Introduction

- ✓ Prosody plays a crucial role in the organization of speech
- ✓ Prosodic groupings chunk the speech continuum
- ✓ Given that prosody interfaces with other linguistic domains, prosodic phrases relate to other constituents: e.g., the intonation phrase (IP) relates to a clause-like unit and sentence/clause boundaries usually align with IP boundaries

(Frota 2012; Shattuck-Hufnagel & Turk 1996; Nespor & Vogel 2007)

Prosody may facilitate language learning.

Introduction

- ✓ Infants are sensitive to prosodic boundaries and use them to segment speech
- ✓ However, IP boundary cues vary across languages: e.g., the cue weighed higher is pitch in Am. English, pitch change and lengthening in German, pause in Dutch
- ✓ Infants attune to the language-particular cues by 6-8 mos
- ✓ In European Portuguese (EP), for adults, pitch change and preboundary lengthening are robust cues to IP boundaries; the pause is not a necessary cue (Frota 2000; Severino 2016) → language-particular cues to IP marking

(Butler & Frota 2018; Frota 2012; Frota & Vigário 2018; Johnson & Seidl 2008; Johnson et al. 2014; Langus et al. 2012; Seidl & Cristià 2008; Wellmann et al. 2012)

Main Goals

Goals:

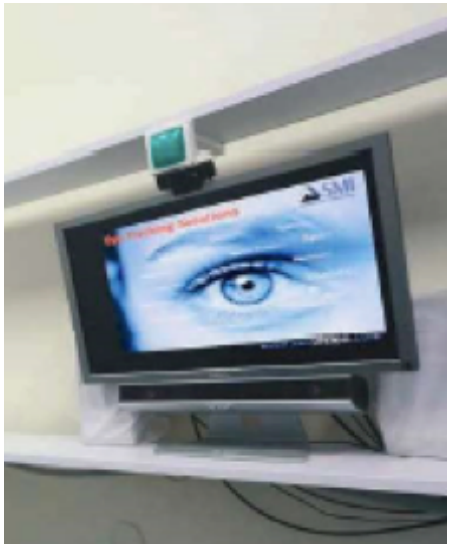
Investigate the **perception of prosodic boundaries in European Portuguese**-learning infants, by testing **9 month-olds**' discrimination of utterances **with and without an internal IP boundary**, cued by pitch rising and final lengthening (**no pause**)
+ the relation between infants' prosodic boundary discrimination abilities and later language outcomes

Main Goals

- If EP-learning infants are sensitive to IP boundaries, and attunement to the language cues is manifested by 6-8 mos, discrimination is predicted.

→ Novel features: use of delexicalized utterances, and eye-tracking

→ First study to explore relations between infants' prosodic boundary discrimination abilities and later language outcomes - a positive correlation is predicted.



Methods

Participants

- Fifteen typically developing infants from monolingual EP homes
- 7 females, mean age 9 months 10 days, range 8 months 6 days – 10 months 27 days)
- 5 other infants rejected
- All infants included:

  > 1 s looking time to one of the conditions

Methods

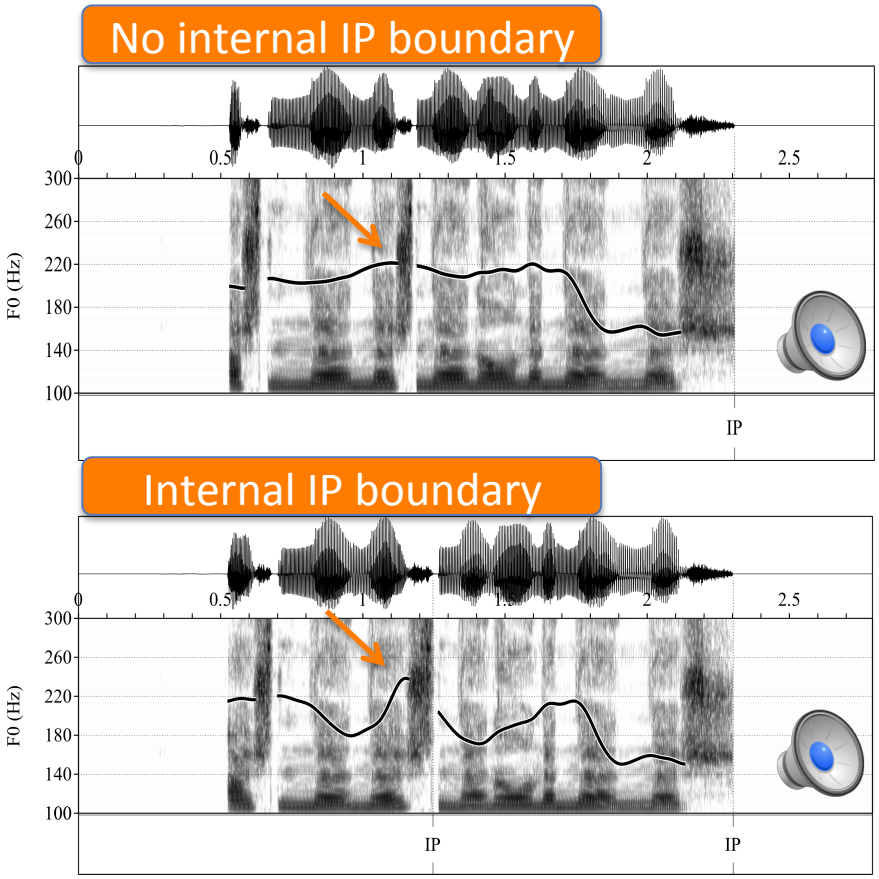
Stimuli

- 2 pairs of short sentences with two distinct prosodic groupings:

(As meninas deram bonecas) $_{IP}$	'The girls gave dolls'
(Às meninas) $_{IP}$ (deram bonecas) $_{IP}$	'To the girls, (they) gave dolls'

- Female native EP speaker
- 2 productions per sentence (2x4) delexicalized using MBROLA:
  All vowels → [ɐ]
  Coda consonants → [ʃ]
  All other consonants → [n]

Methods



Acoustic properties of the stimuli at the target syllable and following syllable (mean values).

	With IP	Without IP
Pitch rise (target syllable)	75 Hz	14 Hz
Duration (target syllable)	283 ms	190 ms
Pitch height (following syllable)	171 Hz	217 Hz

Procedure

- Modified version of the familiarization-preference procedure (Bosch & Sebastián-Gallés 2001), implemented with a SMI RED500 eye-tracker
- Familiarization type (No internal IP/Internal IP) counterbalanced

Methods

EXPERIMENT EXAMPLE

BLOCK 1

FAMILIARIZATION
Maximum of 2 minutes, until the subject gathers one minute of looking time

SENTENCE TY
WITH BOUNDA

PHRASE 1

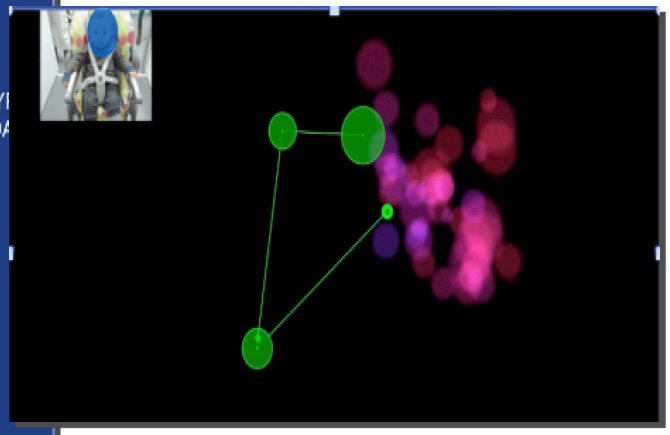
As meninas...

TEST TRIAL 1
4 Repeats
W/ BOUNDARY

TEST TRIAL 2
4 Repeats
W/OUT BOUNDARY

TEST TRIAL 3
4 Repeats
W/ BOUNDARY

TEST TRIAL 4
4 Repeats
W/OUT BOUNDARY



BLOCK 2

Video: *Well done!*

After 400ms fixation moves to next trial

FAMILIARIZATION
Maximum of 2 minutes, until the subject gathers one minute of looking time

SENTENCE TYPE:
WITH BOUNDARY

PHRASE 2

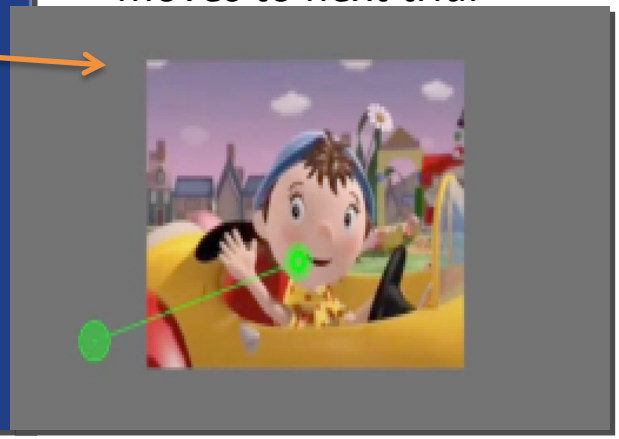
A miuda...

TEST TRIAL 1
4 Repeats
W/OUT BOUNDARY

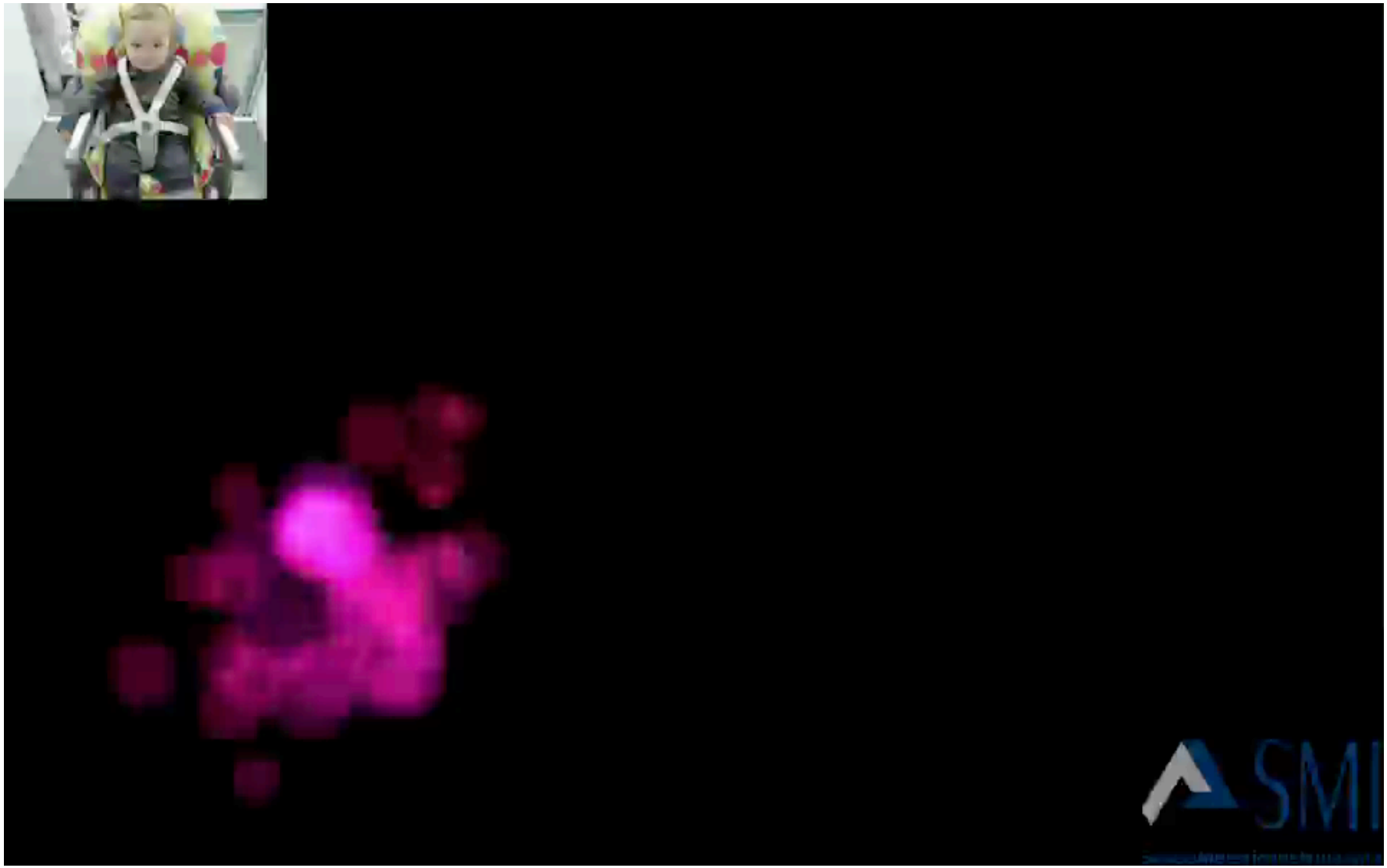
TEST TRIAL 2
4 Repeats
W/ BOUNDARY

TEST TRIAL 3
4 Repeats
W/ BOUNDARY

TEST TRIAL 4
4 Repeats
W/OUT BOUNDARY



ORDER OF TEST TRIALS: Notice that the only constraint in the test trials is that the first two trials are different from each other. The type of the first trial is randomized, as well as the order of the rest of the trials.

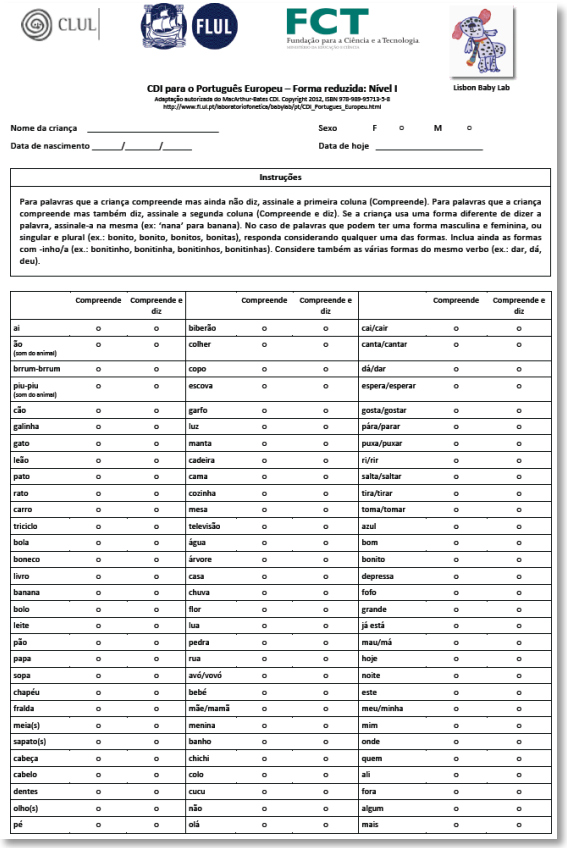

SMI

Methods

Measures of language outcomes:

Infants' caregivers completed the EP version of the CDI short forms (Frota et al. 2016) at 12, 18 and 24 months:

→ a parental checklist measure of the child's **vocabulary**, and of the ability to **combine words**.



CDI para o Português Europeu – Forma reduzida: Nível I

Lisbon Baby Lab

Nome da criança _____ Sexo F ○ M ○

Data de nascimento ____/____/____ Data de hoje _____

Instruções

Para palavras que a criança compreende mas ainda não diz, assinale a primeira coluna (Compreende). Para palavras que a criança compreende mas também diz, assinale a segunda coluna (Compreende e diz). Se a criança usa uma forma diferente de dizer a palavra, assinale-a na mesma (ex: 'nana' para banana). No caso de palavras que podem ter uma forma masculina e feminina, ou singular e plural (ex.: bonito, bonito, bonitos, bonitas), responda considerando qualquer uma das formas. Inclua ainda as formas com -inho/a (ex.: bonitinho, bonitinha, bonitinhos, bonitinhas). Considere também as várias formas do mesmo verbo (ex.: dar, dá, deu).

	Compreende	Compreende e diz		Compreende	Compreende e diz		Compreende	Compreende e diz
ai	○	○	biberão	○	○	cai/cair	○	○
ão (som do animal)	○	○	colher	○	○	canta/cantar	○	○
brrum-brrum	○	○	copo	○	○	dá/dar	○	○
piu-piu (som do animal)	○	○	escova	○	○	espera/esperar	○	○
cão	○	○	garfo	○	○	gosta/gostar	○	○
galinha	○	○	luz	○	○	pára/parar	○	○
gato	○	○	manta	○	○	puxa/puxar	○	○
leão	○	○	cadeira	○	○	ri/rir	○	○
pato	○	○	cama	○	○	salta/saltar	○	○
rato	○	○	cozinha	○	○	tira/tirar	○	○
carro	○	○	mesa	○	○	toma/tomar	○	○
triciclo	○	○	televisão	○	○	azul	○	○
bola	○	○	água	○	○	bom	○	○
boneco	○	○	árvore	○	○	bonito	○	○
livro	○	○	casa	○	○	depressa	○	○
banana	○	○	chuva	○	○	fofo	○	○
bolo	○	○	flor	○	○	grande	○	○
leite	○	○	lua	○	○	já está	○	○
pão	○	○	pedra	○	○	mau/má	○	○
papa	○	○	rua	○	○	hoje	○	○
sopa	○	○	avó/vovó	○	○	noite	○	○
chapéu	○	○	bebé	○	○	este	○	○
fralda	○	○	mãe/mamã	○	○	meu/minha	○	○
meia(s)	○	○	menina	○	○	mim	○	○
sapato(s)	○	○	banho	○	○	onde	○	○
cabeça	○	○	chichi	○	○	quem	○	○
cabelo	○	○	colo	○	○	ali	○	○
dentes	○	○	cucu	○	○	fora	○	○
olho(s)	○	○	não	○	○	algum	○	○
pé	○	○	olá	○	○	mais	○	○

Results

Prosodic boundary discrimination

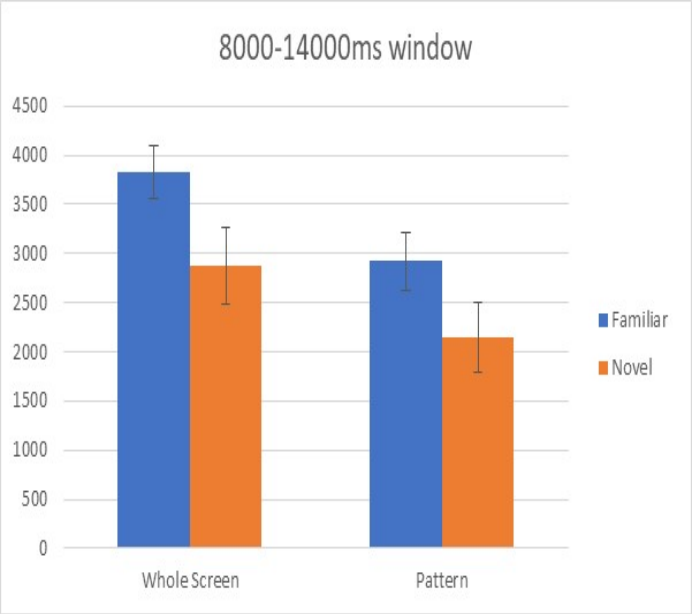
. AOIs
- AOI1 whole screen
- AOI2 dynamic visual moving pattern

. Time window of interest for the familiarity effect: 8000ms-14000ms

. Any consistent difference in looking time between familiar and novel is taken as an indication of discrimination abilities

Results

✓ Evidence for discrimination



Mean looking times (ms) to familiar and novel across the two AOIs

✓ No difference in familiarization looking time between infants familiarized with sequences without-IP and with-IP

($t(13)=.333$, $p=.745$)

	AOI1	AOI2
Familiarity	$F(1,13)=5.536$, $p=.035$, $\eta^2=.299$	$F(1,13)=5.785$, $p=.032$, $\eta^2=.308$
Familiarization condition	$F(1,13)=.236$, $p=.635$, $\eta^2=.018$	$F(1,13)=.024$, $p=.879$, $\eta^2=.002$
Interaction	$F(1,13)=.246$, $p=.628$, $\eta^2=.019$	$F(1,13)=.010$, $p=.923$, $\eta^2=.001$

Repeated measures ANOVA: within-subject factor of familiarity (familiar, novel) and between subject factor of familiarization condition (without, with IP).

Results

✓ Later language outcomes

Correlation between looks to familiar minus novel and EP-CDI scores for vocabulary and word combinations

Near-significant correlation between discrimination performance at 9 months and ability to combine words at 24 months (r=.871, p=.055)

Perception of prosodic boundaries may be related to early development of syntax in production

Discussion

- EP-learning infants discriminate between utterances with and without an internal IP boundary
- The pause is not a necessary cue by 9 mos in line with the language-specific adult pattern. This further supports infants' attunement to the language-particular pattern of boundary cues during the 1st year
- EP infants' discrimination was not affected by the type of prosodic grouping heard during familiarization, unlike German infants (Wellmann et al. 2012)

→ Further research needed to examine cross-linguistic differences in infants' perception

Discussion

- The use of delexicalized stimuli ascertains that infants' successful discrimination could only rely on the processing of prosodic structure (differently from Männel & Friederici 2011)
- This finding is relevant to prosodic bootstrapping theory → infants can exploit prosodic boundary cues to learn about the lexicon and syntax. Our findings suggest that perception of IP boundaries at 9 months may be related to early development syntax
- The use of eye-tracking offers more accurate (time window) and sensitive (AOIs) measures of discrimination abilities

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Thank you!

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