More Than Just Words: The Impact of Environment on Children’s Language Growth

Mandy J Maguire, PhD & Carlos Benitez-Barrera, PhD

Callier Center for Communication Disorders
Center for Children and Families
Language environment to support language development

Quantity & quality of language

Conversational turns
(eg. Gratier et al., 2015; Levinson, 2016)

Maternal (parental) responsiveness
(eg. Tamis-LeMonda, et al, 2006; Rowe et al., 2005; Rowe, 2012)
Children are raised in noisy environments
Auditory environments

**Signal to noise ratio (SNR)**

- **Signal (Language)** should be **15 dB** (decibels) above the surrounding **noise**

**ASHA recommendation**

(American Speech-Language Hearing Association, 2005)

+ 15 dB SNR
Auditory environments

**Signal to noise ratio (SNR)**

Signal (Language) should be **15 dB** (decibels) above the surrounding noise.

- **+ 15 dB SNR**
  - ASHA recommendation
  - (American Speech-Language Hearing Association, 2005)

- **+ 2 dB / + 11 dB SNR**
  - (e.g., Larsen & Blair, 2008)

- **~ 8 dB SNR**
  - (e.g., Benitez-Barrera, Grantham, & Hornsby, 2020)

- **< 15 dB recommendation**
Noise is a problem for learning

- Listening effort and fatigue (e.g., Picou, Ricketts & Hornsby, 2013)
- Inability to concentrate (e.g., Clark & Sörgvist, 2012)
- Poor word learning (e.g., McMillan & Saffran, 2016)
- Access to language (Jamieson, Kranjc, Yu & Hodgetts, 2004; McMillan & Saffran, 2018)
Noise exposure is higher in low income homes

External noise

Internal Noise
Television and language development

- Based on parent report of TV viewing, increased viewing is correlated to worse language development (Byeon & Hong, 2015; Lin et al., 2015; Masur et al., 2016; Lavigne et al., 2015; Ribner et al., 2017; Tomopoulos et al., 2010; Zimmerman & Christakis, 2005 but see Schmidt et al., 2009).

- Why?
  - More noise: Signal to noise ratio
  - Parent interactions:
    - More TV = lower quantity and quality of language (Lavigne et al., 2015) and fewer conversational turns (Cyck & De Anda, 2021; Ambrose, Van Dam, & Moeller, 2014)
    - Techniference (Corkin et al., 2021; Krogh et al., 2021)

- American Academy of Pediatrics recommendations
  - Video chat is exempt
  - Potential educational benefits in bilingual homes (Beck et al., 2015)
    - In preschool kids can learn from TV, when co-viewing (e.g., Richet, Robb, Fender, Wartella, 2010)
    - 4-5 year-old English speakers learned Welsh through TV (e.g., Williams & Thomas, 2017).
Noise exposure is higher in low income homes

External noise

Internal Noise
Chronic noise could be a problem for development

- **Hearing Loss** (e.g., Harrison, 2008)
- **Neural disorganization & impaired learning** (animal studies) (e.g., Cheng et al., 2018; Sun et al., 2011)
- **Parental Stress** (e.g., Troller-Renfer et al., 2022; Magill-Evans & Harrison, 2010)
Current question: Does a childhood in a noisy household affect language development?

- Auditory environment
- Language environment
- Parental response to noise
**Environment**

**LENA: Digital Language Processor**

<table>
<thead>
<tr>
<th>Auditory environment</th>
<th>Language environment</th>
<th>Parental response to noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td></td>
<td><strong>Signal to noise</strong></td>
</tr>
<tr>
<td>overlap speech</td>
<td>Adult word count</td>
<td>(Benita Barrera &amp; Hornsby &amp; Wesley, 2020)</td>
</tr>
<tr>
<td>distant speech</td>
<td>Conversational turns</td>
<td>adjusting language</td>
</tr>
<tr>
<td>outside noise</td>
<td></td>
<td>to account for noise</td>
</tr>
<tr>
<td>TV/media</td>
<td></td>
<td><strong>Parental Responsivity</strong></td>
</tr>
</tbody>
</table>

(Benita Barrera & Hornsby & Wesley, 2020)
Measure of child language

QUIL: ES – Language screener in English and Spanish

– **Vocabulary**: what words do children already know?
– **Syntax**: what do children know about putting words together
– **Process**: How skilled are children at learning new language?
– **Combined scores**: with and across languages
Current study: Is childhood household noise related to language development?

- Language environment
- Auditory environment
- Parental Response to noise

- Brain Structure and function
- Maternal Stress
Current study: Is childhood household noise related to language development?

- Children (ages 3-5 years) from primarily Spanish-speaking homes across a range of SES
- Why?
  - Multigenerational
  - Diversity in SES
  - Bilingualism
Results so far

• 16 Families
• To date:
  – LENA data
  – Spanish and English language measures (QUILS)
• Future directions
  – Transcribing LENA
  – Parental stress
  – EEG
Demographics (SES)

- ~80% of mothers at least some college
- Mean annual income = $61,000
- On average 5 people living in the home (Range: 3 to 9)
- >50% low income or at poverty
Noise in the environment

**Noise**
66.83 dB (SD = 2.36 dB)
range 61.9 - 71.32 dB

**Signal to Noise Ratio**
4.35 dB (SD = 2.04 dB)
range 1.02 - 8.9 dB

< + 15 dB recommendation
TV in the environment

**TV percent**

11.9% (SD = 5%)

range 3%-21%

Similar to other studies with children
Cycyk & De Anda (2021)

~2 hours/day approx.

~30 mins – 4 hours
Results: Child Language

- Spanish

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>110.0</td>
<td>11.66</td>
<td>91</td>
<td>128</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>116</td>
<td>11.59</td>
<td>96</td>
<td>134</td>
</tr>
<tr>
<td>Syntax</td>
<td>106</td>
<td>11.59</td>
<td>84</td>
<td>125</td>
</tr>
<tr>
<td>Processing</td>
<td>113.8</td>
<td>13.35</td>
<td>81</td>
<td>131</td>
</tr>
</tbody>
</table>

- English

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>104.3</td>
<td>12.35</td>
<td>83</td>
<td>129</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>110.9</td>
<td>9.89</td>
<td>95</td>
<td>133</td>
</tr>
<tr>
<td>Syntax</td>
<td>102.2</td>
<td>16.26</td>
<td>74</td>
<td>123</td>
</tr>
<tr>
<td>Processing</td>
<td>106.8</td>
<td>16.8</td>
<td>77</td>
<td>135</td>
</tr>
</tbody>
</table>

$r = .597, p = 0.011$
What predicts language abilities?

- Adult Words
- Conversational Turns
- Noise
- SNRs

Language (Spanish & English)

$r = .452, p = 0.04$
What predicts conversational turns?

TV/Media | SNR | Noise | Maternal Education | Income | Conversational Turns

R² = .884, 88% of variability accounted for by these variables.
What predicts conversational turns?

- TV/Media
- SNR
- Noise
- Maternal Education
- Income

Conversational Turns
What predicts conversational turns?

- TV/Media
- SNR: $B = 1.2, p=0.005$
- Noise
- Maternal Education
- Income

Conversational Turns
What predicts conversational turns?

- **TV/Media**: $B = -5.1, p = 0.003$
- **SNR**: $B = 1.2, p = 0.005$
- **Conversational Turns**
- **Maternal Education**
- **Income**
How does the environment influence this?
How does the environment influence this?
How does the environment influence this?

**Adult-child interaction** – conversational turns

**Parental Responsivity** – signal to noise ratio

What matters to language development is not the noise, but how the parents adjust their language to account for the noise.
How does the environment influence this?

Supports and expands on previous findings. The reason TV negatively influences language development is conversational turns, not at all due to watching TV per se.
Conclusions: Environment Matters

• Language environment
  – Conversational turns

• Children live in *noisy* environments
  – Average SNR was +4 dB (well below +15 dB)

• When families adjust their language to account for noise, children’s language is strong.
  – Coming closer
  – Speaker louder

• SNRs can be seen measure of parental responsivity
Conclusions: TV

- TV effects language development because it is related to adult language (conversational turns)
  - Rates similar to other findings with similar populations
Take home messages

• Noise matters. Overlooked related to language development.
• More responsive parents adjust their speech to the environment – benefits for language development
• TV takes away time from adult-child interactions – Detrimental for language development
• Advice to parents
  - Noise at these levels not necessarily problematic
  - Need to adjust to it
    - Reducing noise or
    - Increasing speech levels
    - Quiet times
• Way more research is necessary.
Thank you!

• Families and children who take part
• Funders
  – ASHA
  – National Science Foundation
  – UTD School of Behavioral and Brain Sciences
• Students and collaborators