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Prosodic and frequency effects on the development of syllable structure in European Portuguese

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1. Introduction

- Background
  - Acquisition of syllable structure in EP (overview)
  - The impact of frequency on language development
  - Frequency studies for EP
- Goals: establish the effects of syllable type frequency and the role of prosodic prominence in syllable development in EP
- Data: input (ADS & CDS), and child data
- Input frequencies and syllable types in child speech
- Prosodic prominence effects: word edges, stress
- Summary of main findings and discussion

2. Background: Acquisition of syllable structure

- Onsets (Freitas 1997):
  C and **Ø** > **CC**

- non-branching onsets (C or Ø) are represented in the system from the beginning of production
- empty onsets are used as a default structure to deal with problematic target onsets
- G may replace a segmentally problematic C target
- branching onsets are the last structure to be acquired

CV, **V**, **Ø**V, GV > CC

- Rhymes **V** > (surface VG>)
  VC_{fric} > **VC_{liq}** / **VG**

- non-branching nuclei are, as expected, represented in the system from the beginning of production
- surface VG structures are present since early stages of production, but the mastery of branching nuclei occurs in late stages of development, by the time syllable-final liquids are acquired; V and VG seem to be interpreted similarly by children (Correia, 2004)

V, VG > VC

2. Background: Acquisition of syllable structure

- Children early productions (examples)

a.	pato	/'pa.tu/	→	['tɐ]	(João: 0;11.6)	'duck'
	dá	/'da/	→	['da]	(Inês: 0;11.14)	'give'
	quer	/'kɛɾ/	→	['ke]	(Marta: 1;2.0)	'wants'
b.	água	/'a.gwɐ/	→	['a.βɐ]	(João: 0;11.6)	'water'
	é	/'ɛ/	→	['ɛ]	(Inês: 1;0.25)	'is'
	água	/'a.gwɐ/	→	['a.wɐ]	(Marta: 1;2.0)	'water'
c.	vês	/'veʃ/	→	['eʃ]	(Marta: 1;3.8)	'see'
	flor	/'flor/	→	['oli]	(Inês: 1;9.19)	'flower'
d.	quer	/'kɛɾ/	→	['kɛ.ɾi]/['kɛ.ɾi]	(Inês: 1;10.29)	'wants'
	papel	/pɐ.'pɛɬ/	→	[pɐ.'pɛ.li]	(Marta: 2;2.17)	'paper'
e.	pato	/'pa.tu/	→	[ɐ.'tɐ]/['tɐ]	(João: 0;11.06)	'duck'
	chupeta	/ʃu.'pe.tɐ/	→	[ɐ.'pi]/['pi]	(Inês: 1;01.30)	'pacifier'
	dá	/'da/	→	[ɐ.'da]/['da]	(Inês: 1;0.25)	'give (me)'
	cão	/'kɐ̃w̃/	→	[ɐ.'kɐ̃w̃]/['kɐ̃u]	(Marta: 1;02.0)	'dog'

2. Background: the impact of frequency

- There is a growing interest in determining the importance of frequency information in linguistic behaviour

  (Bybee, 2000 & 2001; Bybee & Hooper, 2001; Jurafsky, Bell & Girand, 2002; Moates, Bond & Stockmal, 2002; Pierrehumbert, 2002)
- The same is true for the acquisition and development of linguistic systems

  (Fikkert & Freitas, 1998; Lleó & Demuth, 1999; Beckman e Edwards, 2000; Roark & Demuth, 2000; Demuth & Johnson, 2003; Prieto, 2004; Vigário, Freitas & Frota 2005)

- Frequency in EP (adult speech): syllable types (Andrade & Viana, 1994; Vigário & Falé, 1994; Viana et al., 1996); phonetic segments and stress patterns (Viana et al., 1996); words undergoing phonetic reduction (Vigário, 2003); *minimal* words and patterns of cliticization (Vigário, Martins & Frota, 2005)
- Frequency in EP (child speech): development of syllable structure (Fikkert & Freitas; Vigário, Freitas & Frota, 2003); development of word shapes (Vigário, Freitas & Frota, 2005)

2. Background: the frequency tool *FreP*

- ***FreP*** (Vigário, Martins & Frota, 2005)
- Automatically extracts syllable types from written texts;
- Semi-phonological: includes lexical phonological processes (e.g. glide insertion to break a hiatus); ignores all optional processes (deletion of unstressed vowels, optional gliding);
- Includes glides in rising diphthongs that are obligatory (post-tonic in proparoxitons) and V positions between consonants that violate syllable construction principles (Mateus & Andrade 2000);
- Glides between vowels are treated as ambisyllabic

- Goals
- Establish the EP-specific frequency distributions of syllable types in the input
- Measure the effect of input frequencies on syllable type development
- Assess the role of prosodic prominence:

  . position in the word:

  word-edges/monosylw > word internal

  . stressed > unstressed
- Discuss the impact of frequency on development

3. Data (number of syllables by syllable types)

- Spontaneous data from 3 monolingual Portuguese children (CS): (Freitas 1997)

João	aged 0;10.2 – 1;8.13	(n=1003)
Inês	aged 0;11.14 - 1;10.29	(n=3619)
Marta	aged 1;2.0 - 2;2.17	(n=6090)

- Child-directed speech data (CDS):

Inês	(n=24867)
Marta	(n= 10985)

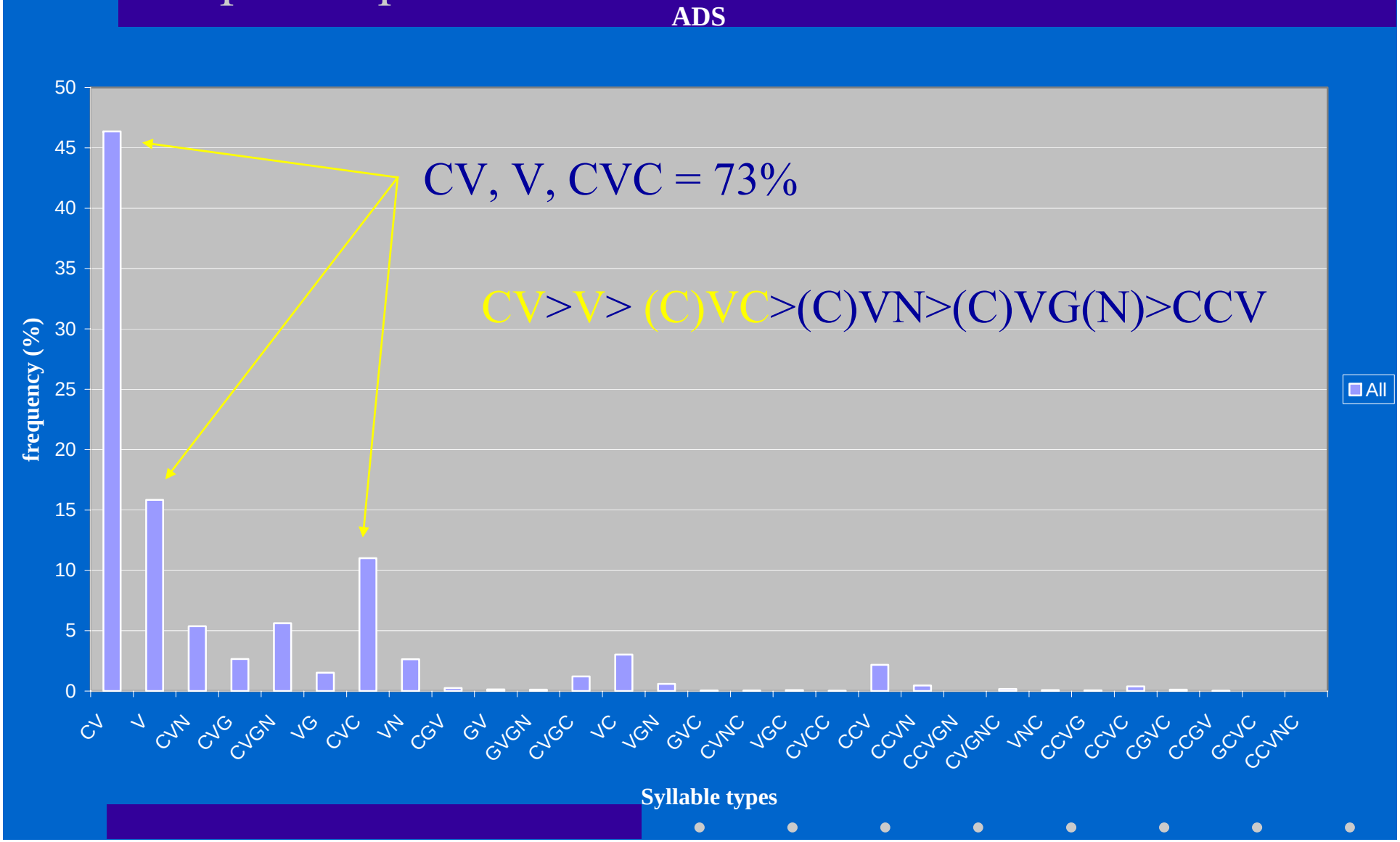
- Spontaneous Adult data (ADS):

  the *Português Falado* corpus (CLUL – CDRom) from 90s (n=41826)

  (Vigário, Martins & Frota 2005)

Data obtained with ***FreP*** (Reliability was above 99.5%)

4. Input frequencies

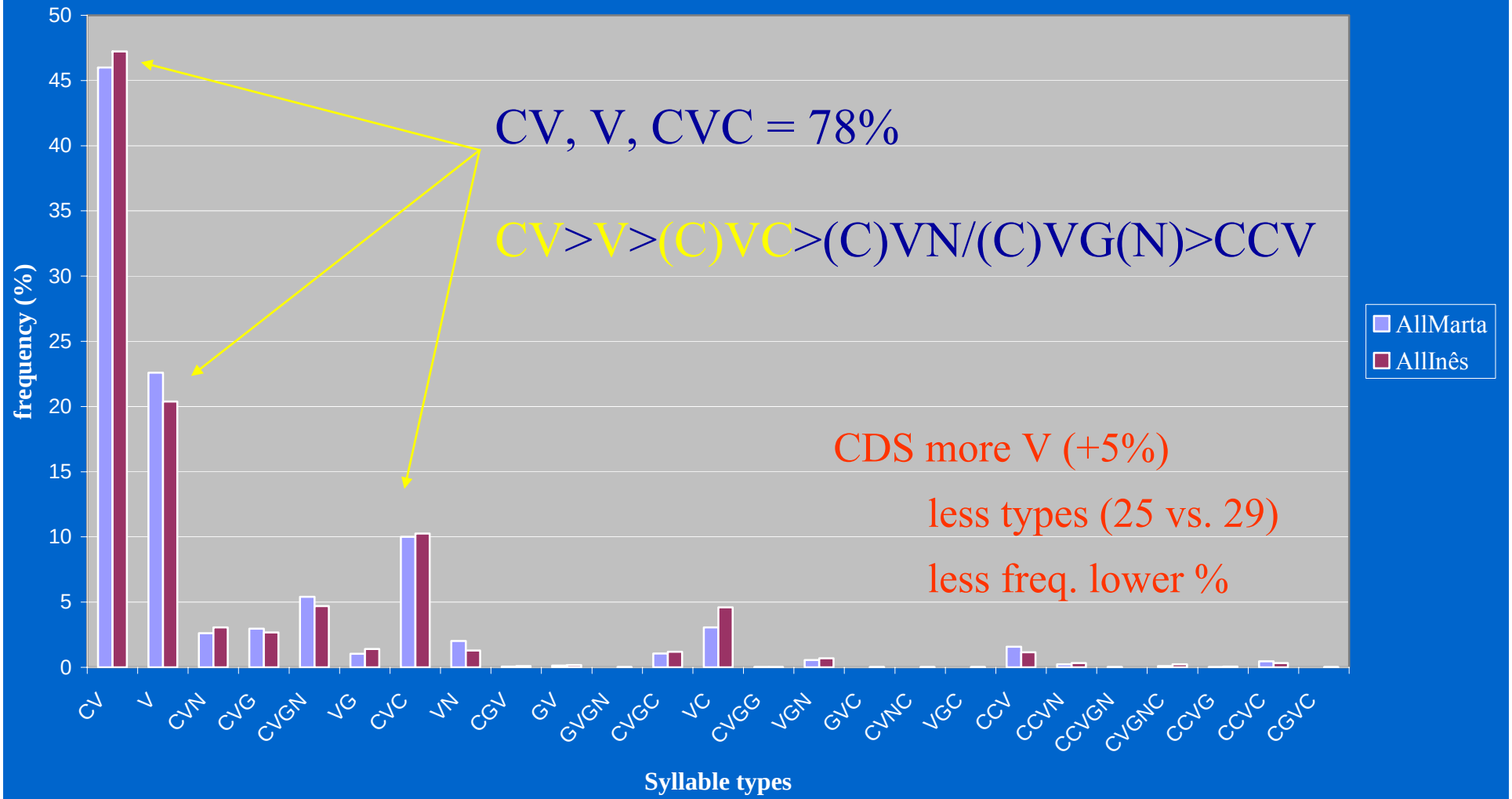


4. Input frequencies

CDS

Prediction: order of emergence of syllable types in CS

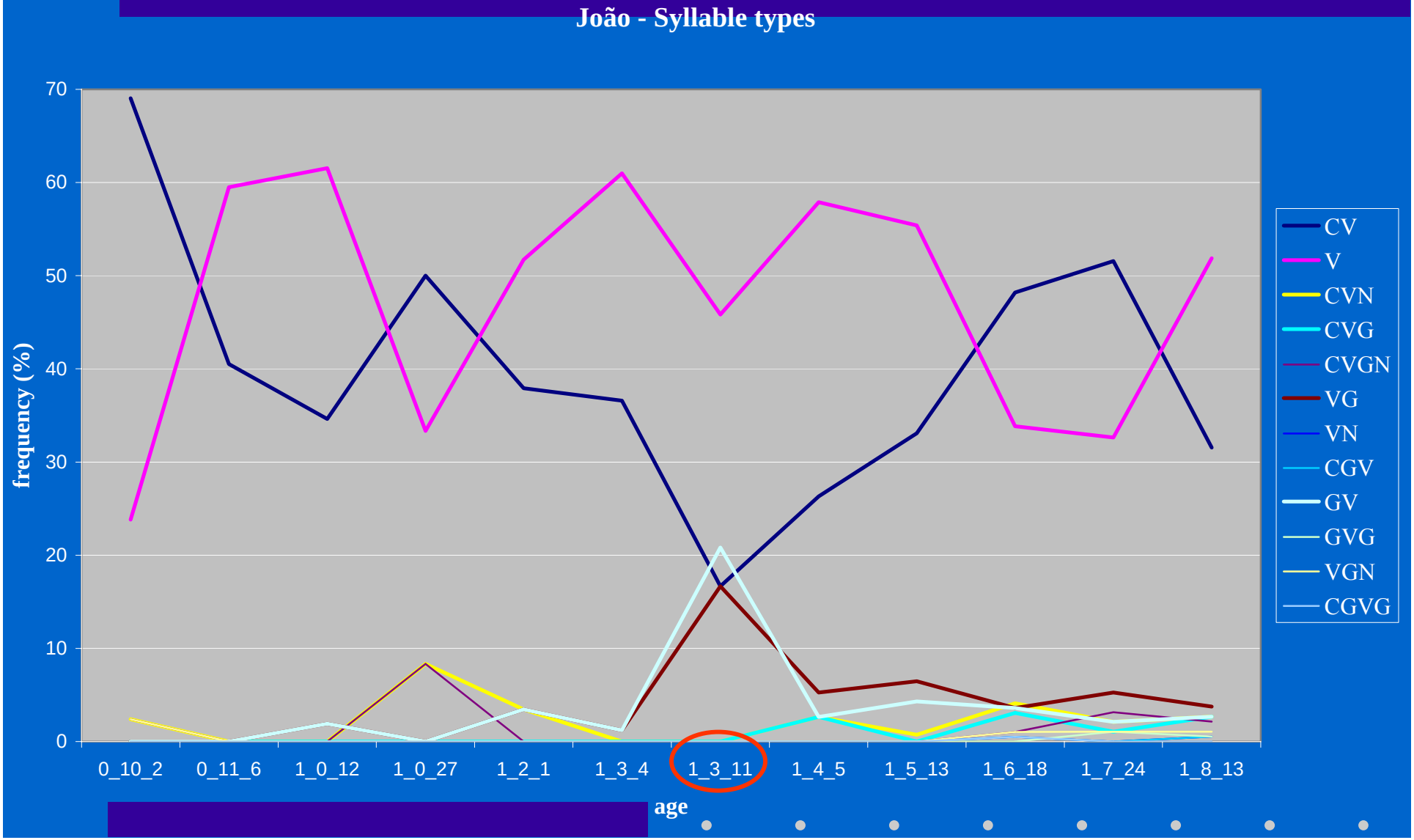
CV>V>CVC>CVG/CVN>CCV



CV>V>CVC>CVG/CVN>CCV

CV / V > (C)VN > (C)VG, GV

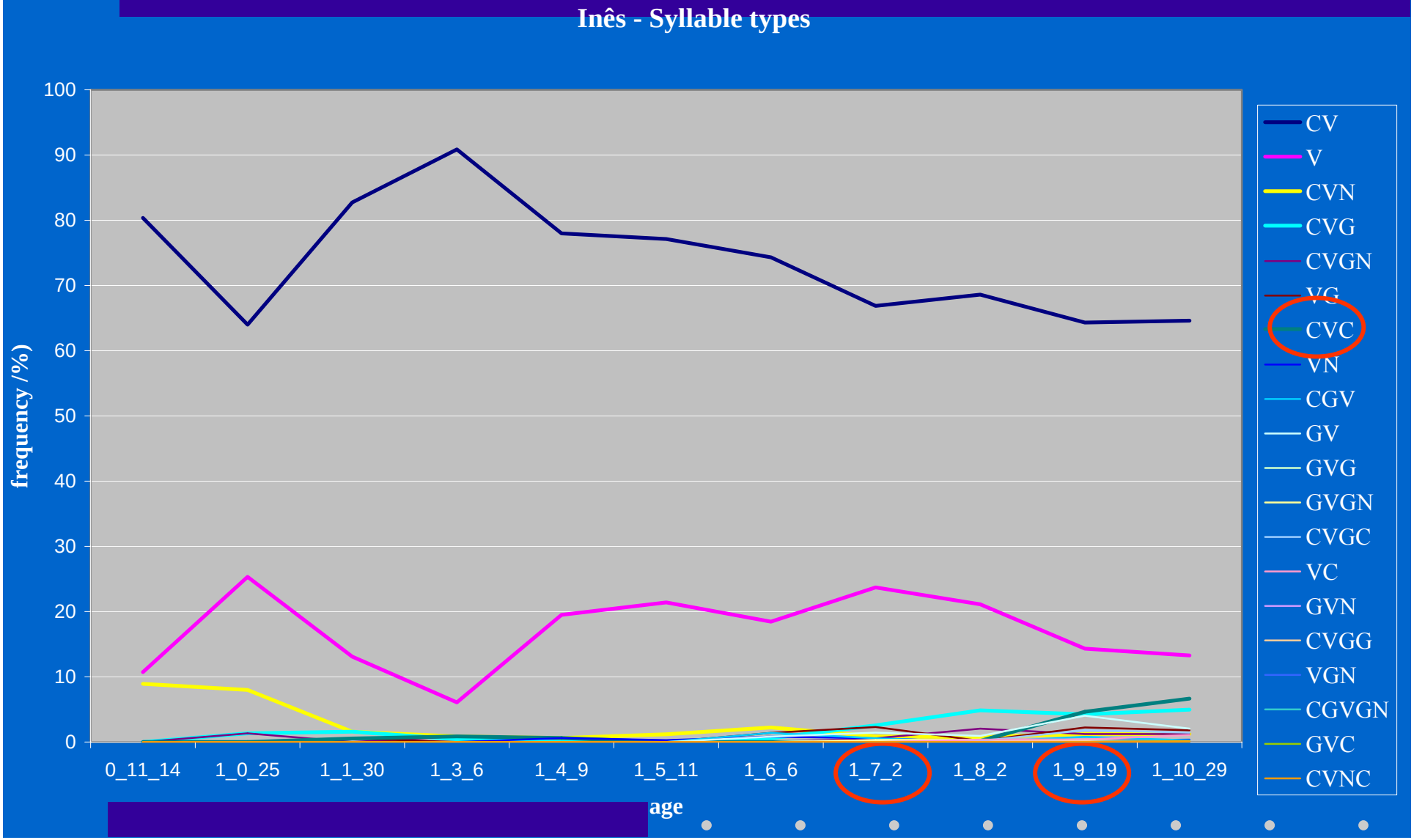
4. Development of syllable types



CV>V>CVC>CVG/CVN>CCV

CV / V > (C)VN > (C)VG > (C)VC

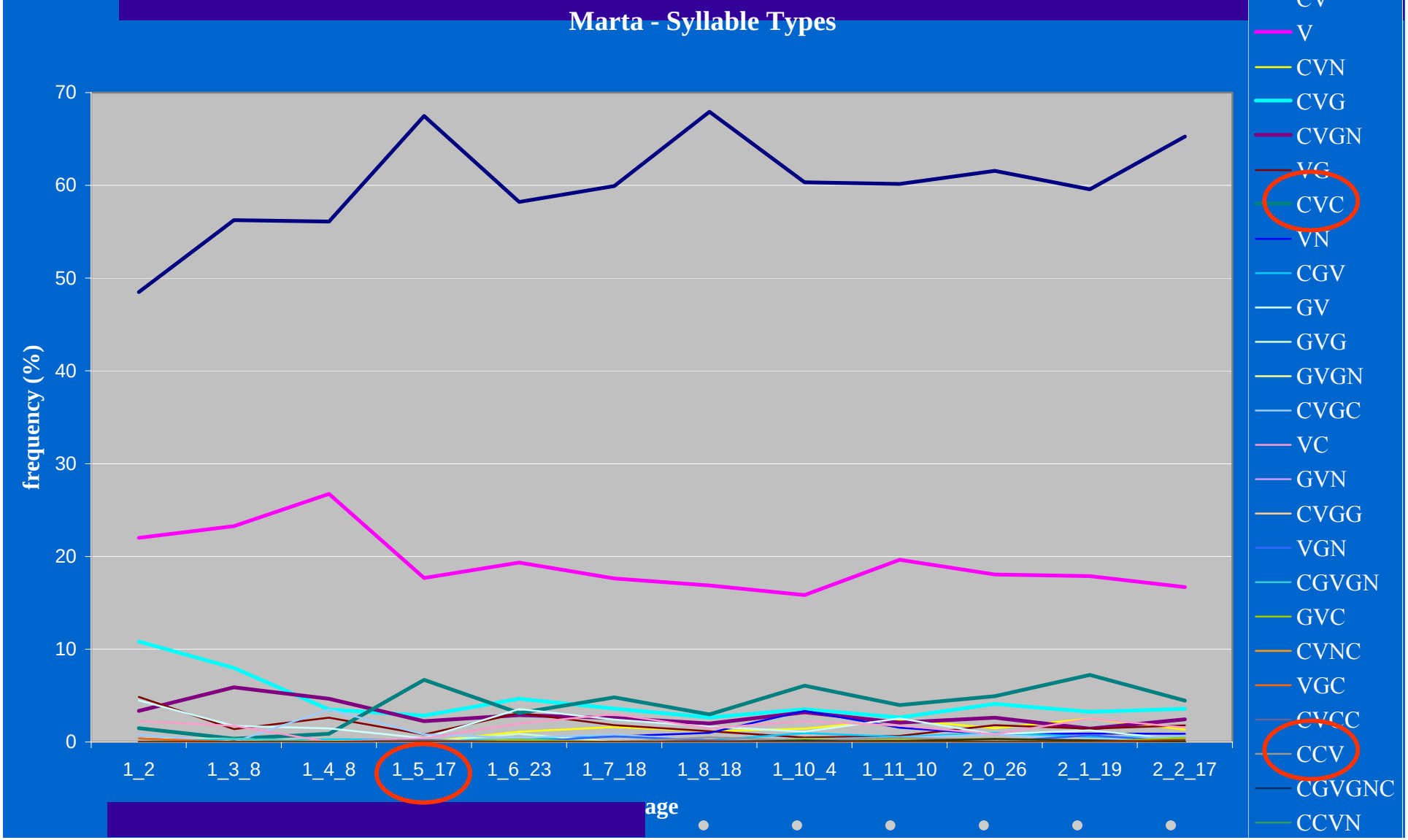
4. Development of syllable types



CV>V>CVC>CVG/CVN>CCV

CV / V , (C)VN, (C)VG > (C)VC

4. Development of syllable types



5. Prosodic Prominence and frequency

- Two mismatches

- Development of syllable types and input frequencies:
  CV ***and*** V
  (C)VG/(C)VN *before* (C)VC
- Hypothesis: prosodic prominence (stress and/or word-edges) may have a role to enhance V, and CVG/N relative to CVC in the input

e.g. Echols 1987; Peters 1977,1983

- Prosodic Prominence (EP)

- Word-edges (Vigário 2003):

Prosodic word initial position

often gets emphatic stress

vowels are exempt from regular reduction in stressless positions
e.g. [e / ɛ]rguEr vs. ro[ɨ]dOr
[o / ɔ]piniÃo vs. mi[u]lInho

Prosodic word final position

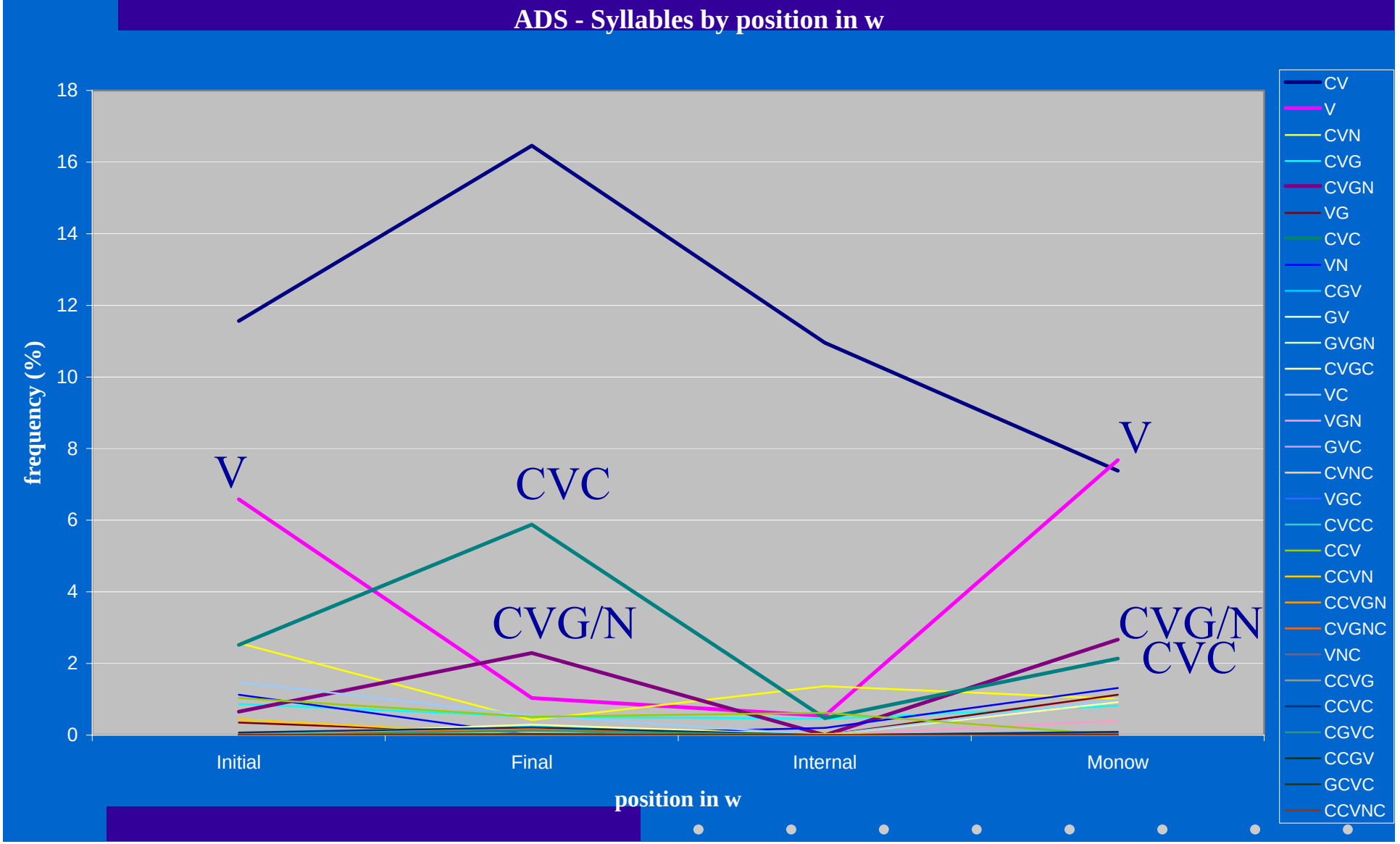
tends to show more variable/complex structures (more V reduction/deletion)

- Stress: stressed syllables are acoustically longer; no vowel reduction

Syllable diversity & complexity:

Final>Monow>Initial>Internal

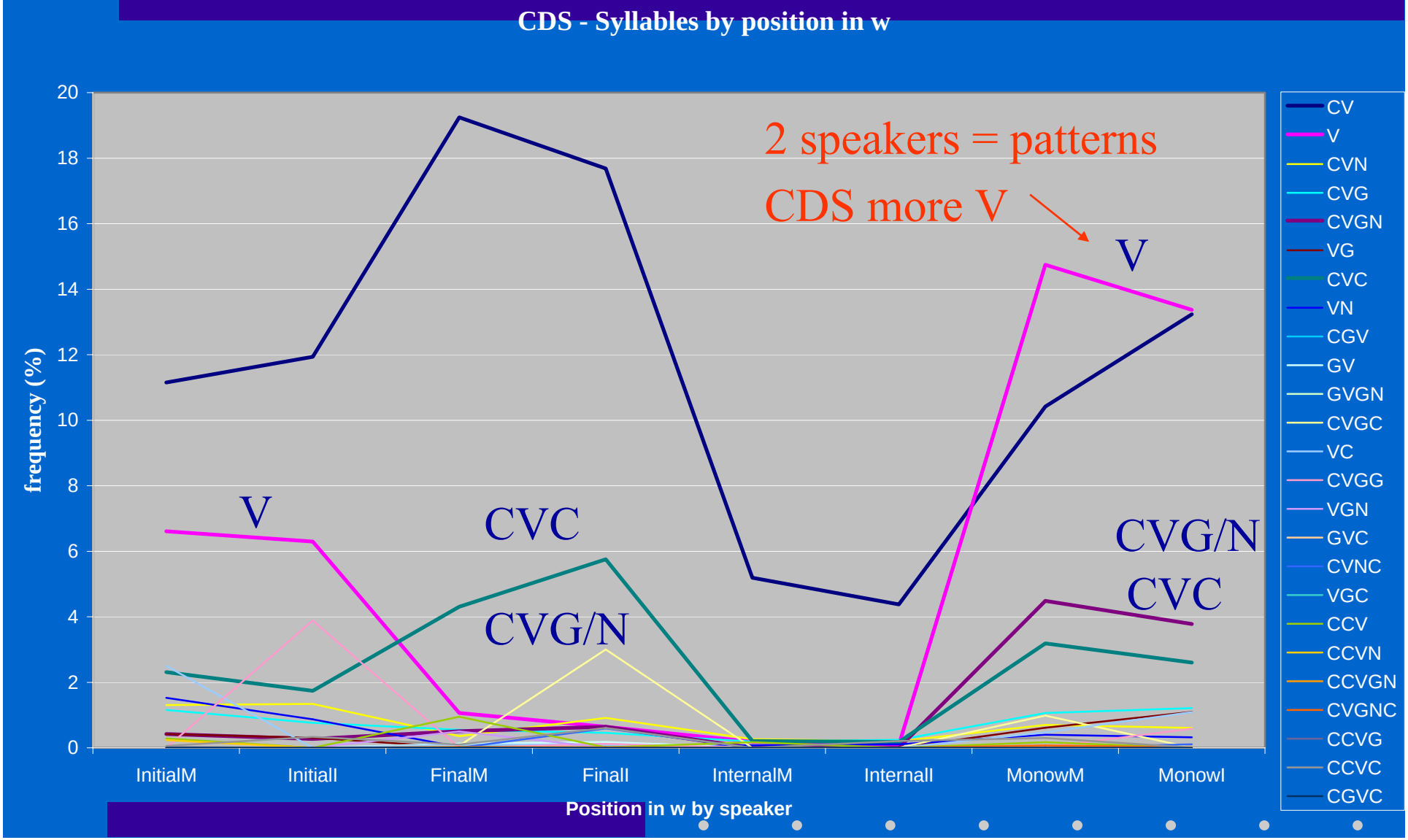
5. Input: word-edges vs. internal position



Syllable diversity & complexity:

Final>Monow>Initial>Internal

5. Input: word-edges vs. internal position



5. Word-edges vs. internal position

- Input
- V syllables in ADS, CDS

Initial+monopw 54%, 56%

Initial+monow 90%, 95%

- V clitics are proclitics and occupy pw initial position (don't reduce if followed by C and never delete – [u] carro; [u / w] aluno])
- Initial V syllables are not reduced even if stressless
- V syllables in monopw are obviously stressed

Most V syllables occur in a prominent word position

- Input
- CVG/N and CVC in ADS, CDS

Final+monopw

CVGN 88%, 100%

CVC 62%, 74%

- Final syllables and monosyllabic words display more diversity and complexity of types
- CVGN and CVC in monopw are obviously stressed

Most CVGN and CVC syllables occur in a prominent word position, but CVGN does so more often (mainly in CDS)

5. Word-edges vs. internal position

- CS: **CV / V > (C)VN > (C)VG > (C)VC**

- So, prosodic prominence may have a role to enhance **V**, and **CVG/N** relative to CVC in the development of syllables types
- Initial w-position displays more **V** syllables than all other positions (as in the input but with higher frequency)
- Syllable diversity and complexity in CS closely mirrors the input:
  Final, Monow>Initial>Internal

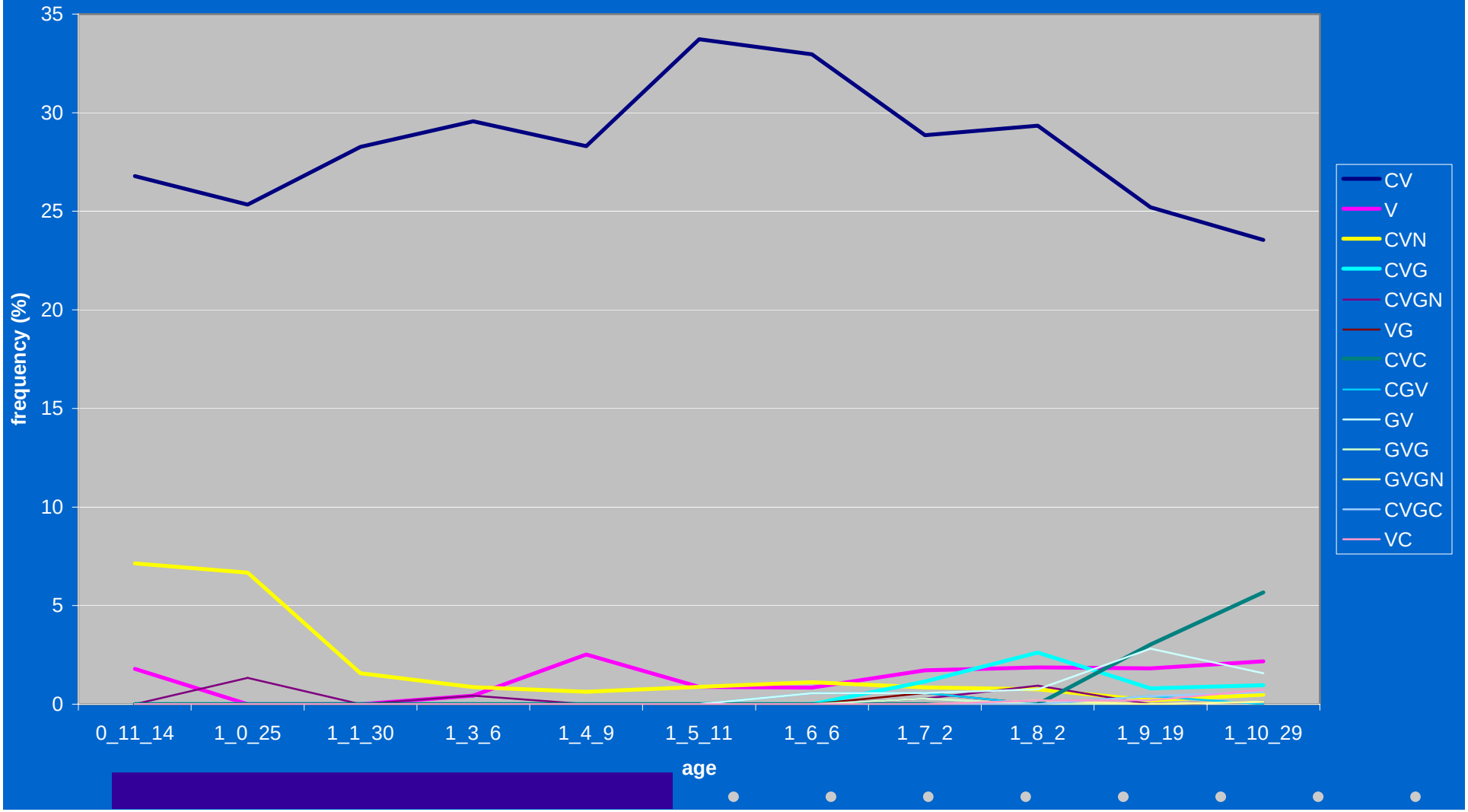
- CS

- More complex types appear first in final w-position and monosyllabic words and are more frequent in these positions

Types	INITIAL	FINAL	MONOW	INTER
CV	BEGIN	BEGIN	BEGIN	BEGIN
V	BEGIN	BEGIN	BEGIN	BEGIN
(C)VG	J, I, M	M	M	M
(C)VN	M	J, I	M	
(C)VGN		I, M	J, I, M	----------
(C)VC		M	I, M	
(C)VGC	----------	I	I, M	----------
CC...	M			

5. Word-edges – initial position

5. Word-edges – final position



5. Word stress

- ADS

- We saw that word position may have a role to enhance **V**, and **CVG/N** relative to CVC in the development of syllables types. What about stress?
- CV, V, CVC more frequent in **unstressed** position
- CVG, CVN more frequent in **stressed** position
  - CVN **82%;** CVG(N) **66%**

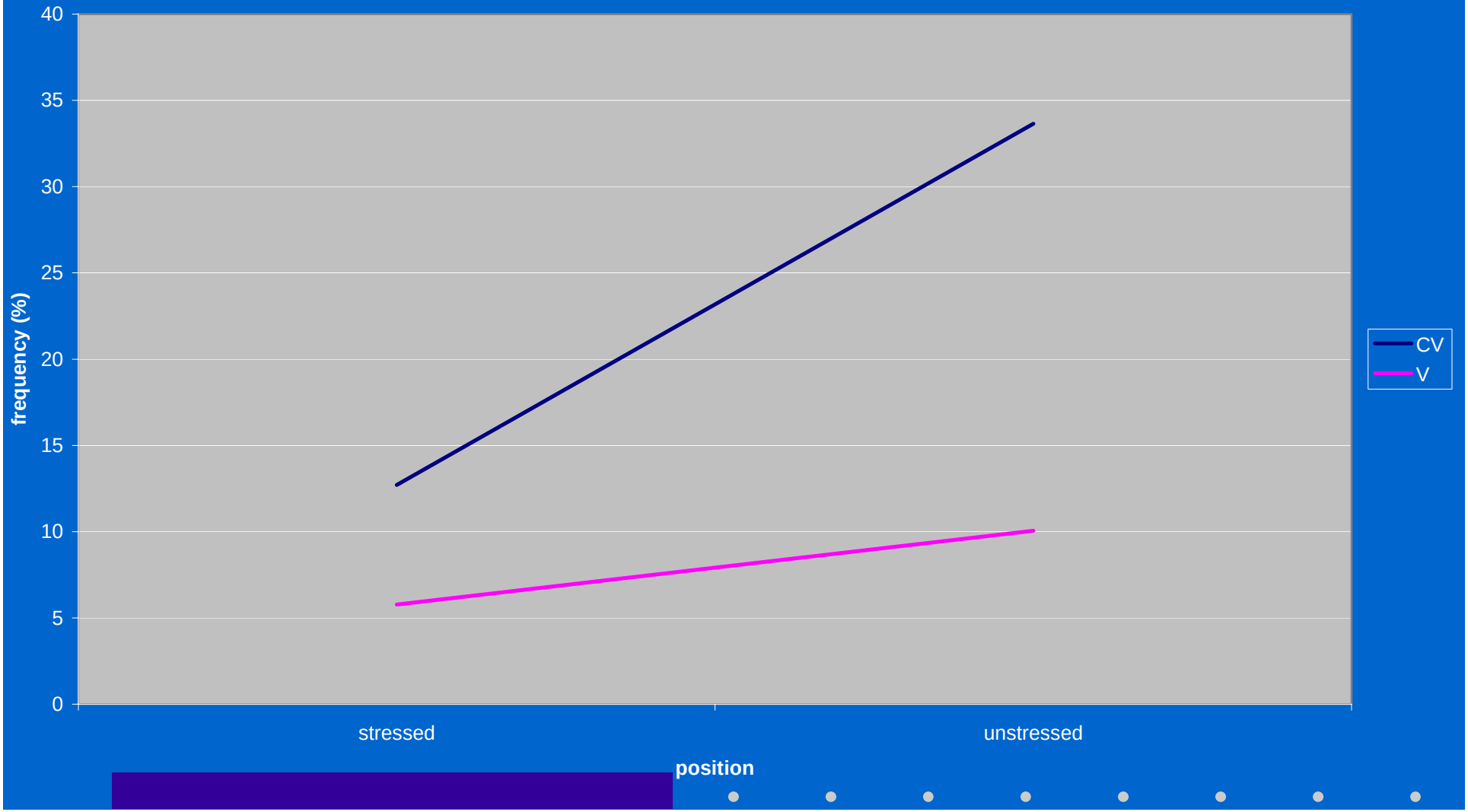
Stress strengthens the word position effect

- CDS

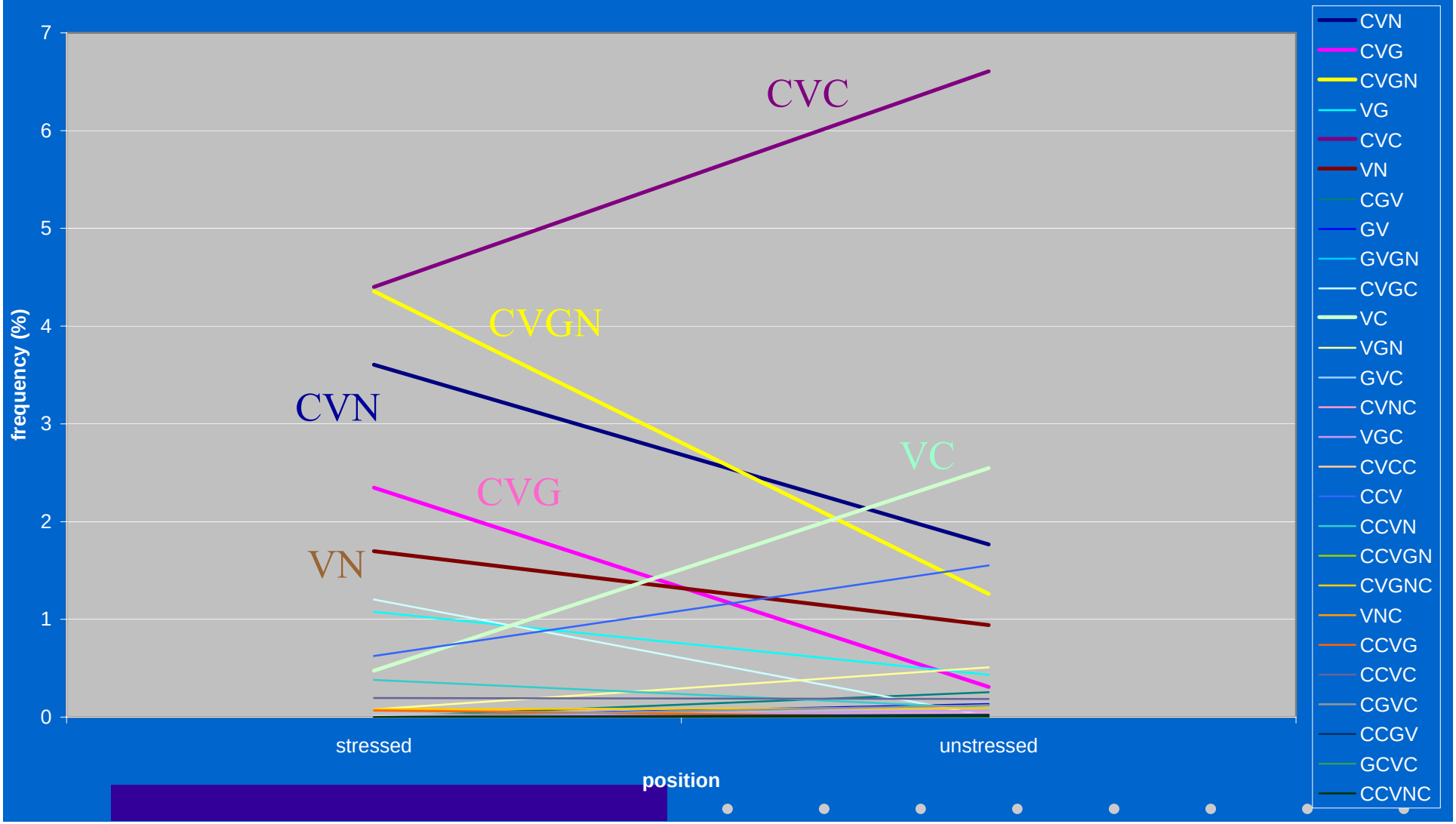
- CV, V more frequent in **unstressed** position
- CVG, CVN and **CVC** more frequent in **stressed** position
  - CVG(N) 98%
  - CVN 78%
  - CVC 60%
- Still CVG and CVN occur more frequently in stressed position !

Overall, prosodic prominence may play a role to enhance CVN/G relative to CVC

5. Word stress: CV, V



5. Word stress: CVN, CVG



6. Summary

- EP frequency distributions of syllable types in the input (ADS and CDS) predict the following order of emergence of syllable types: **CV>V>CVC>CVG/CVN>CCV**
- **CS: CV / V > (C)VN, (C)VG > (C)VC**
- Two mismatches:

CV ***and*** V

(C)VG/(C)VN *before* CVC

- Role of prosodic prominence offers an explanation to the mismatches:

  word-edges vs. internal position

  stressed vs. unstresssed position

- ADS & CDS: Most V syllables occur in word-initial position
- ADS & CDS: Most CVGN syllables occur in final position and CVGN outranks CVC in this position
- ADS & CDS: CVG(N), CVN more frequent in **stressed** position

✓ Structural information (prosodic prominence) and frequency together predict the correct order of emergence of syllable types

CV > V > CVC > CVG/CVN >CCV

CV / V > CVG/CVN > CVC >CCV

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- Our data: ‘semi-phonological’ syllables
- Vowel deletion [i , u]
  - Promotes surface C clusters
  - Demotes CV
- Against the syllable type patterns shown in CS
- But:
  - V deletion only in internal and final position (not in initial position)
  - V deletion only in unstressed position

- And:
  - Hypothesis: properties in the signal that cue the type of syllabic grammar, namely rhythmic properties that place EP in the group of syllable timed languages

Vigário,Frota & Freitas 2003