NeuroD_WEL$_L$ - Workshop on early language in neurodevelopmental disorders
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Early language development in European Portuguese-learning infants and toddlers with Down Syndrome measured with the CDI

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Fundação para a Ciência e a Tecnologia

Introduction

Introduction

Background

- CDI Short form I & II
- Normative Study
- Language development in Down Syndrome

Method

- Participants
- Materials & Procedure

Results

Discussion

Final remarks

Background

- McArthur-Bates Communicative Development Inventories short forms (CDI SFs) widely used to assess language skills in both toddlers and infants
- CDI adapted to more than 60 languages

  Short forms:

  → Easier to apply in research, educational and clinical settings

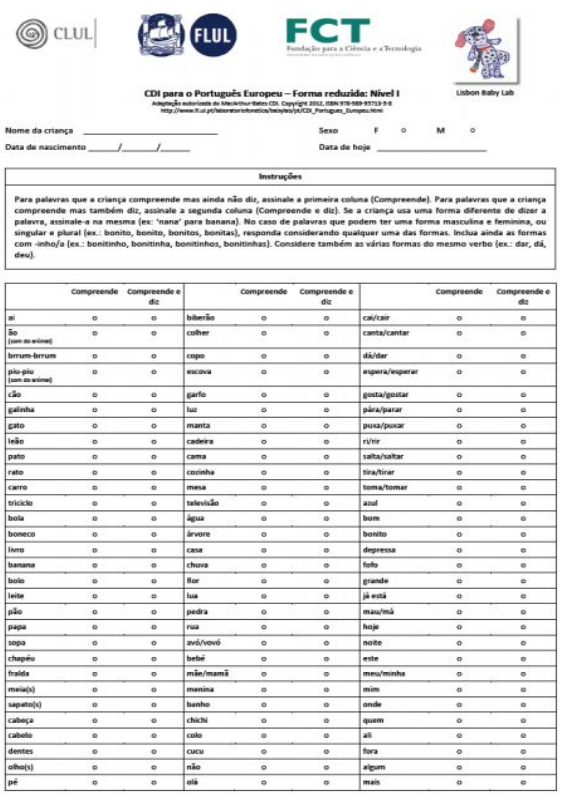
  → SFs' and LFs comparable reliability
- CDI SF adapted to European Portuguese (EP); norming study with monolingual children published.
  - SFI – 8 – 18 months (90 vocabulary items)
  - SFII – 16 – 30 months (99 vocabulary items + 1 word combination)

Fenson et al. (1993; 2007), Jackson-Maldonado et al. (2013), Frota et al. (2016)

Background

- **EP-CDI SFs :**

✓One page questionnaire ✓Easy to fill



CDI para o Português Europeu – Forma reduzida: Nível I

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	○	○	avô/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	○	○

CDI para o Português Europeu – Forma reduzida: Nível II

Nome da criança _____ Sexo F ○ M ○

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

Instruções

As crianças compreendem mais palavras do que dizem. Neste questionário, estamos interessados em saber as palavras que o/a seu/sua filho/a DIZ. Por favor, assinale as palavras que ouviu a criança dizer. Se ela diz a palavra de uma maneira diferente, 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, bem como as formas com -inho/a (ex.: bonitinho, bonitinha, bonitinhos, bonitinhas). Considere também as várias formas do verbo (ex.: dar, dá, deu).

ai	○	caixa	○	dá/dar	○	mãe/mamã	○
mé-mé	○	computador	○	finge/fingir	○	menina	○
miau	○	garfo	○	gosta/gostar	○	mim	○
pumba	○	luz	○	pensa/pensar	○	onde	○
tau-tau	○	óculos	○	põe/pôr	○	quem	○
cão	○	tapete	○	quer/querer	○	ali	○
cavalo	○	toalha	○	salta/saltar	○	fora	○
gato	○	cadeira	○	vê/ver	○	algum	○
pato	○	cama	○	azul	○	mais	○
rã	○	escada(s)	○	bom	○	meu/minha	○
urso	○	frigorífico	○	bonito	○	muito	○
barco	○	quarto	○	depressa	○	nenhum	○
carro	○	árvore	○	fofo	○	olho(s)	○
helicóptero	○	baloiço	○	frio	○	sou/são/é	○
bola	○	céu	○	já está	○	perna	○
brinquedo	○	chuva	○	maior	○	porque	○
livro	○	sol	○	pequeno	○	unha(s)	○
água	○	circo	○	depois	○	palavras terminadas em -zinho (ex.: leãozinho)	○
banana	○	escola	○	dia	○		
bolacha	○	amigo	○	hoje	○		
carne	○	mãe/mamã	○	isto	○		
iogurte	○	professor	○	mim	○		
pão	○	banho	○	nosso	○		
queijo	○	não	○	tu	○		
sumo	○	obrigado(a)	○	onde	○		
casaco	○	olá	○	aqui	○		
chapéu	○	por favor	○	dentro	○		
meia(s)	○	acaba/acabar	○	em cima	○		
sapato(s)	○	brinca/brincar	○	muito	○		
mão	○	cabe/caber	○	nenhum	○		
olho(s)	○	cai/cair	○	sou/são/é	○		
perna	○	compra/comprar	○	porque	○		
unha(s)	○	corre/correr	○	palavras terminadas em -zinho (ex.: leãozinho)	○		

A sua criança começou a combinar palavras, como por exemplo, 'bola amarela', 'quero pintar' ou 'menino voa'?
Não ○ Às vezes ○ Muitas vezes ○

Frota et al., 2016

Background

- **EP-CDI SF - Normative Study**

Main findings:

- Comprehension precedes production
- Steady vocabulary increase with age; more so after 24 months
- Production shows a ceiling effect at 27 months (~ American English, Spanish and Galician)
- Correlation between expressive vocabulary and word combinations
- Gender differences, girls > boys - advantage throughout all age groups

Article

FIRST LANGUAGE

First Language
2016, Vol. 36(5) 525–545

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SAGE

Infant communicative development assessed with the European Portuguese MacArthur–Bates Communicative Development Inventories short forms

Frota et al. (2016)

Background

- **Language development in Down Syndrome (DS)**
  - Most individuals with DS show language and speech deficits

    . delayed vocabulary growth

    . late emergence of two-word utterances

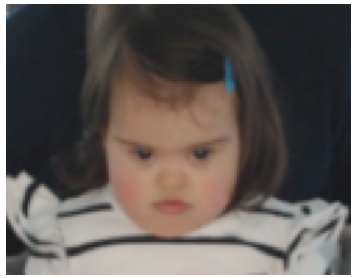
    (Abbeduto et al. 2007; Roberts et al. 2007; Iverson Longobardi & Casselli 2003; Galeote et al. 2013; Deckers 2016)

Background

- **Vocabulary growth and syntactic development in DS**
  - High correlation between size of vocabulary and syntactic development in (Vicari et al. 2000, Zampini and D'Odorico 2011)
  - Lexical development precedes grammatical development (Galeote et al. 2013)
- **Very few studies on early language**

  → Even those that look at early stages, tend to not include children below 2 years old (or 3 years when mental age is matched) (Deckers 2016; Galeote et al. 2013; but Berglund et al. (2001)
- DS language development has been investigated in **few languages**; no studies for Portuguese

Method



- **Data collection: DS**
  - Questionnaires filled by the caregiver when/before children visited the Baby Lab for other studies
  - Collaboration with Down syndrome parents' and friends' associations (*Diferençcas*)
- **Inclusion criteria – DS**
  - Medical diagnosis of Trisomy 21
  - No/mild hearing loss (audiometrical assessment)
  - Monolingual families
  - Between 8-30 months

Method

- **Data collection: other groups**
  - Infants and toddlers Typically Developing monolinguals (TD) (N=836), At Risk (AR) =82, and Bilingual TD
  - In this presentation we will compare the results of DS with TD and AR

    → TD inclusion criteria: Frota et al. (2016)

    → AR inclusion criteria:

    . Familial risk for neurodevelopmental disorders (LD, ASD, SCD)

    . Premature birth (< 37 weeks)

    . Low birth weight (< 2500 g)

    . Late talkers (< 10th percentile in the CDI before/at 24 months

Method

- **SFI - 19 Infants**

CDI SFI	
Month	Total
8,9 months	7
10, 11 months	2
12, 13 months	4
14, 15, 16 months	3
17, 18 months	3
Total	19

Table 1 - Data distribution by age, SFI

- **SFII - 23 Toddlers**

CDI SFII	
Month	Total
16, 17, 18 months	4
19, 20 months	5
21, 22 months	3
23, 24 months	5
25, 26, 27 months	3
28, 29, 30 months	3
Total	23

Table 2 - Data distribution by age, SFII

Method:
Employment Status

- **EP-CDI: SD**

Parental Employment Status	CDI-I		CDI-II	
	N(19)	%	N(23)	%
Highly Qualified	7	37%	11	48%
Medium Qualified	7	37%	9	39%
Low Qualified and Workers	1	5%	0	0%
Unemployed	4	21%	3	13%

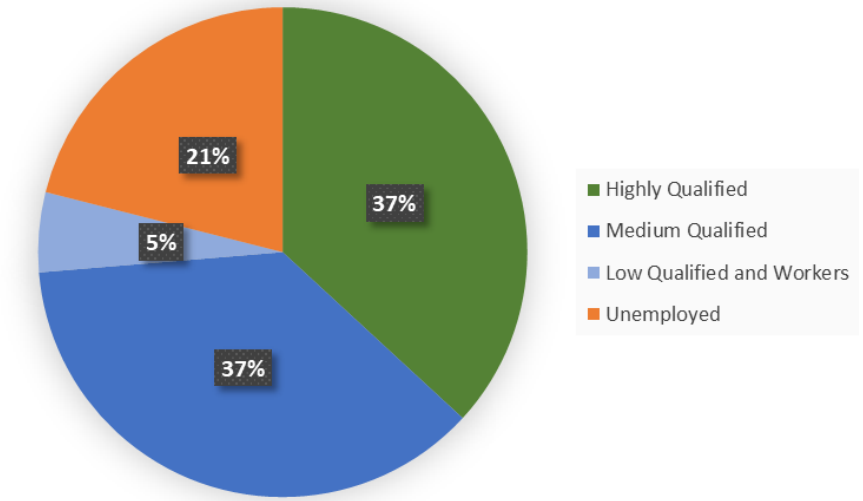


Figure 1. Participant distribution by parent employment status (infant short form, EP-CDI SFI).

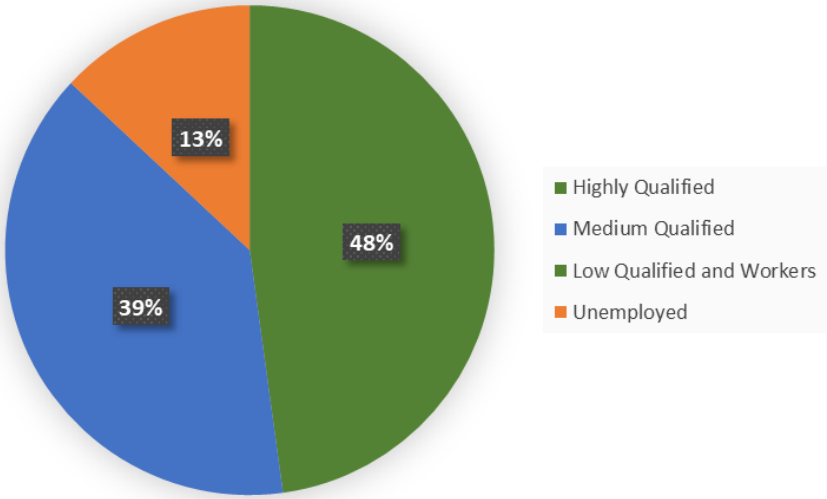
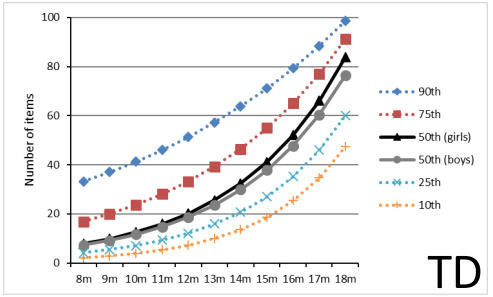


Figure 2. Participant distribution by parent employment status (toddler short form, EP-CDI SFII).

Results



TD

- **EP-CDI SFI results for DS - Comprehension**
  - At 17-18 months DS are reported to understand 14 words on average
  - Comprehension increases very little with age; difference not significant (8-12 vs 13-18: t(17)=-1.641, p=0.119)

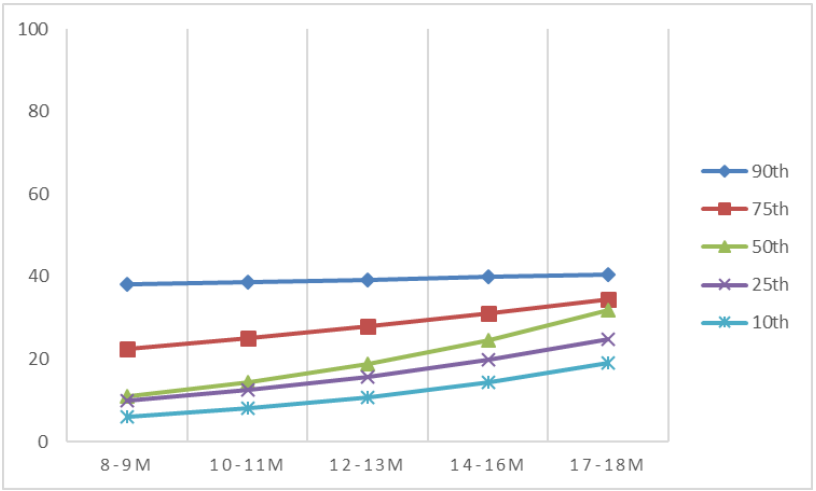
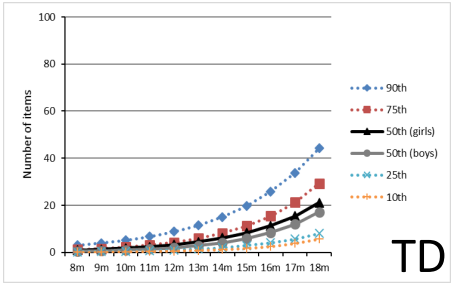


Figure 3. Words understood as a function of age (months) and percentile level. Fitted score (infant short form, EP-CDI SFI).

Results



TD

- **EP-CDI SFI results for DS - Production**
  - The first words start appearing only at 16-18 months (2 words on average)
  - Small but significant improvement with age for production (8-12 vs 13-18: t(6.505)=-3.261, p=0.015)

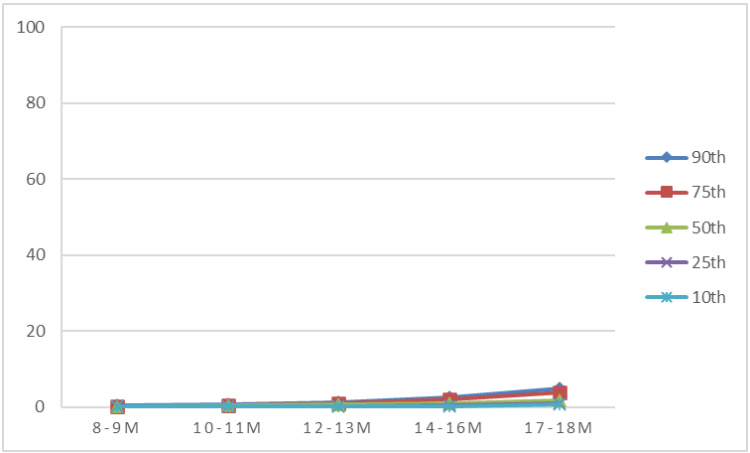


Figure 4. Words produced as a function of age (months) and percentile level. Fitted score (infant short form, EP-CDI SFI).

Results

- **EP-CDI SFI results for TD and DS – Comprehension and Production**
  - DS show delayed and slower development; less steep growth curves

  → At 17-18 months:

  DS understand 14 words vs 55 words in TD

  DS start producing the first words, while TD are already producing 22 words

- DS differ significantly from TD in comprehension; difference due to the older group (shallower development in DS)
- In production, DS performed significantly lower than TD in both age groups

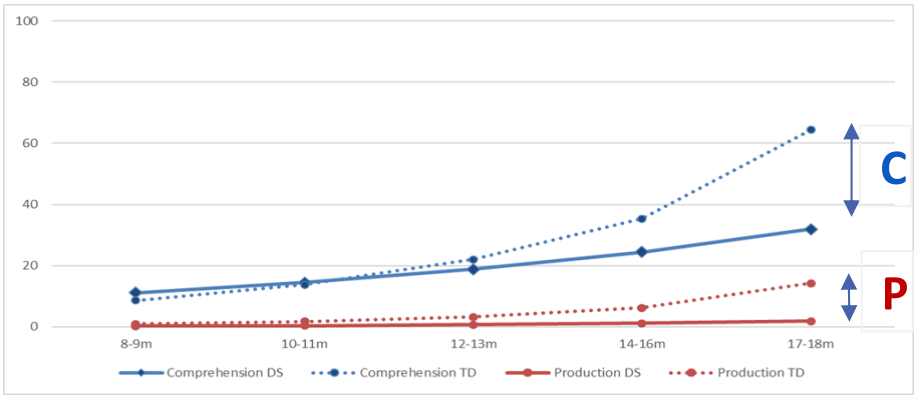


Figure 5. Words produced and understood as a function of age (months) and TD (Typical Development) vs. DS (Down Syndrome). Median score (50th percentile) (infant short form, EP-CDI SFI).

Results

- **EP-CDI SFI results for TD, At Risk (AR) and DS - Comprehension**
  - AR and DS do not differ significantly for comprehension (F(1,50)=0.164, p=0.687) in both age groups (8-12, AR vs. DS: U=99,000, p=0.131; 13-18, AR vs. DS: U=37,000, p=0.892)

- AR and DS differ significantly from TD

Post Hoc
DS vs. AR: p=1.000
TD vs. AR: p<0.001
TD vs. DS: p=0.010

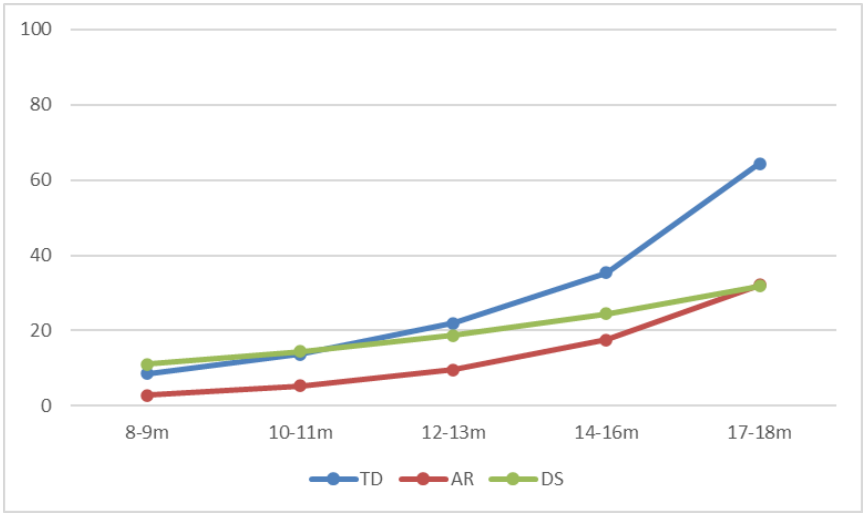


Figure 6. Words understood as a function of age (months) and TD vs. AR (At Risk) vs. DS. Median score (50th percentile). (toddler short form, EP-CDI SFI)

Results

- **EP-CDI SFI results for TD, AR and DS - Production**
  - AR and DS do not differ significantly for production (F(1,50)=0.006, p=0.936) in both age groups (8-12: AR vs. DS: U=113,000, p=0.259; 13-18: AR vs. DS: U=34,500, p=0.717)

  - AR and DS differ significantly from TD

    Post Hoc
    DS vs. AR: p=1.000
    TD vs. AR: p<0.001
    TD vs. DS: p=0.005

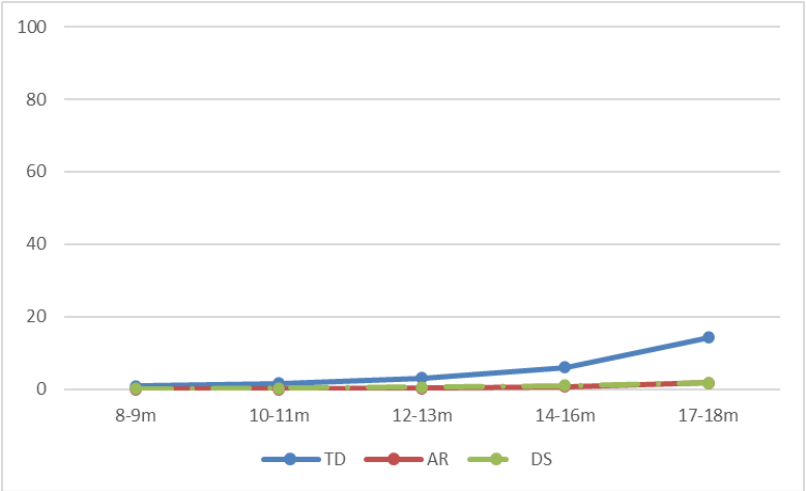
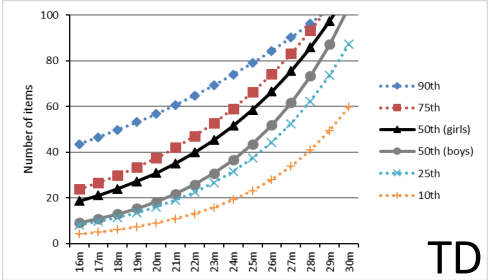


Figure 7. Words produced as a function of age (months) and TD vs. AR (At Risk) vs. DS. Median score (50th percentile). (toddler short form, EP-CDI SFI)

Results



- **EP-CDI SFII results for DS - Production**
  - Significant development in production (F(2,21)=7.042, p=0.005)

→ Especially when the last age group is compared with the younger one (16-20 vs. 26-30 p=0.006)

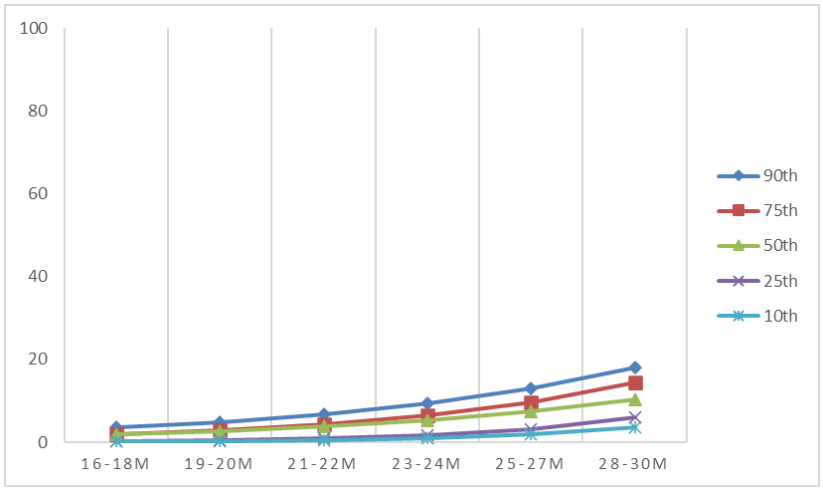


Figure 8. Words produced as a function of age (months) and percentile level. Fitted score (infant short form, EP-CDI SFII).

Results

- **EP-CDI SFII results for DS and TD - Production**
  - DS strongly underperform compared to the TD; difference very significant (F(2,447)=12.856, p<0.001)
  - Still small vocabulary in DS at 28-30 months produce (10 Words), while TD already show a ceiling effect by this age

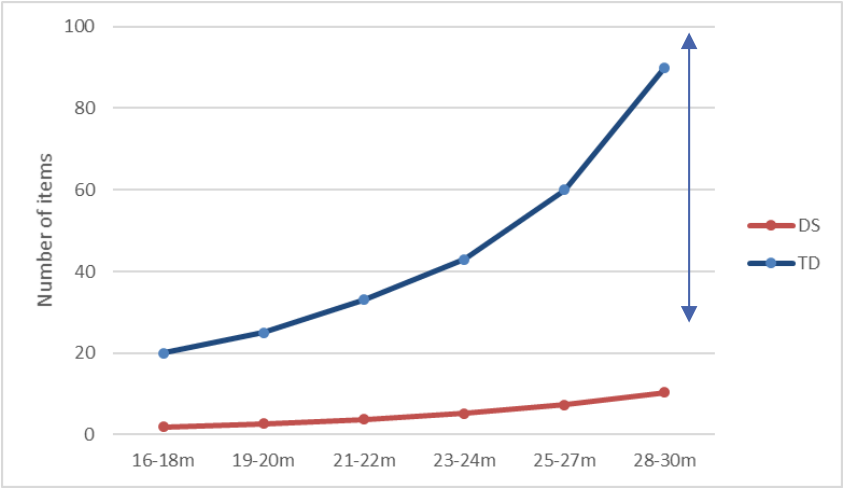


Figure 9. Words produced as a function of age (months) and TD vs. DS. Median score (50th percentile) (infant short form, EP-CDI SFII).

Results

- **EP-CDI SFII results for TD, AR, DS - Production**
  - AR differ significantly from DS (F(1,67)=8.932, p=0.004)
  - All groups differ significantly (F(2, 493)=40.721, p<0.001)

Post Hoc
DS vs. AR: p=0.001
TD vs. AR: p<0.001
TD vs. DS: p<0.001

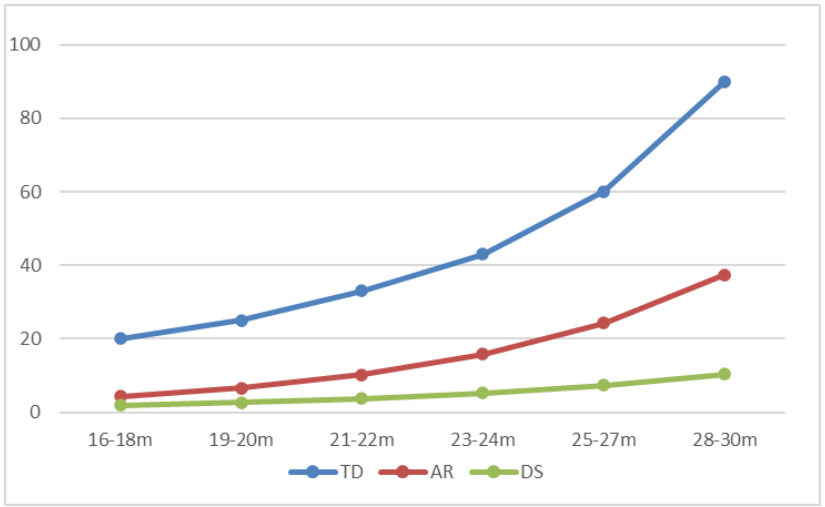
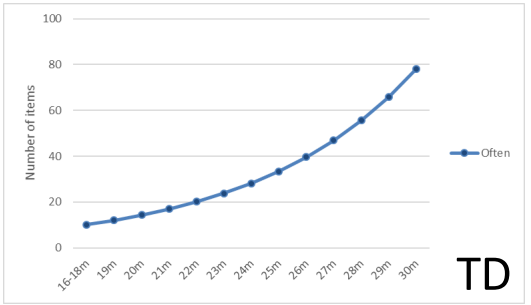


Figure 10. Words produced as a function of age (months) and TD vs. AR vs. DS. Median score (50th percentile) (infant short form, EP-CDI SFII)

Results



- **EP-CDI SFII results for DS - word combination**
  - At 28-30 months DS have almost no word combinations
  - Effect of age only seen in the comparison between early and late periods (16-20 vs 21-25 months)

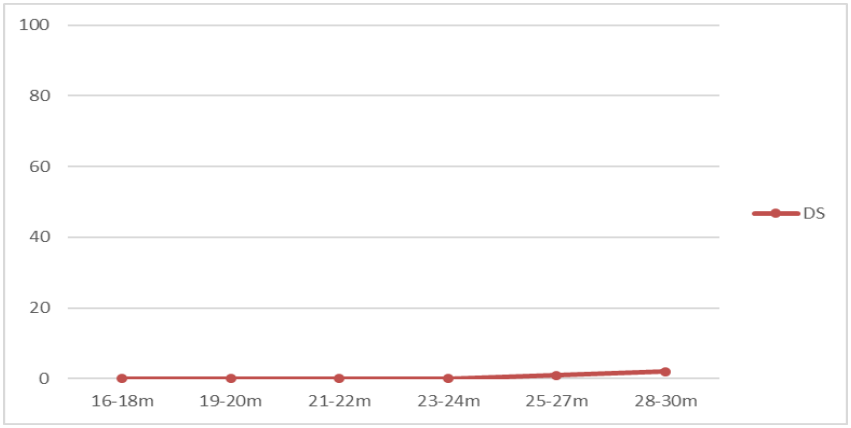


Figure 11. Words produced as a function of age (months). Median score (50th percentile) (infant short form, EP-CDI SFII).

Results

- **EP-CDI SFII results for DS and TD - word combination**
  - DS strongly delayed compared to the TD: at 28-30 months DS are not yet combining words, unlike TD, who already combine words by 16-18 months and show steep increase after 24 months
  - The two groups differ significantly (F(1,447)=12.531, p<0.001) in all age groups

16-20 – TD vs. DS – U=308.00, **p=0.019**

21-25 – TD vs. DS - U=301.00, **P=0.001**

26-30 – TD vs. DS - U=75.00, **p=0.002**

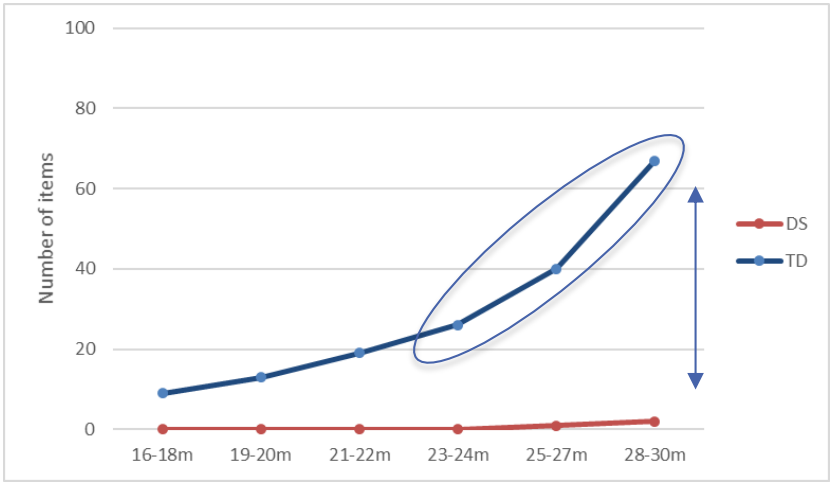


Figure 12. Words produced as a function of age (months) and DS vs. TD. Median score (50th percentile) (infant short form, EP-CDI SFII).

Results

- **EP-CDI SFII results for TD, AR and DS - word combination**
  - Significant difference between AR and DS in word combination emerges after 24 months
  - TD, AR and DS groups differ significantly

Post Hoc
DS vs. AR: p=0.012
TD vs. AR: p<0.001
TD vs. DS: p<0.001

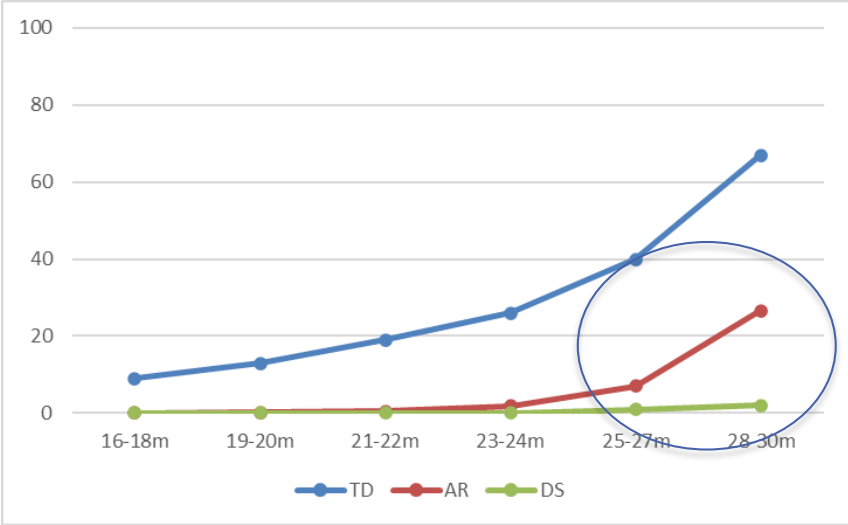


Figure 13. Proportion of children combining words 'often', as a function of age (months) and TD vs. AR vs. DS (Fitted data) (infant short form, EP-CDI SFII)

Discussion

- DS show delayed comprehension and production
- Despite slow, there is a developmental curve, especially observable in production and in particular after 24 months
- By the end of the period under observation (28-30 mo)
  - DS still show very reduced vocabulary
  - DS still do not combine words
- While AR and DS do not differ until 17-18 months in number of words understood and produced, unlike DS, AR show great vocabulary growth after 18 months (though much less than TD)
- By 24 months, AR and DS also differ in the ability to combine words

Discussion

- There seems to be an association between vocabulary size and combination of first words:

  . at the end of the period under observation, DS produce only 10 words and show virtually no word combination

  . AR start combining words after 24 months; at this age they produce a bit more than 20 words

  . when TD produce 20 words (16-18 months), they are already combining words

  → In line with the hypothesis that a *critical mass* of words is required in the child vocabulary for the emergence of word combination (Bates and Goodman 1999; Galeote et al. 2013)

- No signs of a difference in the *path* of development; just delay

Final remarks

- EP-CDI is a useful tool to assess relevant aspects of DS language development, allowing straightforward comparisons with TD
- The results referring to the lexical size and first word combinations suggest that EP-CDI may be useful for predicting language later outcomes, not only for TD (Frota et al. 2016), but also for AR and DS
- Work planned:

  . Analyse data from later stages in DS (and AR)

  . Investigate further correlations between vocabulary growth and other areas of language development

Thank you!

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