
LABFON - CLUL

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# Early Vocal Patterns: typically developing infant and toddlers with autismo spectrum disorders

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**WELL**
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# INTRODUCTION

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is characterized by deficits in:
  - Social interaction/ Communication
  - Behaviour

- American Psychiatric Association.2013

# INTRODUCTION

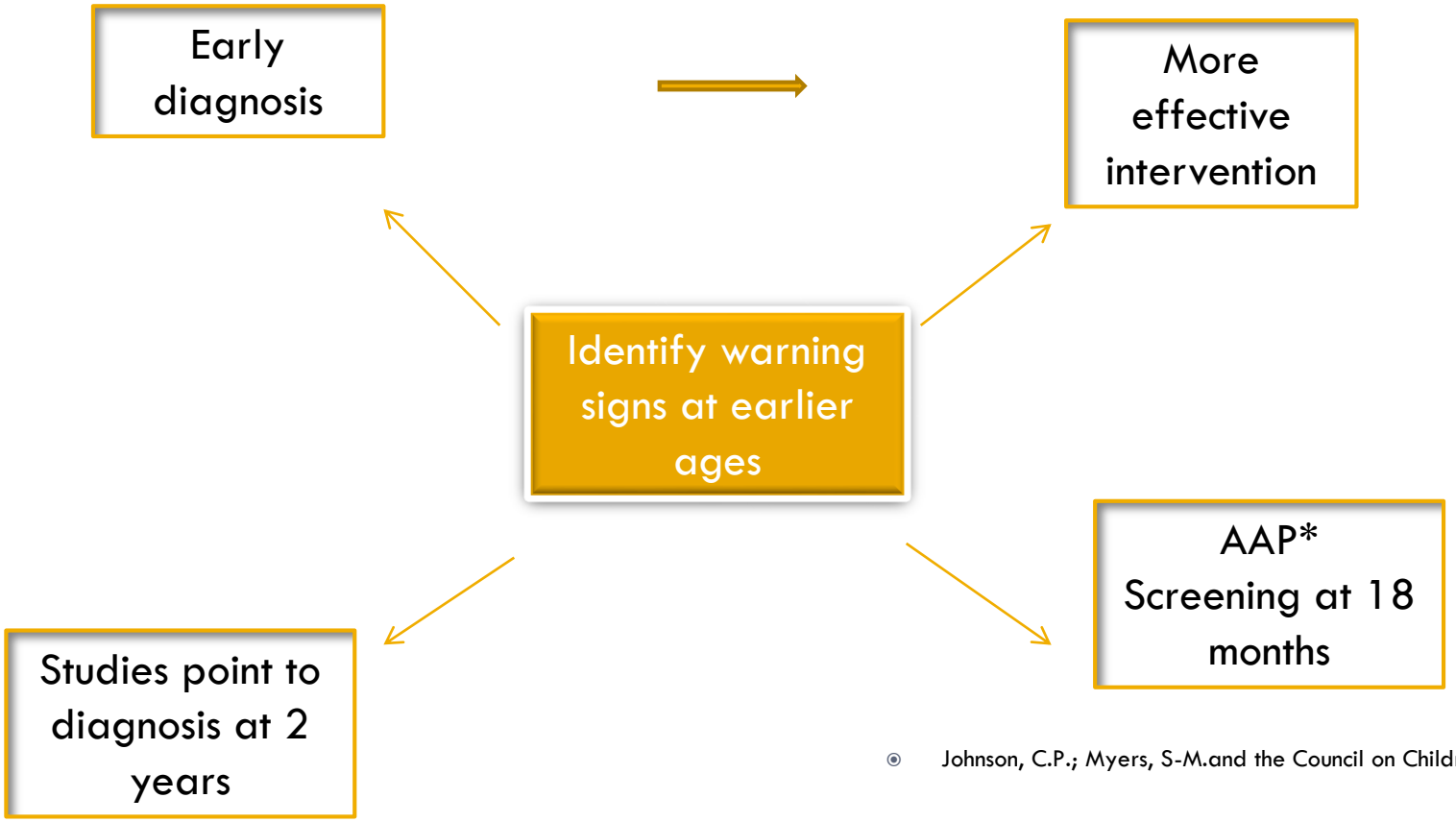
- ASD:
  - Clinical entity well documented and defined in *Diagnostic and Statistical Manual of Mental Disorders (DSM -5)*, Fifth Edition; United States, 2013.
  - Frequent neurodevelopment disorder with a world prevalence of 1%, in USA a prevalence of 1/68[2] children 2010 (USA-CDC)
  - About half the population does not acquire verbal language


1.Oliveira G, Ataíde A, Marques C, Miguel TS, Coutinho AM, Mota Vieira L, et al., 2007.

2. Jon Baio, EdS, National Center on Birth Defects and Developmental Disabilities, CDC.2010

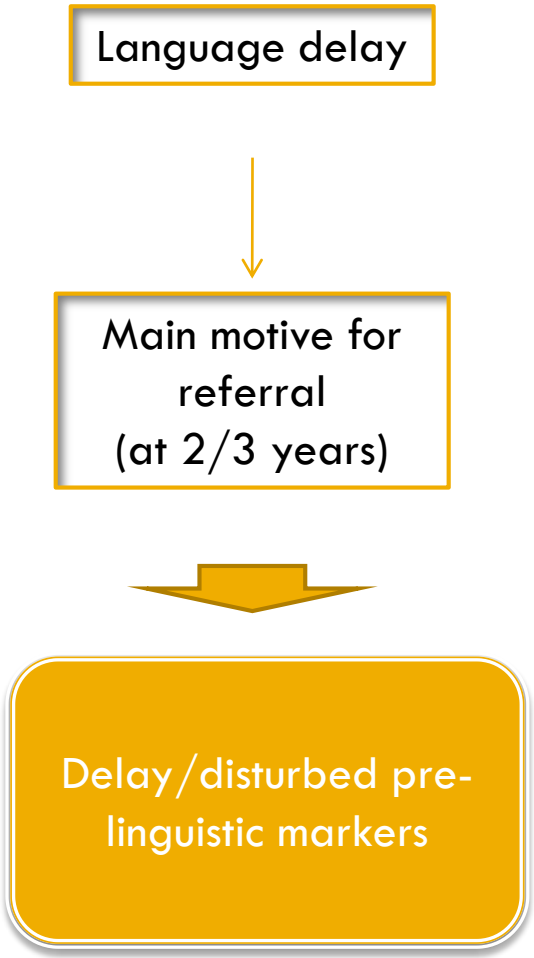

- ASD disorder with an early start (in first year of life), but
  - Diagnosis in preschool age (3 and 4 years old).

# INTRODUCTION




- Johnson, C.P.; Myers, S-M.and the Council on Children With Disabilities , 2007

# INTRODUCTION



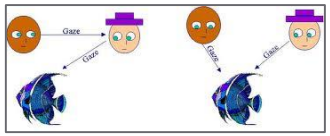
# INTRODUCTION

- Tipycal developmental of communication:

Eye contact

Facial expression

Joint attention



pointing

Speech production

1° year of life – “critical period”

# INTRODUCTION

- In children with ASD there is an absence or delay in communication and language skills:

**Eye contact**
- Doesn´t look
- Do not follow the eye contact of others
- Failed in coordination of eye contact and others communicative acts (gesture and expressions)

**Vocalizations**
- Babling delay aquisition
- Failed reciprocity between the child's vocalizations and parental verbalization
- Decrease in the frequency and quality of vocalizations

**Gesture/imitation**
- Failure in pointing
- Failure in show or give when asked
- Failure to make social gesture: goodby
- Do not nods for yes / no
- Failure to imitatet gestures

Johnson, C.P.; Myers, S-M.,and the Council on Children With Disabilities (2007); Tuchman, R. & Rapin, I. 2006; Robins, D. L., Fein, D., & Barton, M. L. 1999; Wetherby, A., Woods, J., Allen, L., Cleary, J., Dickinson, H. and Lord, C2004. .

# INTRODUCTION

- Experimental research: Vocalizations

Atypical vocalizations

predictors of lower expressive language.

- *Elizabeth Schoen, Rhea Paul, Kasia Chawarska, Ami Klin, & Fred Volkmar.*

- At 12 and 18 months of age, children with ASD have less frequent vocalizations and have a lower proportion of vocalizations with consonants. They use more atypical vocalizations and higher stress.( *Plumb, 2008;* Schoen, E., Rhea P., and Chawarska, 2011).

- Delay in first words acquisition, (38 months is an average age of acquisition in children with ASD) (Howlin, 2003).

- There are changes in vocal quality – ASD children produce greater number of syllables with atypical vocal quality. (Sheinkopf et al 2000)

# INTRODUCTION

- Experimental research: Vocalizations
  - Study of siblings of children with ASD followed for a period of 24 months. (6,9,12m and 24m); later separated into three samples: ASD; LD; TD.
  - *A perceptive analysis was made for 50 utterance productions for each children:*

Non speech like

1. Delight: Laughing or giggling.
2. Distress: Crying, whining or fussing.
3. Atypical: High-pitched squeals, low-pitched growls, yells, grunts

Speech like

Consonant and syllabic inventory

**Table V. Sounds Based on Developmental Acquisition**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Early-8 | /m/ | /b/ | /j/ | /n/ | /w/ | /d/ | /p/ | /h/ |
| Middle-8 | /t/ | /ŋ/ | /k/ | /g/ | /f/ | /v/ | /ʧ/ | /ʤ/ |
| Late-8 | /ʃ/ | /θ/ | /s/ | /z/ | /ð/ | /l/ | /ɹ/ | /ʒ/ |

*Conclusion:*

**Table VIII. Nonspeech Productions Produced by ASD, TDA, and TDL Groups**

| | Group | | | | | |
|---|---|---|---|---|---|---|
| Production type | ASD ($n = 30$) *M* (SD) | TDA ($n = 11$) *M* (SD) | TDL ($n = 23$) *M* (SD) | *F*(2, 61) | Significance | *d* (effect size)[a] |
| Laugh | 4.73 (8.82)[1] | 1.73 (2.10)[1] | 0.65 (1.34)[1] | 3.01 | NS | |
| Atypical | 5.07 (5.70)[1] | 1.09 (1.92)[2] | 0.61 (1.34)[2] | 8.89[b] | $P < 0.02$ | ASD vs. TDL: 1.08<br>ASD vs. TDA: 0.94 |
| Squeal | 3.37 (4.53)[1] | 0.18 (0.60)[2] | 0.26 (0.86)[2] | 7.75[b] | $P < 0.003$ | ASD vs. TDL: 0.96<br>ASD vs. TDA: 0.99 |
| Growl | 1.27 (2.32)[1] | 0.91 (1.81)[1] | 0.35 (0.94)[1] | 1.61 | NS | |
| Yell | 0.27 (0.69) | – | – | 2.49 | | |
| Distress | 3.07 (7.57)[1] | 0.36 (0.67)[1] | 3.57 (5.93)[1] | 1.01 | NS | |

**Table IX. Comparison of Consonant and Syllable Shape Variables in ASD, TDA, and TDL Groups**

| | Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ASD ($n = 30$) | | | TDA ($n = 11$) | | | TDL ($n = 23$) | | | |
| | *M* | SD | Range | *M* | SD | Range | *M* | SD | Range | *F* (2,61) |
| *Consonant inventories* | | | | | | | | | | |
| Different consonants | 6.73 | 3.16 | 2–12 | 13.82 | 2.93 | 8–18 | 7.52 | 4.13 | 0–15 | 17.14* |
| Number of early-8 consonants | 5.50 | 2.13 | 1–8 | 7.36 | 0.92 | 5–8 | 4.57 | 2.39 | 0–8 | 6.69* |
| Number of middle-8 consonants | 2.27 | 136 | 0–5 | 4.18 | 1.78 | 1–8 | 1.83 | 1.44 | 0–4 | 10.01* |
| Number of late-8 consonants | 0.87 | 1.07 | 0–3 | 3.09 | 1.51 | 0–6 | 1.09 | 1.20 | 0–4 | 14.49* |
| Different consonant blends | 0.97 | 1.47 | 0–5 | 3.00 | 3.72 | 0–10 | – | – | – | – |
| *Syllable structure* | | | | | | | | | | |
| Syllable structure level | 1.69 | 0.41 | 1.0–2.4 | 2.28 | 0.26 | 1.9–2.7 | 1.36 | 0.027 | 1.0–2.0 | 25.94* |

Rhea Paul, Yael Fuerst, Gordon Ramsay, Kasia Chawarska,and Ami Klin.2011
**Out of the mouths of babes: Vocal production in infant siblings of children with ASD**

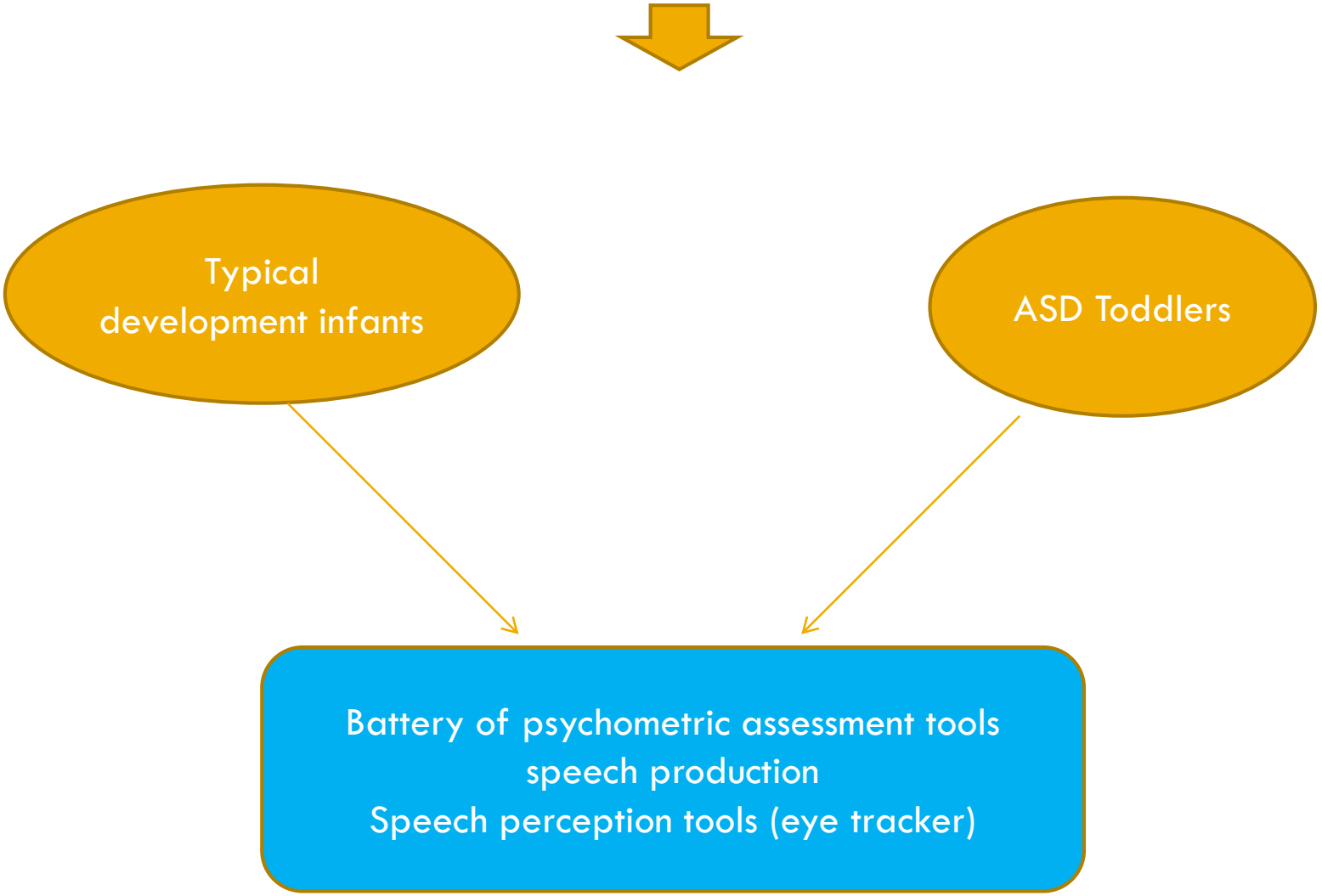
# INTRODUCTION

- What are the marker of pre-verbal communication that are related to the acquisition and development of language in ASD?

# OBJECTIVE

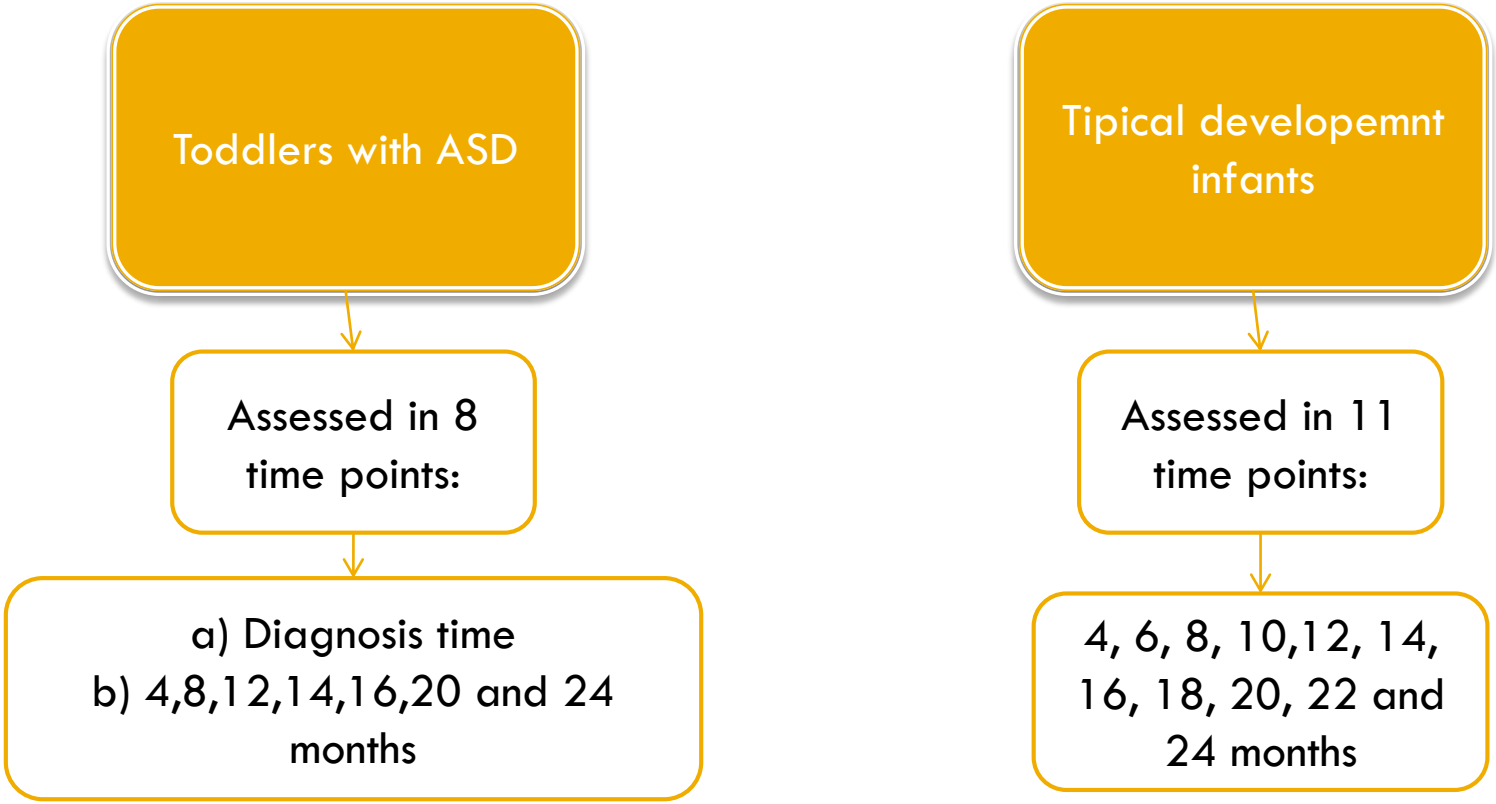
- Investigate the communication and language acquisition and development in children with ASD, in order to define early markers for prognosis in:
  - Communication
  - Speech perception
  - Speech production

# OBJECTIVE


Typical development infants
ASD Toddlers
Battery of psychometric assessment tools
speech production
Speech perception tools (eye tracker)

# METHODOLOGY

- Longitudinal prospective study with data collection of:



# METHODOLOGY - Sample

- *ASD toddlers*: recruited in Santa Maria Hospital and LógicaMentes neurodevelopmental clinics:
  - 20 toddlers
  - ***Inclusion criteria***:
    - All children with formal diagnoses of ASD
    - Chronological age up to 48 months
    - No oral language (0 to 5 words at first collection)
  - ***Exclusion criteria***:
    - Global development quotient < 25
    - Moderate to severe sensory deficits (visual and auditory)
    - Epilepsy.

# METHODOLOGY - Sample

- *Tipical development (TD) infant recruited in Portuguese educational schools*
  - 20 infants
  - ***Inclusion criteria*:**
    - Infants from 4 months of age
    - apparently healthy
    - Typical psychomotor development.
  - ***Exclusion criteria*:**
    - ASD symptoms (positive M-CHAT and/or positive clinical observation)
    - Psychomotor development delay (<-2dp),
    - Perinatal risk factors (prematurity - gestational age of 37 weeks, very low-birth weight <1500 g)
    - Identified genetic syndromes and sensory deficits.

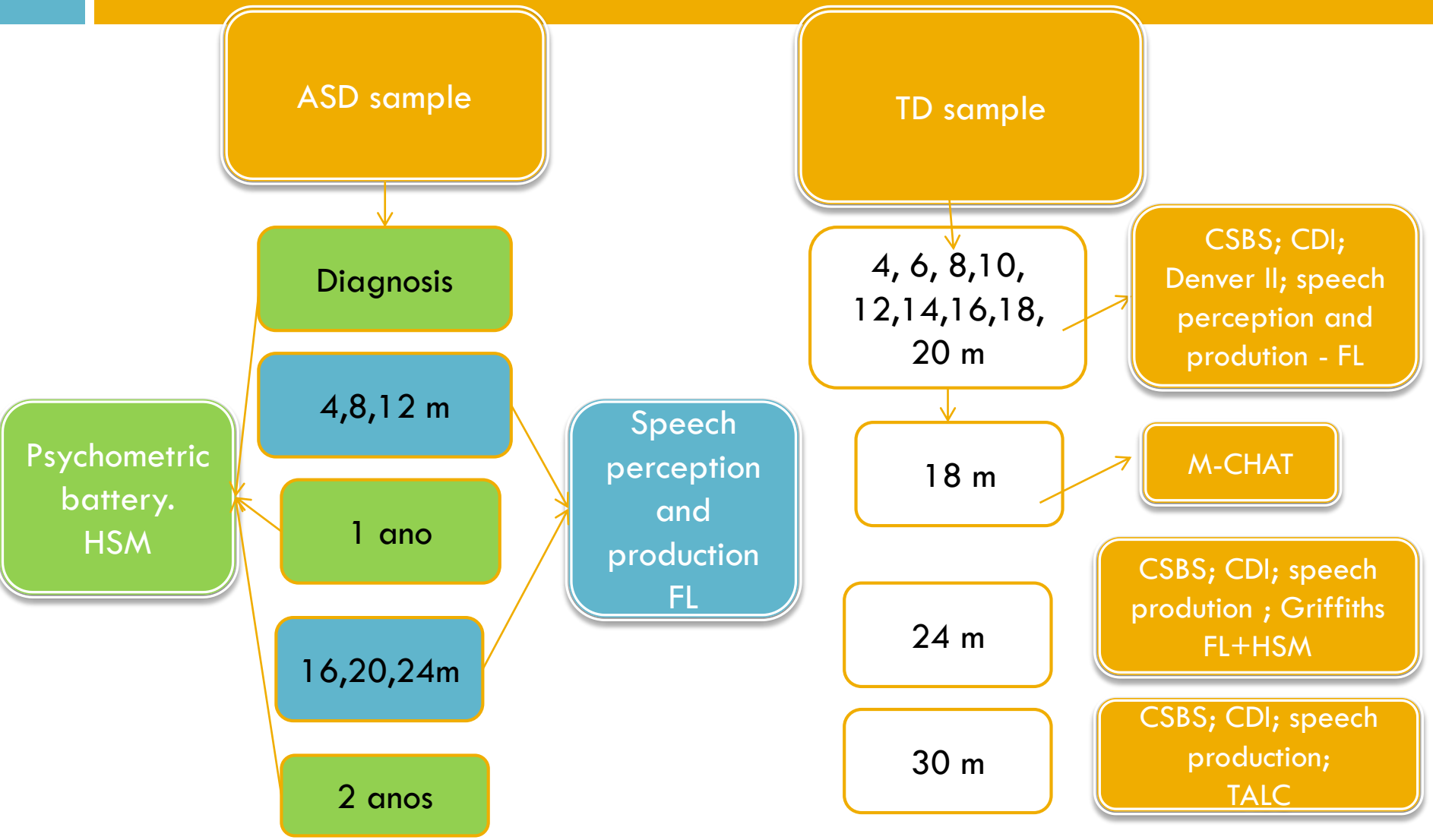
# METHODOLOGY- tools

- **Procedures: Instruments assessment:**
  - **ASD diagnosis and symptoms characterization**
    - Modified Checklist for Autism in Toddlers (M-CHAT),
    - Childhood Autism Rating Scale (CARS),
    - Autism Diagnostic Interview – Revised (ADI-R),
    - Diagnostic and Statistical Manual of Mental Disorders (DSM5)
  - **Psychomotor assessment**
    - Ruth Griffiths Developmental Scale (Griffiths).
    - Denver II
  - **Communication assessment**
    - **Scale translation: Communication and Symbolic Behaviour Scales (CSBS DP) Infant-Toddler Checklist,**
    - Video analysis
  - **Language assessment:**

    **C**ommunicative development inventory (CDI – Portuguese version)

    Teste de Avaliação da Linguagem na Criança (TALC)

# METHODOLOGY – assessment times



# METHODOLOGY – Speech Production

- **Recordings of speech productions in TD and ASD children:**
  - Productions were recordings for a period of 20 minutes each time;
  - In infants with TD the recordings occurred at intervals of 2 months;
  - In toddlers with ASD recordings occurred at intervals of 4 months;
  - It was explained to parents the procedures and objectives of the experiment and asked to make an interaction with the child as natural as possible.

# METHODOLOGY – Speech Production

- **Perceptive codification:**
  - All the productions were classified according this criteria:
    - Silent durations: period of time < 300 ms (Oller et al 2010)
    - Utterances: production with one or more intonational phrase and with pauses inferior to 300 ms.
    - Production were classified in production category:
      - Non speech production
      - Speech like production

# METHODOLOGY – Speech Production

- **Perception codification:**
  - Productions Categories :

| | |
|---|---|
| *Non_Speech_Prod*<br>***The non speech category included productions characterized by non speech resonance (e.g. screams, laughter, crying) without recognizable consonants.*** (Rhea et al,2010) | **Distress (cry, groan and whining )**<br>**Pleasure (Laughing or giggling)**<br>**Atypical (: High-pitched squeals, low-pitched growls, yells, grunts)**<br>**Others (vegetative sounds and others not specified)** |
| ***Speech-like Prod***<br>*The speech-like events were characterized by the production of consonants and/or vowels that could be represented by phonetic symbols and contained speech like resonance.* (Rhea et al,2010) | Vocalization<br>Babbling<br>Vowel<br>Consonants<br>Syllable<br>Word |

# METHODOLOGY – Speech Production

- **Acoustic codification:**
  - All the production were classified according this criteria:
    - intonational phrase:
      - Duration;
      - F0 values: maximal minimal, initial and final pitch values; pitch range
    - Vowel:
      - F1 and F2 values.

# RESULTS - sample

- Sample:

| ASD | TD |
|---|---|
| Inicial sample:50<br>Sample selected: 21 without words and age inferior to 48m | Incial sample: 20 |
| Dropouts:<br>2 | Refuse in participating in a long term study: 3<br>Dropouts:<br>3 |
| Final sample: 19 | Final sample: 14 |
| Longitudinal floow-up:<br>Diagnoses to 2 years | Longitudinal floow-up:<br>4m - 30m |
| Mean age of first collection: 29 m | Mean age of first collection: 4 m |
| Sex: 89,5% M; 10,5% F | Sex: 35,7% M; 64,3% F |
| ASD | Normal psychomotor development |

# RESULTS – Autism and neurodevelopment profile

- Autism symptoms:

| test | Results |
|---|---|
| CARS | 33 (dp 5,7) |
| M-CHAT | 11,7 (dp 4,51) |

- Psychomotor development:

**Descriptive Statistics**

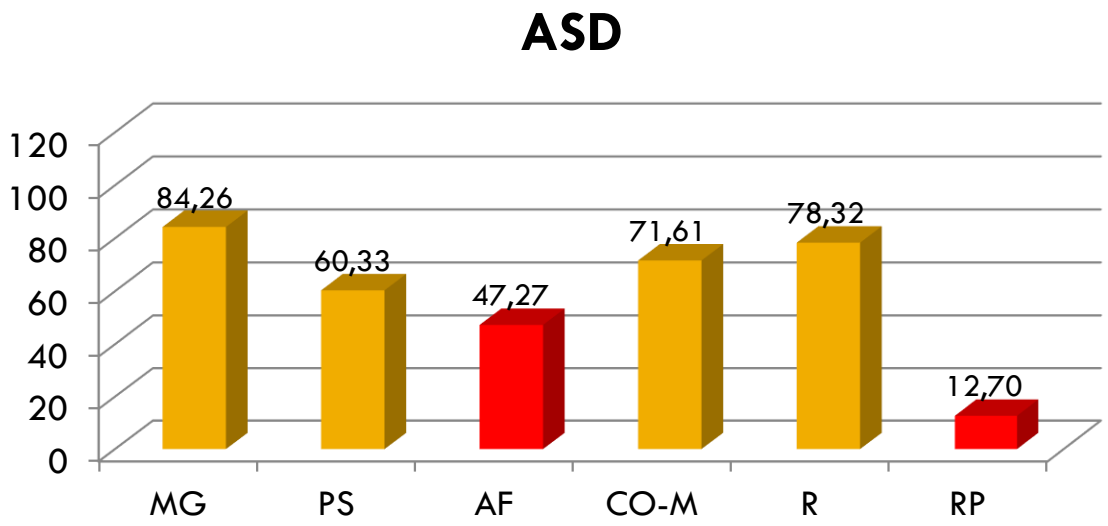
| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| QG1 | 19 | 45,24 | 88,50 | 68,3184 | 11,65753 |
| Motricidade Grosseira | 19 | 64,20 | 113,30 | 84,2579 | 14,22003 |
| Pessoal/Social | 19 | 39,70 | 80,90 | 60,3263 | 11,00539 |
| Audição e Fala | 19 | 22,80 | 84,10 | 47,2684 | 17,03242 |
| Coordenação Olho-Mão | 19 | 48,70 | 93,00 | 71,6105 | 13,29151 |
| Realização | 19 | 11,40 | 141,60 | 78,3158 | 28,29472 |
| Raciocínio Prático | 16 | ,00 | 72,60 | 12,7038 | 27,43511 |
| Valid N (listwise)* | 16 | | | | |

Mild psychomotor delay
With negative dissociation in language sub-scales

# RESULTS – Language profile

- Language profile in ASD:
  - Language delay:

All the ASD children had a delay in language and no word production in the first collection data

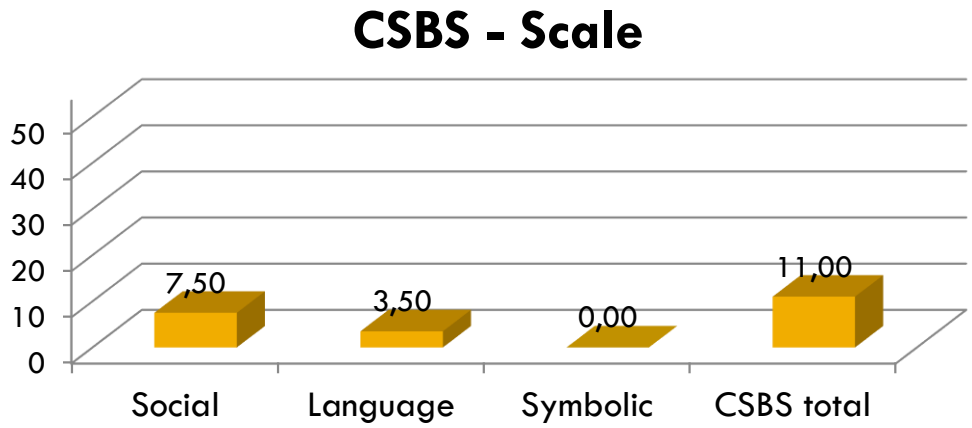



There is a significant difference between language performance and global psychomotor performance. (2 dp) (68,31)

# RESULTS – Communication profile

- Communication Profile

The communicative level is significant lower in relation to the expect for the typical age.. (normative value=51).




Communicative level= p1

**Mean values expect for 9 months of age**

# RESULTS

- **After 2 years of follow-up results for the 8 ASD children that ended the period under study:**

| Data | 8 ASD children 1ª collection |
|---|---|
| Age (months) | 32 m |
| Autism (CARS) | 34,43 |
| GQ (Griffiths) | 59,51 |
| Linguistic level | 39,63 |
| Non verbal cognitive level | 67,27 |
| Communicative level | 28 |
| Number of words | 0 |

Correlation with number of words produced after 2 years of follow up

The communicative level (p=0,011) and the non verbal cognition (p=0,003) were the data that best correlate with future language development

# RESULTS – Communication profile

- **Communication areas that were predictive of language development:**

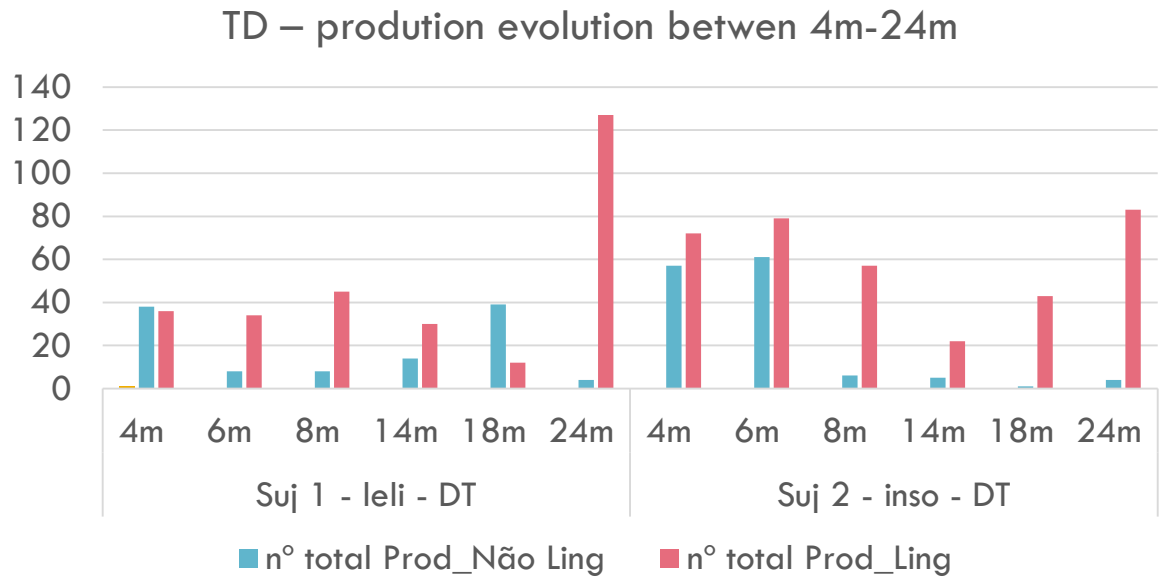
CSBS Scale

| Social | Language | Symbolic |
|---|---|---|
| Emotion and eye contact | Sounds | Comprehension |
| Communication | Words | Use of object |
| Gesture | | |
| p = 0,013 | p=0,852 | p=0,008 |

The social and symbolic areas (CSBS scale) were the most correlated with later language development

# RESULTS – Perceptive analysis

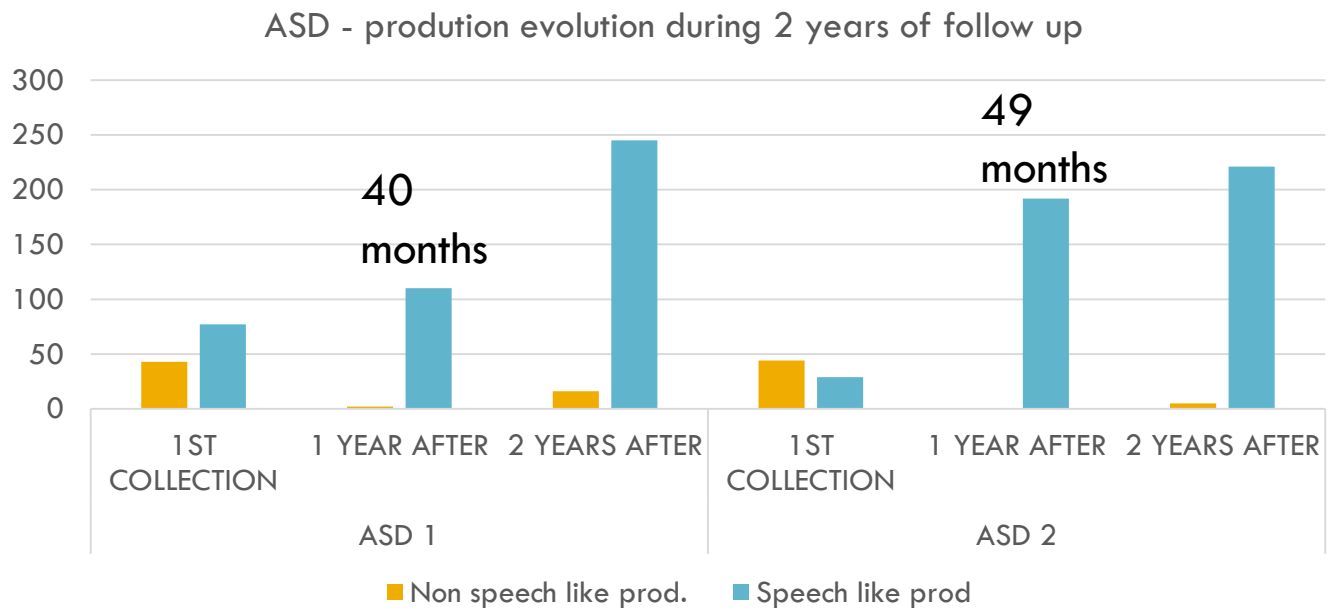
- For the analysis production type (non speech/speech) evolution over time in children with TD were analysed 12 sessions each lasting 20m = **905 utterances**




Initially the speech and non speech prod had similar proportions, but from six months for the first child and eight months for the second child there has been a growing predominance of speech prod.

# RESULTS – Perceptive analysis

- For the analysis production type (non speech/speech) evolution over time in children with TD were analysed 6 sessions each lasting 20m = **984 utterances**




Initially the speech and non speech prod had similar proportions, but from 1 year of follow-up the speech prod is predominant. Development path corresponds to the evolution that happens at 24m in the DT children

# RESULTS – Perceptive analysis

- TD and ASD samples production

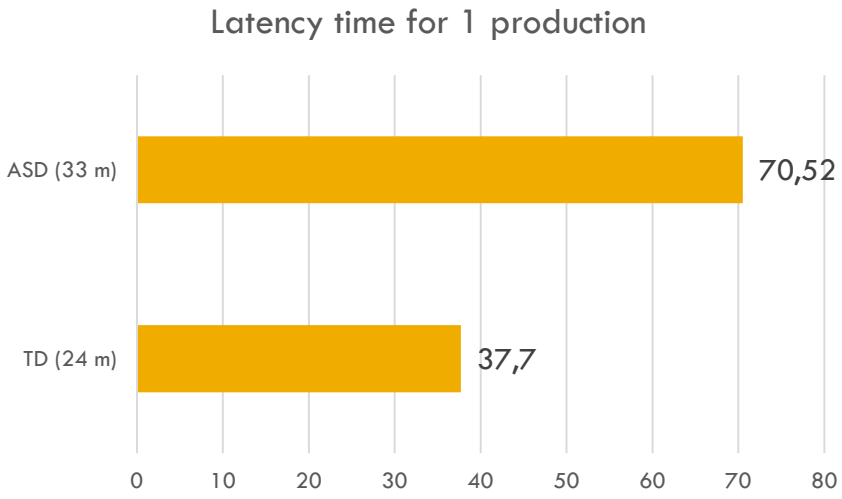
| N=4 | Production total nº | Speech prod total nº | Non speech prod nº |
|---|---|---|---|
| TD – 24m | 113,5 | 105 | 4 |
| ASD – 33m | 96,5 | 53 | 43,5 |

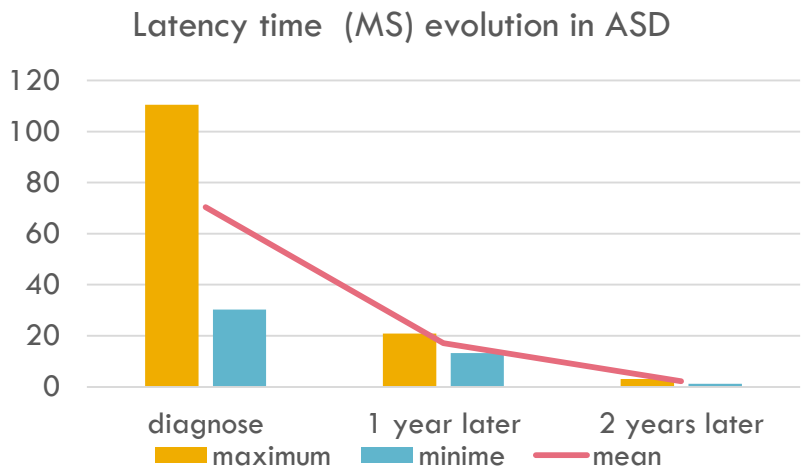
Although the difference is not very significant between the two samples in total of prod., we can observe that children with ASD produce significantly less speech prod and more non speech prod. (distress, atypical)

.

# RESULTS – Perceptive analysis

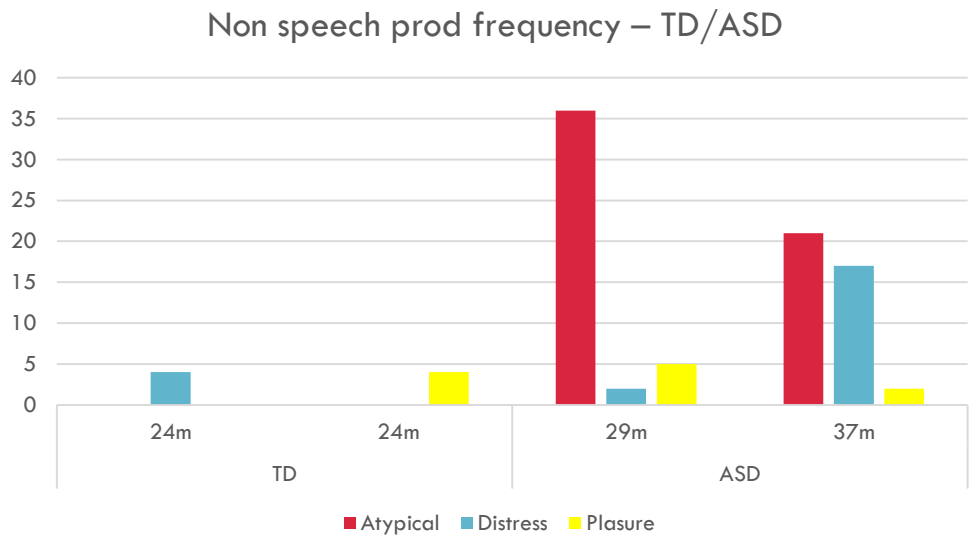
- **Latency time for the first production in TD and ASD:**

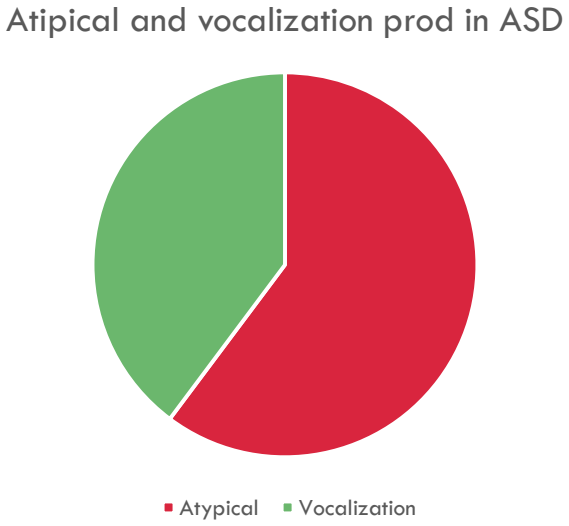



- Children with ASD demonstrate a much increased latency, but over time decreases significantly.

# RESULTS – Perceptive analysis



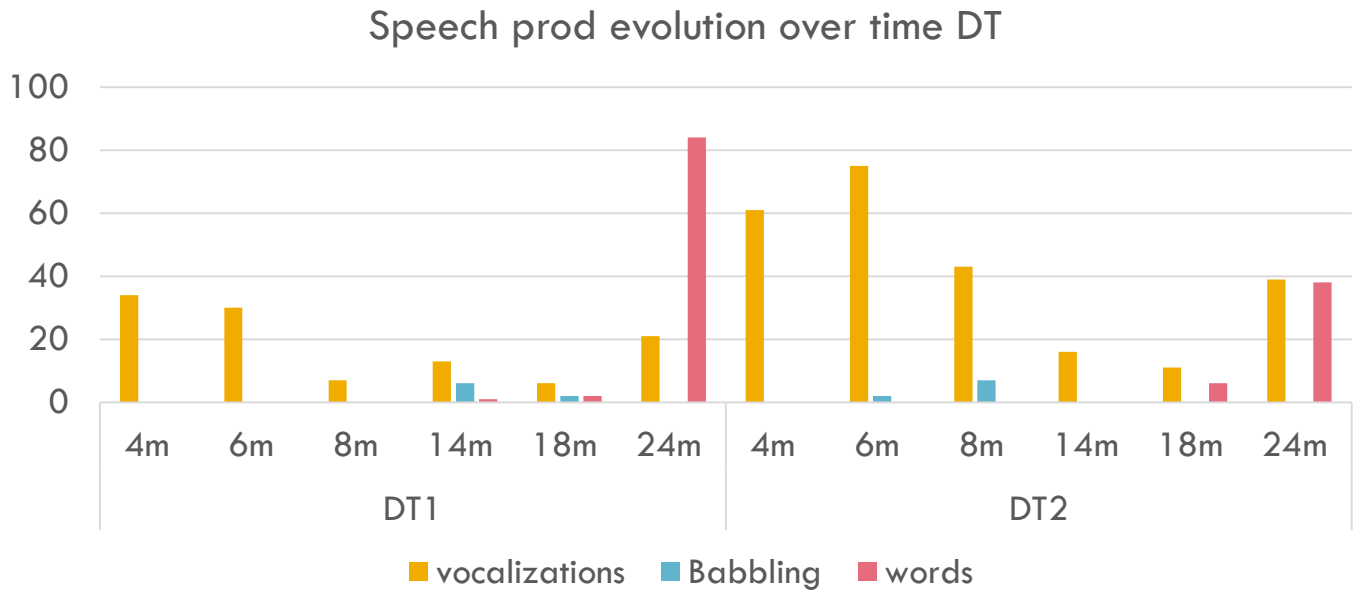




In children with DT there are few non speech prod and there aren´t atypical prod. In children with ASD the atypical prod prevail.

Rhea Paul, Yael Fuerst, Gordon Ramsay, Kasia Chawarska,and Ami Klin.2011

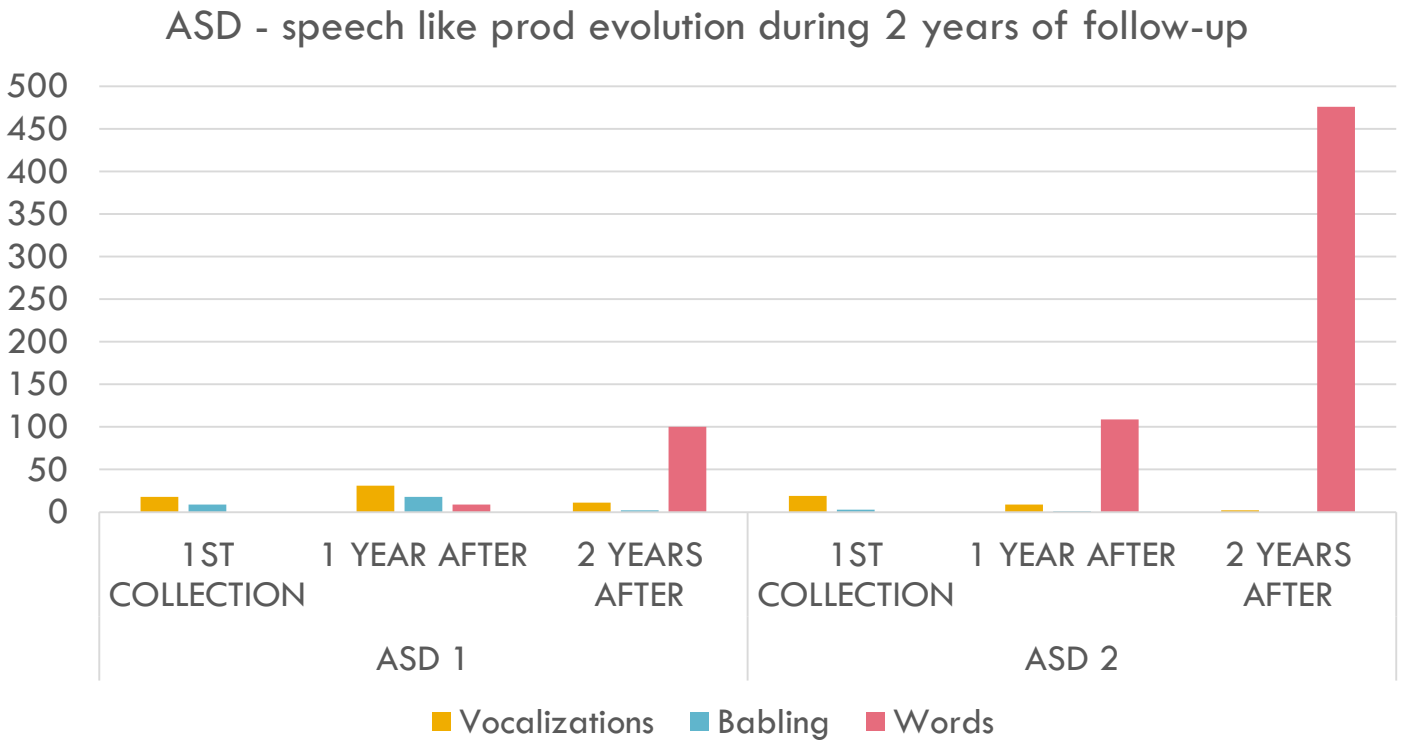
Atypical prod: squeals and yells

# RESULTS – Perceptive analysis



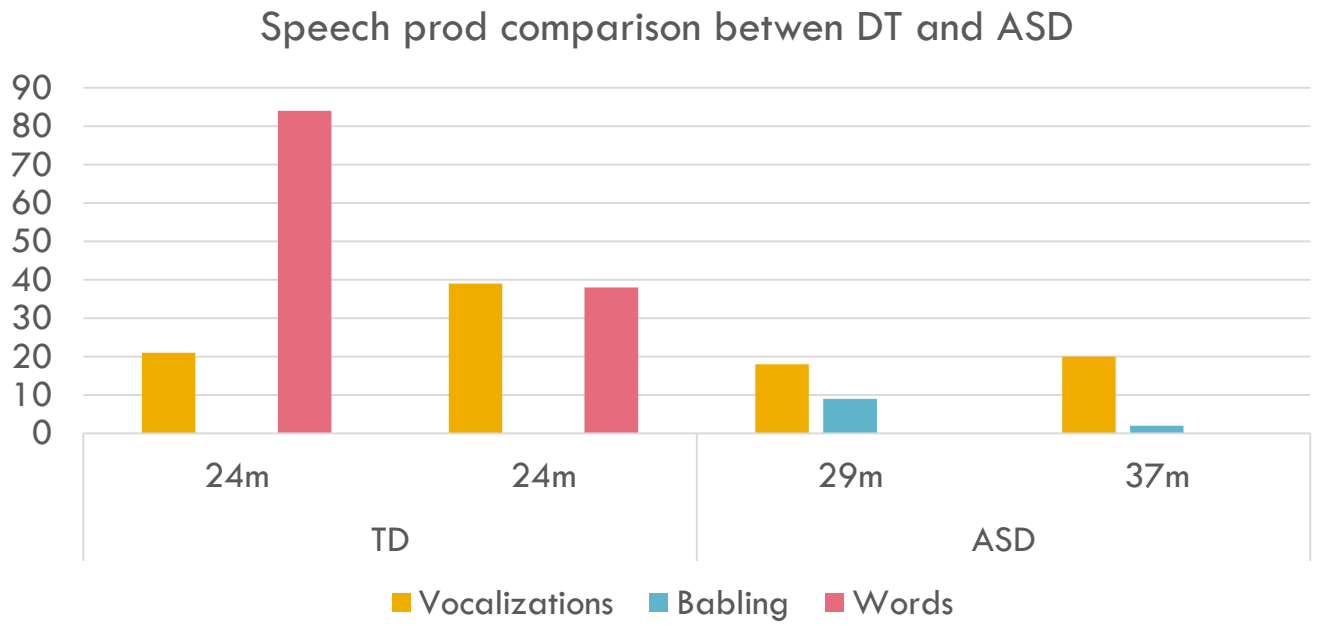

Significant increase in production words at 24m. The number of words produced at 24 m is consistent with the literature data that point to a production of at least 50 words to 24m (Sheridan, M 1997;Goldbloom, R. 1992).

# RESULTS – Perceptive analysis



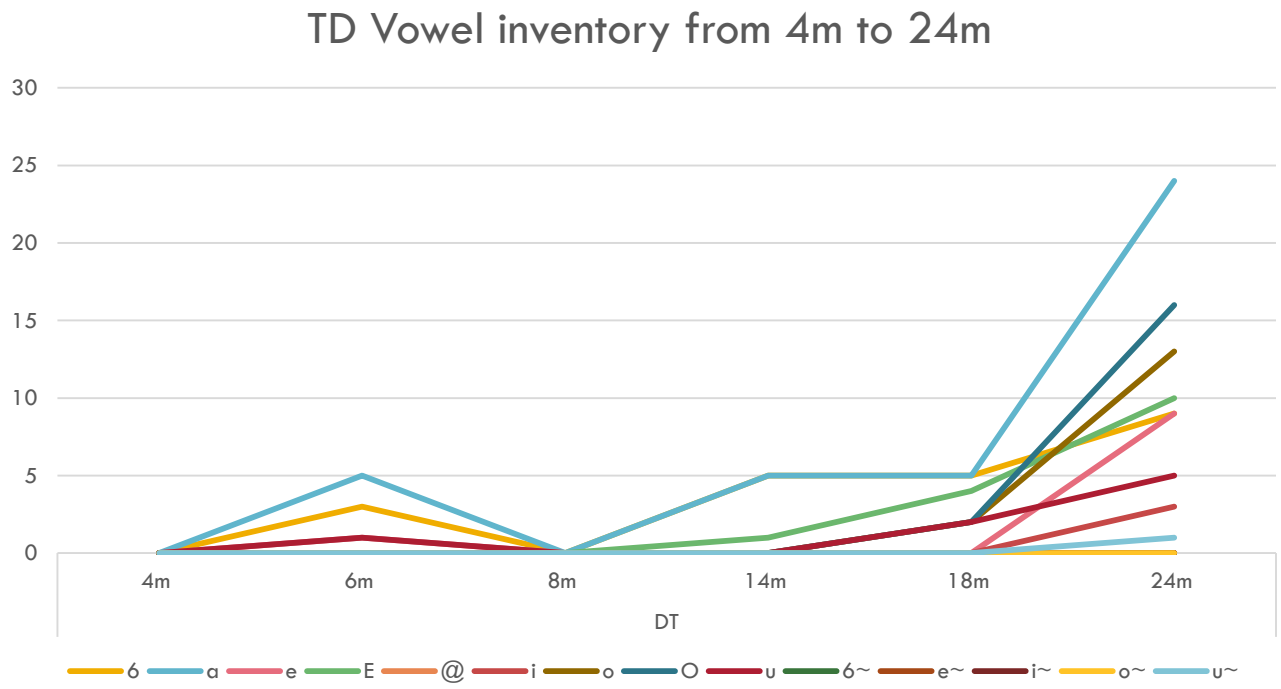

After 2 years of follow-up the ASD the speech prod were mainly words. The ASD 2 children had develop utterances of 5/7 words, and the ASD1 children only acquire utterances of 1/2 words.

# RESULTS – Perceptive analysis



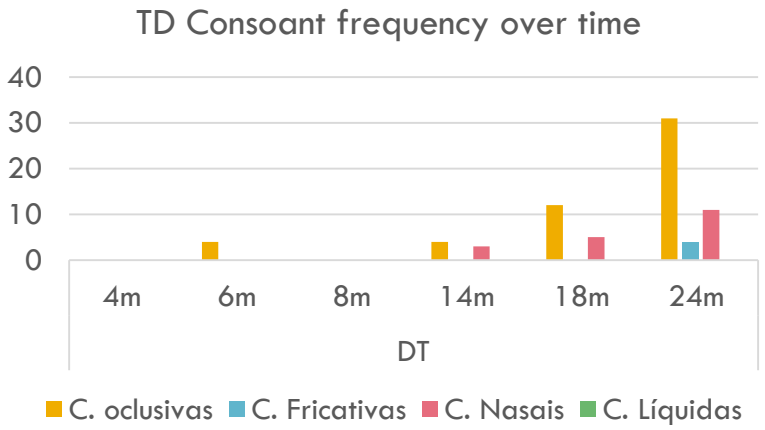

The children with ASD are still in language development stage that is characterized by the predominant vocalization and babbling phase that characterise the stage between 6m and 14m in typical development.

# RESULTS – Perceptive analysis

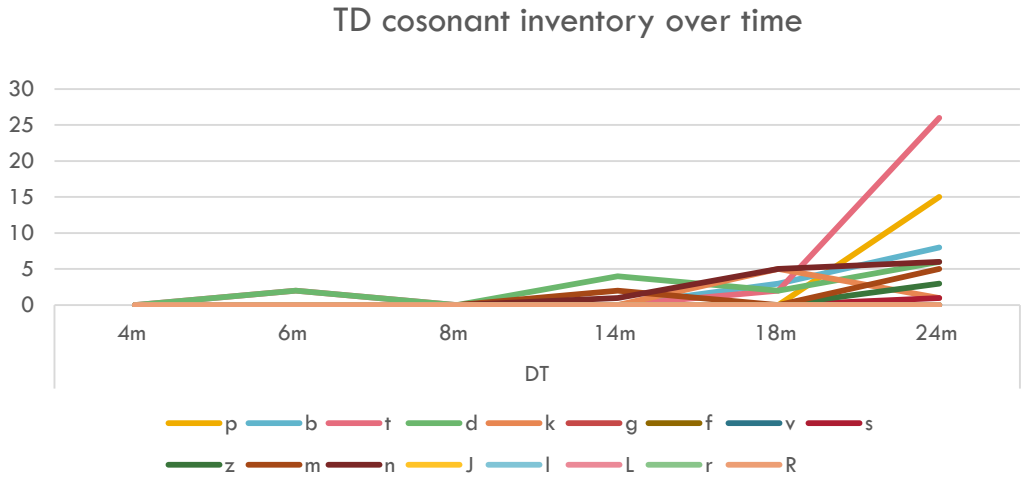



There sis a more diverse type of vowels produce at the 18m stage.
Vowels more frequent ate 24m : a, O, o, E
Vowels less frequent at 24m: i, u, @

# RESULTS – Perceptive analysis



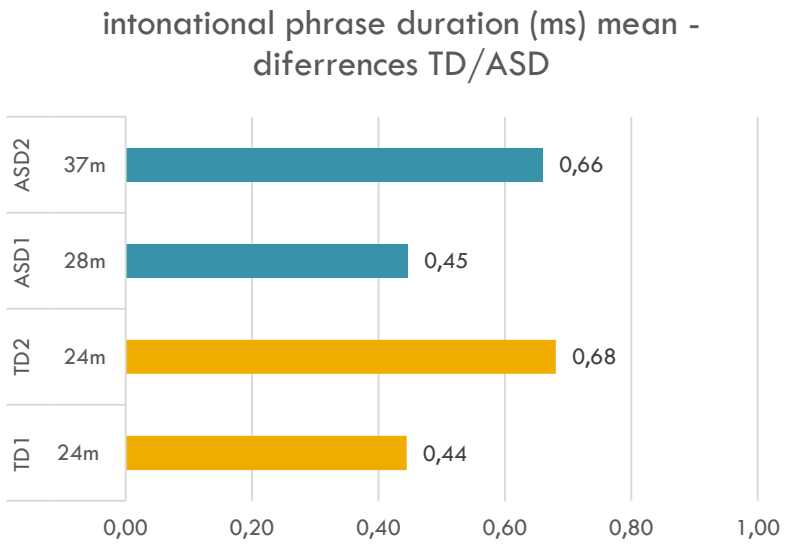

The plosive consonants were the fist to be produced and the more frequent in DT sample

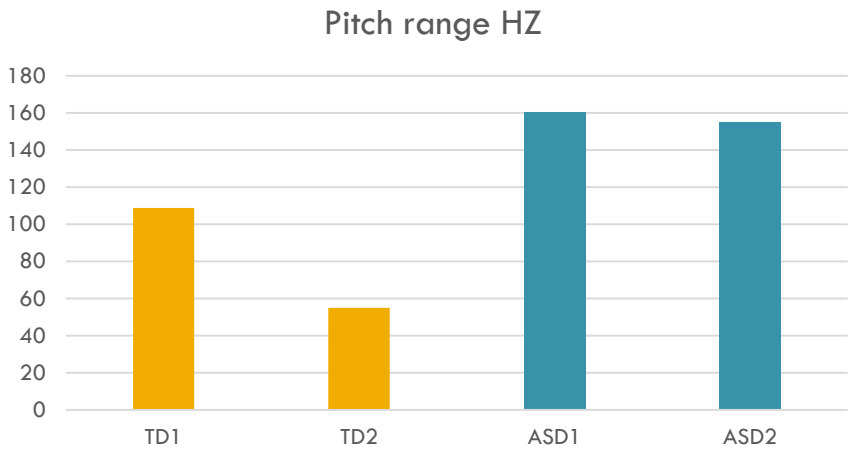



The consonant more frequent at 24 m were: t, p, b, d, n

# RESULTS – Acustic analysis

- Intonational phrases




The intonational phrase have similar values in the two samples

The ASD children have a higher pitch range.

# CONCLUSION

- In ASD children a higher rate of atypical prod is found;
- The higher latency time for the first production in ASD may be an indicator of pathology;
- The data that correlate in an early stage with the future linguistic development were the communicative level and nonverbal cognition.
- We need to extend the analysis of the other subjects before any conclusions may be drawn.