; Graf-Estes et al., 2011**	- Children prefer listening sequences of sounds that are legal in the ambient language (e.g. including legal onset or offset clusters) - Children are more likely to link such sequences to meaning - Children early segment CVC words (dice) but not VC words (ice) in C#VC sequences (cold ice).	English Dutch	- From the age of 9 months - CVC words : from the age of 8 months - VC words : from the age of 16 months

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Phonological cues to word segmentation in the child (2)

Matthys & Jusczyk, 2001 → Important results for the case of liaison

- children do not recognize a VC target word preceded by a linking consonant until the age of 16 months (*ice* included in *weird ice*)
- even if the linking consonant varies (*ice* preceded by /d/, /k/ and /v/ in *weird ice*, *fake ice*, *give ice*)

→ Very similar to French liaison.

Lexical cues to word segmentation in the child

Cues	Strategy for segmentation	Languages	Age
Lexical cues **Höhle & Weissenbrn, 2000** **Shi et al., 2006** **Shi & Lepage, 2008**	Children use existing representation of the determiner in order to segment the following new noun	English German French	- 8 months (English and French) - 11 months (German)

Liaison acquisition and word segmentation: a developmental scenario

A developmental model explains how the child deals with the complexity of liaison.

Chevrot et al., 2009, *Journal of Child Language*; Dugua et al., 2009, *Journal of Experimental Child Psychology*, Chevrot et al., 2013, *Language Sciences*

The model is rooted in the principles of the usage-based theory of language acquisition

Tomasello, 2003

1/ The specific utterances that speakers hear constitute the experience from which they construct their linguistic knowledge

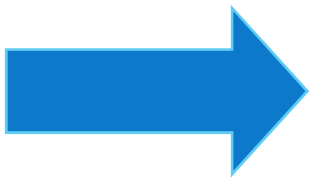
2/ On contact with these usage events, the speakers memorize concrete pieces of language formed from a sound sequence which is associated with a communicative intention.

- one-word or multiword sequences
- e.g. very frequent determiner-noun sequences

Pine and Lieven, 1993, 1997; Arnon and Snider, 2010; Janssen and Barber, 2012

3/ Linking together previously stored exemplars sharing phonological and functional characteristics, children generalize productive item-based schemas.

un garçon ‘a boy’
un livre ‘a book’
un ours ‘a bear’



un + X

Implementing this framework to the acquisition of liaison between determiner and noun

Assumption : at an early age, children memorize frequent determiner- noun sequences as chunks, some of which include a liaison.

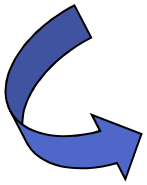
e.g. les amis 'the friends', *les cadeaux*, 'the gifts', etc.

When they have built up a large enough store of these chunks, children form a general schema based on the determiner

General schemas
les + X (X is a free slot to insert new elements)

At the same time, children segment the noun

For converging reasons, they place the lexical boundary before the liaison



The liaison is attached to the start of the noun:
/zarbr/ or /zami/

Children encounter each noun preceded by different determiners inducing different consonants or no liaison at all

un arbre ‘a tree’ → [œ̃**n**arbr]

les arbres ‘the trees’ → [le**z**arbr]

joli arbre ‘pretty tree’ → [ʒɔliarbr]

Children will thus acquire multiple variants of each noun:
/narbr/, /zarbr/, /arbr/

The model accounts for the two very frequent types of liaison errors recorded in children in terms of which variant is inserted into the schema

Chevrot, Nardy & Barbu, 2011

les + [**n**arbr] → liaison substitution (/n/ instead of /z/)

les + [arbr] → liaison omission (no liaison instead of /z/)

Children continue to memorize frequent determiner-noun sequences including a liaison:

les ours [le**z**urs], 'the bears', ***les*** *ânes* [le**z**an] 'the donkeys',

les amis [le**z**ami] 'the friends'

Specific schemas

les+/zX/ : *les* is followed by a variant starting with a /z/

un+/nX/ : *un* is followed by a variant starting with an /n/.

Explaining a third type of errors : regularization errors

The non variable initial /n/ of *nuage* is replaced by a /z/, that is the liaison consonant induced by the determiner *les*

The target sequence *les nuages* [le**n**yaʒ] is produced [le**z**yaʒ]

Target sequence	Schema	Created variant by analogy	Resulting type error
Les nuages (the clouds)	*les* + /zX/	[nyaʒ] modified [zyaʒ]	Substitution of initial consonant: **[lezyaʒ]**

Several aspects of this model have been/ are being tested

Evidence for the storage of multiple variants of the nouns

Chevrot et al., 2009; Dugua et al., 2009; chevrot et al., 2013; Gallot et al.,, 2009

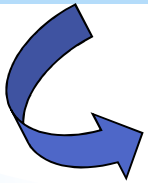
Earlier knowledge of liaison in perception task (before 30 months) ?

Buerkin-Salgado et al., submitted; Babineau & Shi, 2011, 2013, submitted

Persistence of the storage of determiner-noun sequences once the liaison has been acquired ?

Chevrot et al., submitted

Focus on one aspect of the model:
Why does the child posit the word boundary before the liaison consonant?



First answer in the speech addressed to French-speaking children

Prenominal liaison and phonological processes in child-directed speech

- 18 094 noun phrases (NPs) in the speech addressed by their mother to five French-speaking children
- During their second and third years of life
- 2 girls and 3 boys from high-SES families
- Parisian French

Paris corpus on the CHILDES website:
http://childes.psy.cmu.edu/browser/index.php?url=Romance/French/Paris/

Morgenstern & Parisse, 2012

The noun starts with a consonant	The noun start with a vowel	
86,69% (15686)	**13.3%** (2408)	
	The vowel is preceded with a linking /l/ resulting from the elision of the determiner	
	l'ours [lurs] 'the bear' **6.65%** (1204)	
	The vowel is preceded with a liaison	
	4.92% (890)	
	/z/ les ours [lezurs] 'the bears'	2.87% (519)
	/n/ un ours [œ̃nurs] 'a bear'	1.94% (351)
	/t/ cet ours [sɛturs] 'this bear'	0.11% (20)
	The vowel is preceded with a linking consonant that is not a liaison	
	1.12% (202)	
	/n/ une ourse [ynurs] 'a female bear'	0.62 (113)
	/l/ quel ours [kɛlurs] 'what bear'	0.32% (57)
	/t/ cette ourse [sɛturs] 'this female bear'	0.17% (31)
	/r/ notre ours [notrurs] 'our bear'	0.02% (4)
	/k/ chaque ours [ʃakurs] 'each bear'	0.01% (1)
	The V-initial word is a "h-aspirated word" that blocks liaison and elision (appearance of a hiatus)	
	un hibou, le hibou, les hiboux, [œ̃ibu] [ləibu] [leibu] **0.60%** (108)	

Consonants are more reliable points of reference than vowels to indicate the word-onset

Children are generally confronted with determiners without liaison and without elision

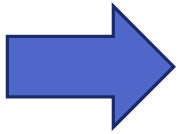
- e.g. the plural determiners *les*, *deux, des* (the+plural, two, indefinite+plural) in the form /le/, /dø/, /de/ without /z/ liaison

- e.g. the definite determiners *la* or *le* in their long form, without elision

The reason why children construct item-based schemas on these forms: /le/+X, /dø/+X, /de/+X

Two good reasons to posit the boundary before the /z/ and not before the /a/ in the sequence *les amis* [lezami] ‘the friends’

- /z/ is a consonant
- The non-liaison form /le/ of the determiner is used as point of reference



Not easy to distinguish the phonological reason and the lexical one

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/nV/ initial noun and /zV/initial nouns in the input

	Tokens	Types
Words starting with /zV/	56	5
Words starting with /nV/	262	30

Approximately five or six times more words starting with /nV/ than starting with /zV/.

True for the types or the tokens of word

In brief

1/ Phonological and lexical factors converge for attaching the liaison at the start of the noun.

2/ The input favors three types of variants of the noun: variants starting with /l/, /z/ and /n/.

Chevrot et al., 2009

3/ Liaison /z/ is more frequent than /n/ liaison

4/ Noun starting with /nV/ are more frequent than word starting with /zV/.

Is the child sensitive to this patterns when segmenting nouns in liaison context ?

Segmenting pseudo-nouns: an experiment

From Dugua, 2006

1/ Children listen to pseudo-nouns preceded by a determiner

- the singular *un* 'one' which requires an /n/ liaison,
- the plural *deux* 'two' which requires /z/ liaison.

The pseudonoun represents an imaginary animal

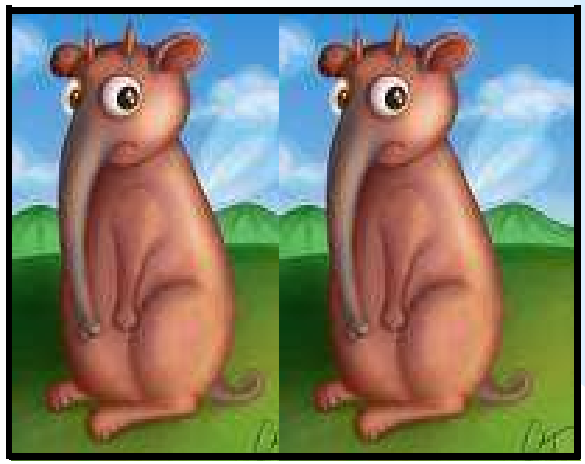
The experimenter says :

*C'est un-**n**-ivak* 'this is [œ̃nivak]'

The /n/ is ambiguous
liaison consonant ? [œ̃ + LC + ivak]
initial consonant ? [œ̃ + nivak]

2/ The experimenter shows the child a picture with the same animal drawn in two exemplars

What can we see in this picture?



The child has segmented [œ̃] + [nivak] → S/he produces *deux nivak* [dønivak]. → **CV production**

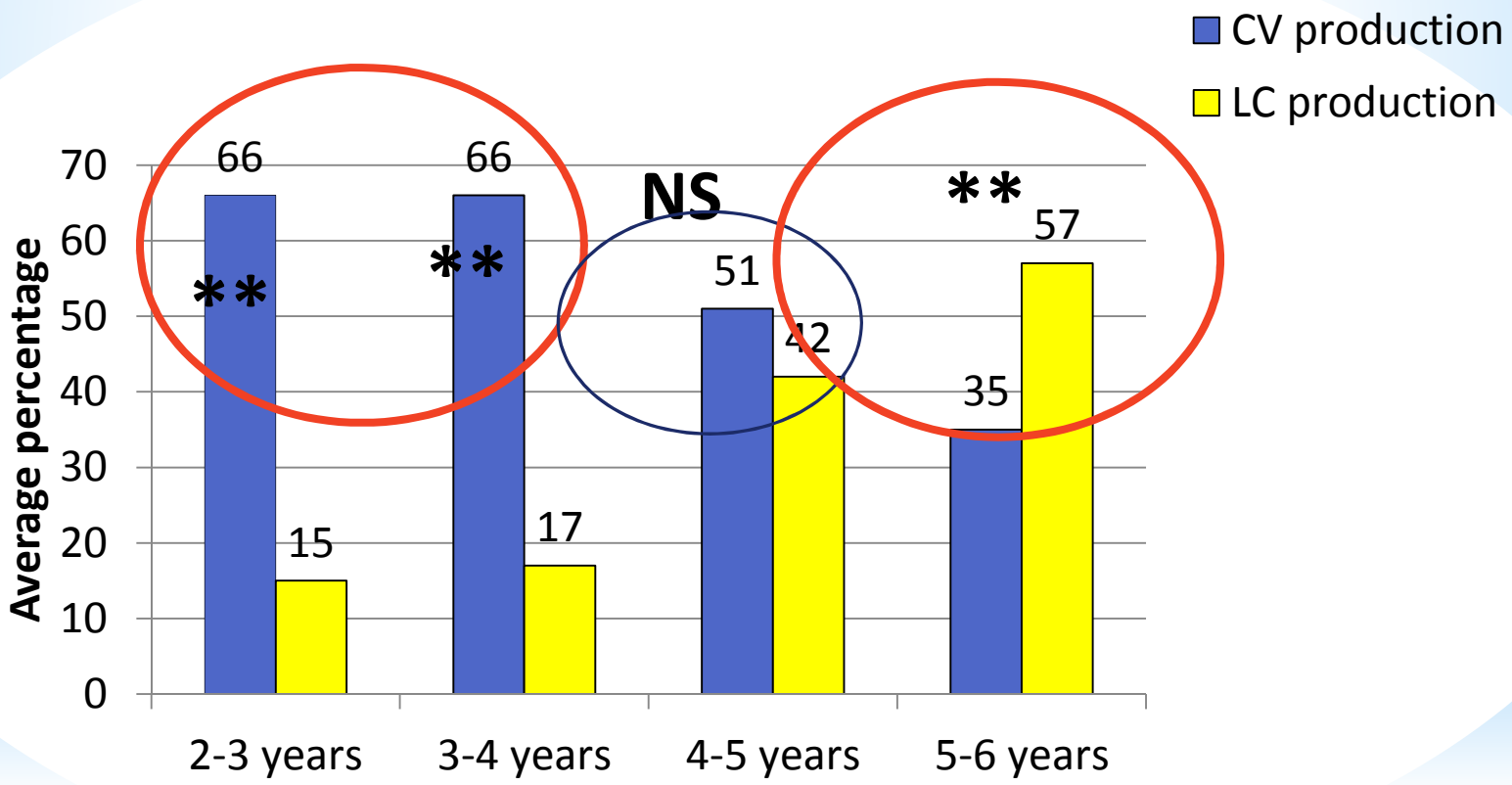
The child has processed the [n] in [œ̃nivak] as a liaison. → S/he produces *deux zivak* [døzivak]. → **LC production**

The child omits the ambiguous consonant → S/he produces 8% [døivak] → Not taken into consideration

- Pseudonouns : masculine two-syllable words (e.g. [ivak], [ytrɛl], [ikat], [ysa])
- No nominal phonological neighbor in the vowel-initial form ([ivak]) or in the liaison- or elision form ([nivak], [zivak], [tivak], [livak]).
- No child hears the same pseudo-nouns preceded by /n/ and /z/.

	Number	**Age bracket**	**Mean age**
Age group 1	49 children	2;4-3;1	2;9
Age group 2	50 children	3;2-4;1	3;6
Age group 3	52 children	4;2-5;1	4;7
Age group 4	49 children	5;2-6;1	5;7

Do children prefer CV production over LC production ?



There is an early and strong tendency to attach the liaison consonant to the following noun.

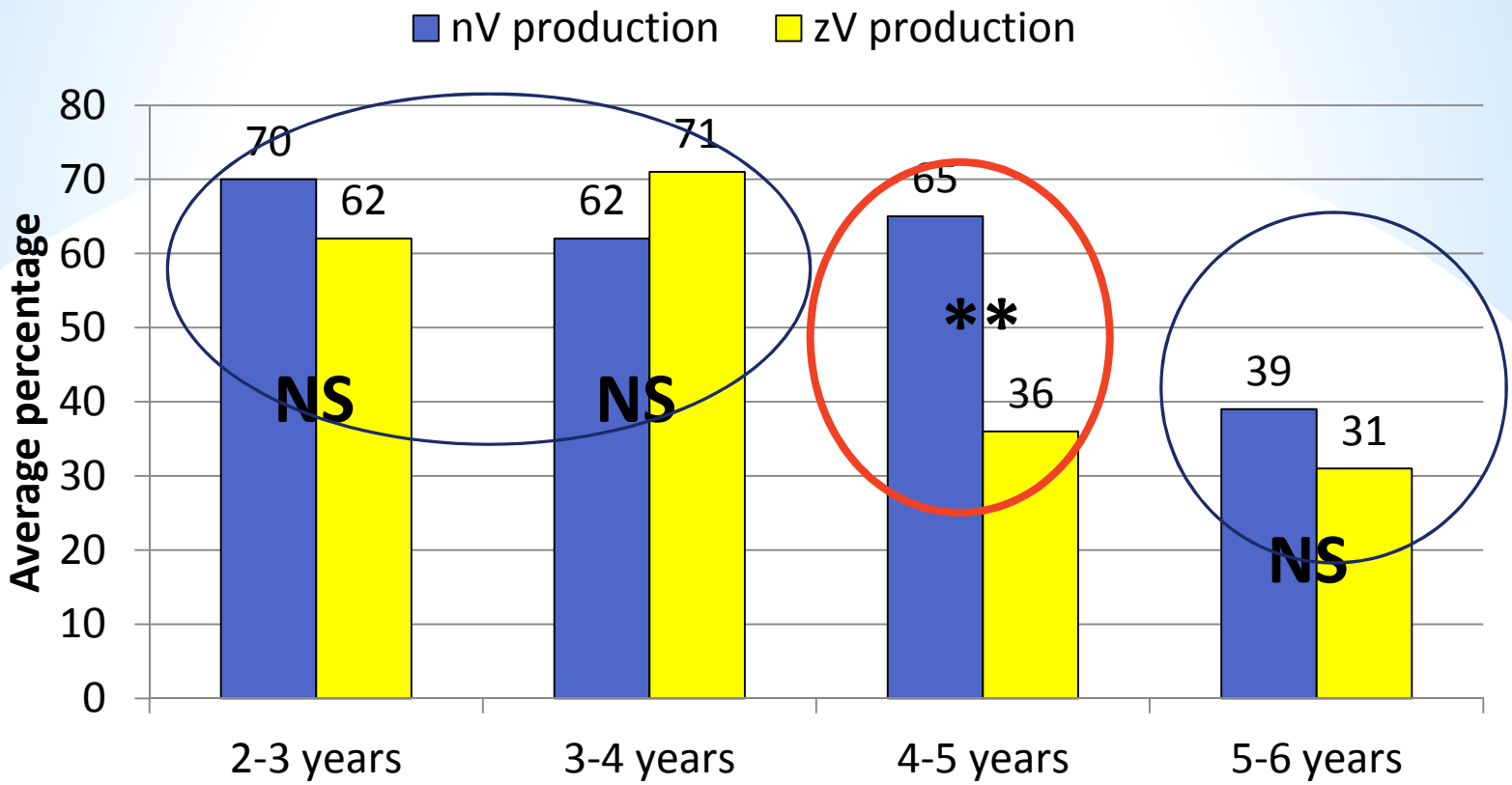
Phonological strategy : children use the consonant as a cue for the word-onset

Lexical strategy : children use the frequent form of the determiner as a point of reference

A way to distinguish between the two strategies

1/ Oppose CV production where the consonant is /z/ and CV production where the consonant is /n/.
2/ Phonological cues: advantage to /nV/ production over /zV/ production
3/ Lexical cues: no advantage

Do children prefer /nV/production over /zV/ production ?



CV production does not depend on the segmental content of the consonant in the two first age groups

Segmentation is based on the lexical strategy during this period

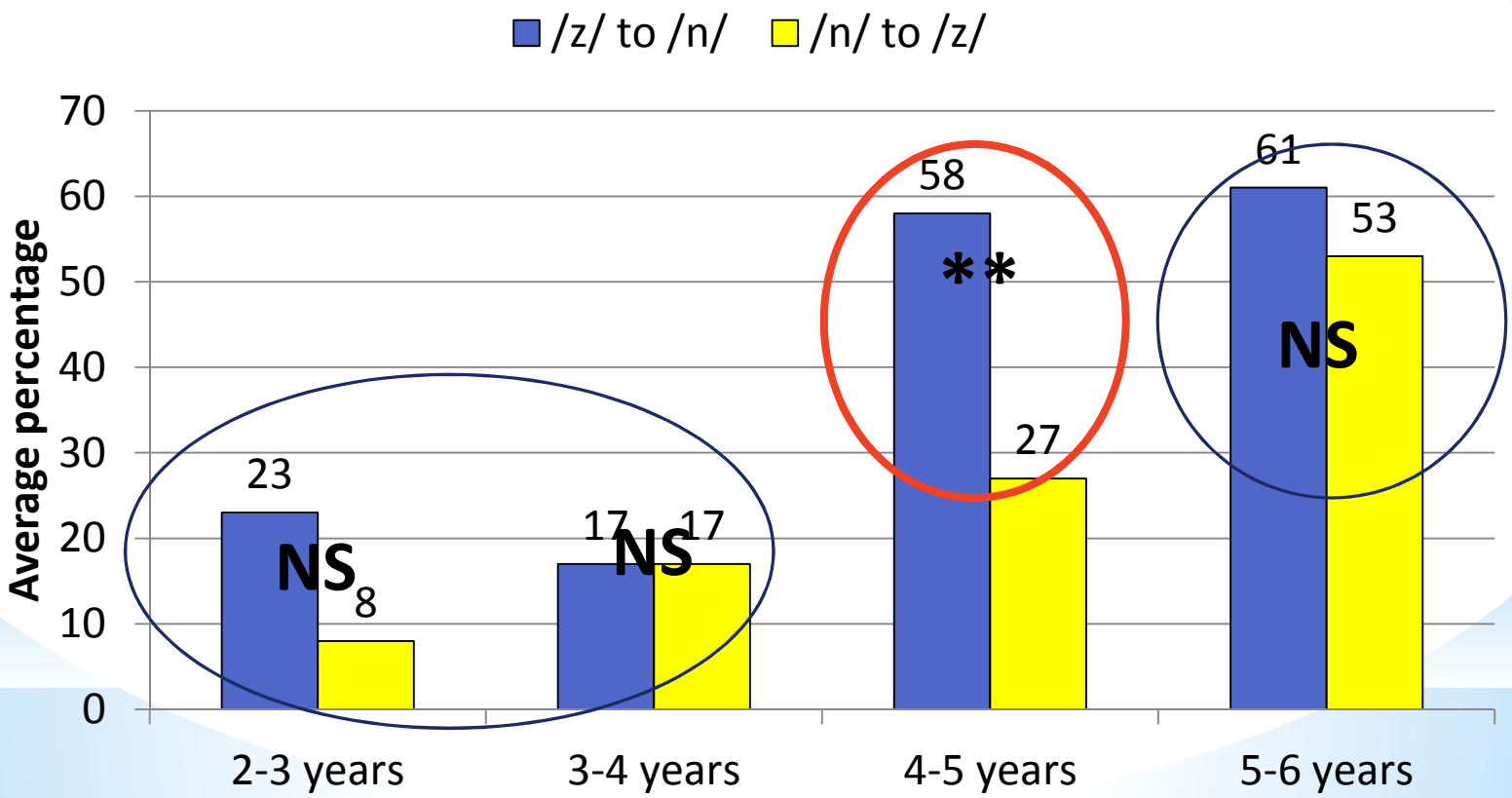
At the age of 4-5 years, children use phonological cues.

Learning of the liaison renders the lexical strategy inefficient (4-5 years, 80% correct liaison, Dugua, 2006)

Children start using the information, that /z/ liaison is more frequent than /n/ liaison at the same age.

Do children prefer /z/ → /n/ production over /n/ → /z/ production ?

Producing [œ̃nivak] after hearing [døzivak]: /z/ → /n/ production
Producing [døzivak] after hearing [œ̃nivak]: /n/ → /z/ production



Summary of results and conclusion

Liaison in the child-directed speech	Experiment on pseudonoun segmentation
Phonological and lexical factors converge for attaching the liaison at the start of the noun.	Until the age of 4, children prefer CV production over LC production
Noun starting with /nV/ are more frequent than word starting with /zV/.	At the age of of 4-5 years, but not earlier, children prefer /nV/production over /zV/ production
Liaison /z/ is more frequent than /n/ liaison.	At the age of 4-5 years, but not earlier, children are more likely to process the heard /z/ as an alternating consonant.

Linguistic knowledge un usage-based models : multiple layers of increasing level of abstraction

Dabrowska, 2006

Level of representation	Example
Second-order generalization	**Liaison /z/ as a plural prefix of the noun** Morin and Kaye, *Journal of Linguistics*, 1982
Local generalization (making it possible to produce the correct liaison)	**Schema associating a specific determiner with a class of variants of the noun** *les* + /zX/ ([zekyroej] [zarbr]) *un* + /nX/ ([nekyroej] [narbr])
Lexical units	**Variants of the noun** [nekyroej] [zarbr]
Memorized frequent sequences	**Determiner-noun sequences** [rezarbr]

The lower level of concrete sequences is phonetically informed. Speakers generalize phonotactic pattern across the segmental content of these stored sequences.

Välimaa-Blum, 2009

Generalization of different probabilistic patterns around the age of 4.

A- /z/ follows the determiner *deux* ➔ the following word is likely to have an alternating variant starting with /n/.

B - /n/ follows the determiner *un* ➔ the following noun is less likely to have an alternating variant starting with /z/.

Why so late ?

The task is difficult : not only finding phonotactic patterns but distinguishing which pattern is more/less likely to alternate

Is there a phonotactic grammar that is « outside the lexicon » ?

Boll-Avetisyan, 2012

A possible answer is another question :
Where does the lexicon stops and where does grammar starts ?

Bybee & McClelland, 2005; Laks, 2013; Bates & Goodman, 1997

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