Linguistic type-frequency differences in young children with and without hearing loss

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Background

Linguistic type-frequency A measurement of lexical diversity used to determine the total number of different words spoken (Hess, Sefton, & Landry 1986).

Type frequency in development. By certain age milestones children should acquire a specific number of different words in their lexicon. Type frequency can provide insight into rate of development (Turnbull & Justice 2017).

Type frequency in boys versus girls. Girls typically outperform boys in word acquisition during beginning years of language development. Data varies at to whether this difference continues with age progression (Kaushanskaya, Gross, & Buac 2014).

Type frequency in kids with hearing loss. Hearing loss can negatively impact language acquisition and result in decreased type frequency (Turnbull & Justice 2017).

Automatic methods to look at speech and language development. Audio recordings are the prominent method for gathering speech and language data. Resources such as LENA, CHILDES, and HomeBank are used to collect and analyze audio recordings (VanDam, et al).

What is HomeBank? A centralized location for easy access and storage for daylong audio files and associated analytical tools (VanDam et al 2016).

Main research questions

1. **Does linguistic type-frequency differ in children with and without hearing loss?**
2. **Does linguistic type-frequency differ in boys and girls?**
3. **Does linguistic type-frequency interact with hearing status and sex of the child?**

Method

Participants

Participants include 53 families. 37 families (11 boys, and 26 girls) with toddlers who have a hearing loss **(HL)** with no comorbid diagnoses. 16 families (7 boys and 9 girls) with toddlers who were typically developing **(TD)**. The mean age was 29.8 months (SD=2.8 months) and did not vary by sex or hearing status (p>.1). Children with HL had a mean BEPTA of 47.6 dB (SD=12.1 dB).

Materials

The LENA (Language ENvironment Analysis; LENA, Boulder, CO) was used to record daylong audio files.

LENA processing algorithms were used to process data. Each daylong recording was blocked into 5-minute segments. The top three non-adjacent blocks with the greatest conversational turn values (as determined by the LENA estimates) were extracted. A total of 13.25 hours of transcribed audio was analyzed. All blocks were transcribed by a panel of trained experts using CLAN (Computerized Language Analysis).

All (raw) audio files, complete transcriptions, and metadata concerning participants are publicly available via the HomeBank database (VanDam 2018).

Procedure and data analysis

Data were collected from the CLAN transcriptions in the HomeBank database, and linguistic type-frequency raw and summary measures were generated using the default settings in CLAN.

Raw values of the estimates of type frequency by recording (n=159) were compiled. Welch's unequal variances t-tests were used to test for differences between groups, and estimates of the mean and 95% confidence intervals were computed and plotted in the figures.

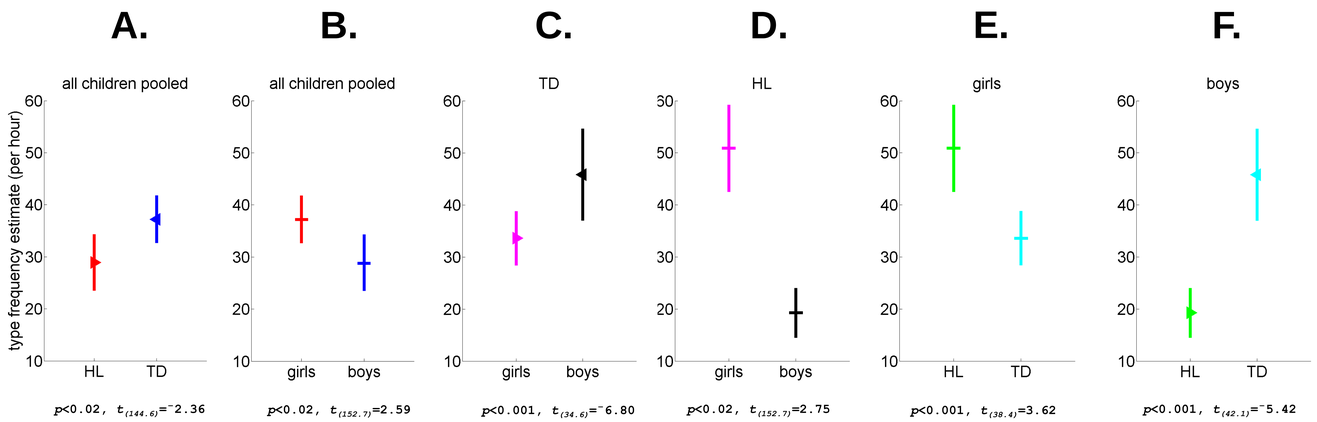

Figure 1. Type-frequency by hearing status and sex. Note: d.f. values in figures are computed using Satterthwaithe approximations, assuming unequal variances.

Results

1. **TD children show greater type-frequency than HL children** (*Fig.* 1A). ☺
2. **Girls show a greater type-frequency than boys** (*Fig.* 1B). ☺
3. **TD boys show greater type-frequency than TD girls** (*Fig.* 1C). 😐
4. **HL girls show greater type-frequency than HL boys** (*Fig.* 1D). ☺
5. **HL girls show greater type-frequency than TD girls** (*Fig.* 1E). 😐
6. **TD boys show greater type-frequency than HL boys** (*Fig.* 1F). ☺

Conclusions

1. Type-frequency differs between TD children and HL children and between girls and boys in the direction expected (Results 1 & 2).
2. Type-frequency differs between sex, but an interaction suggests HL children favor girls while TD children favor boys (Results 3 & 4). The TD boys advantage is unexpected.
3. Type-frequency differs between HL and TD children, but an interaction suggests boys favor TD children while girls favor HL children (Results 5 & 6). The HL girls advantage is unexpected.

Future directions

1. Replication of this study with a larger sample population, including different ages and hearing statuses.
2. Analysis of type-token ratios between typically developing children and children with hearing loss.

References

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Acknowledgements

For raw data and to download the acoustic WAV files, go to `http://homebank.talkbank.org/`.
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