Differential Phonological Profiles of Typically Developing Toddlers, Low-Verbal Toddlers with ASD, and Middle-Verbal Toddlers with ASD

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BACKGROUND

- Findings on phonological delays/differences in children w/ASD have been **mixed**[1]
  - 3yos w/ASD → no difference in consonant production (/16) relative to lang-matched typically developing (TD) infants during semi-structured phonological elicitation task[2]
  - 7-9yos w/ASD → on Photo Articulation Test[3], 24% scored in "impaired" range[4]
- Most research has studied **consonant** inventories but not **vowel** inventories
  - 18-36mos w/ASD → fewer consonant types (/24), and different consonant types, than age-matched but not lang-matched TDs[5] during CSBS-DP[6]
  - Consonant inventory (/10) during CSBS-DP[6] at 24mos → positive correlation with verbal & nonverbal DQ[7] at 36mos[8]
  - Consonant inventory (/13) during CSBS-DP[6] at 36mos → value-added predictor of expressive language at 48-52mos[9]
- ASD characterized by heterogeneity → should we subdivide participants w/ASD?

OBJECTIVE

Analyze the consonant and vowel inventories of **Low-Verbal (LV)** and **Middle-Verbal (MV)** children w/ASD, compared to TD children

PARTICIPANTS

- 20 children from Longitudinal Study of Early Language[10]
  - Study onset: matched on expressive language (EL)[7] but not age (Table 1)
  - Low-verbal (LV) and middle-verbal (MV) groups determined by EL[7] at onset
  - Transcription timepoint: ~4 months later

Table 1. *Participant Age and Language Level by Group*

	Group			Comparison			
	TD (*N*=7)	MV (*N*=6)	LV (*N*=7)				
STUDY ONSET	*M(SD)*	*M(SD)*	*M(SD)*	*F*	*p*	η^2	post-hoc
Age (months)	18.37 (3.32)	33.34 (6.80)	34.46 (4.93)	**21.22**	**< .001**	**0.71**	**LV&MV > TD**
MSEL[7] EL (raw)	15.14 (2.34)	17.00 (1.90)	10.43 (1.40)	**20.70**	**< .001**	**0.71**	**TD&MV > LV**
TRANSCRIPTION							
Age (months)	23.91 (0.76)	37.49 (6.80)	37.43 (4.74)	**19.19**	**< .001**	**0.69**	**LV&MV > TD**

Note. MSEL[7] = Mullen Scales of Early Language, expressive language subtest.

TRANSCRIPTION

- Videos of 30-min caregiver-child play sessions, noted Speech-Like Vocalizations (SLV)
- Every discernible SLV was transcribed in the CLAN[11] %PHO line (**Figures 2 & 3**)
  - Transcribed: words, self-stimulating vocalizations, babbles
  - NOT transcribed: grunts, whines, crying, laughing

Figure 1. *Sample Transcript (TD)*

```
*MOT:   what's he wearing ?
*CHI:   green shirt
%PHO:   ĩn ʧʊʧ
*MOT:   a what ?
*CHI:   green sweater .
%PHO:   gĩn ˈfɛ̩ ˌdʊ
*MOT:   a green sweater ?
*MOT:   and what's the baby bear wearing ?
*CHI:   red shirt
%PHO:   wɛd ʧʊt
*MOT:   red shirt .
*MOT:   oh .
```

Note. Diacritics & diphthongs were included for maximum specificity.

Figure 2. *Sample Transcript (LV)*

```
*MOT:   stand up .
*CHI:   yyy .
%PHO:   la ˈbɛ.jə ˈbɪ.jə ˈbɪ.jə ˈbɪ.jə ˈbi.jə
*MOT:   up .
@Comment:       (child pushes tower down.)
*CHI:   yyy .
%PHO:   da ˈbɛ.jə ˈbɪ.jə
*MOT:   that's it ?
*MOT:   we knocked it all down ?
*CHI:   yyy .
%PHO:   kɜ
*MOT:   okay .
```

Note. 'yyy' was the initial transcription for unintelligible vocals.

ANALYSIS

- Used Kruskal-Wallis to analyze group differences in:
  - C/V types
  - C/V tokens
  - C/V types & tokens by features (e.g., C manner of articulation)

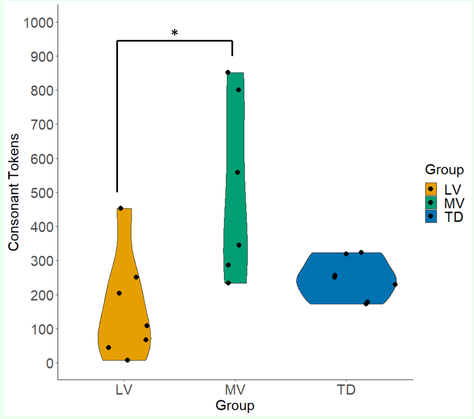
Table 2. *Vowel and Consonant Types Produced By At Least One Participant*

Vowel Types (*N*=18)	æ ɐ ɑ ɔ ə ɛ ɪ ʊ ʌ a e i o u	œ ʏ ɨ ɜ
Consonant Types (*N*=24)	ð ŋ ɹ ɾ ʃ ʒ θ b d f g h j k l m n p s t v w z	ɰ

Note. Use of glottal stop /ʔ/ was not coded. C/V not found in General American English (GAE; in red above) were rare and included only if diacritical marks on GAE C/V would not suffice to describe the phonemes.

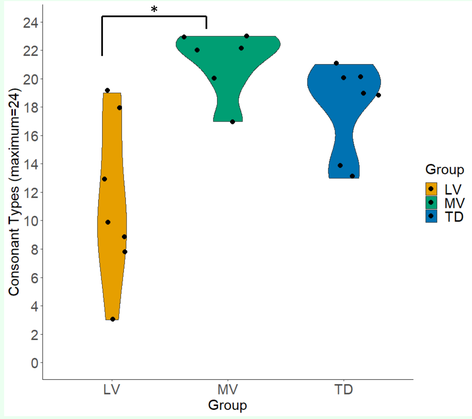
RESULTS

Figure 3. *MV > LV for Consonant Tokens*



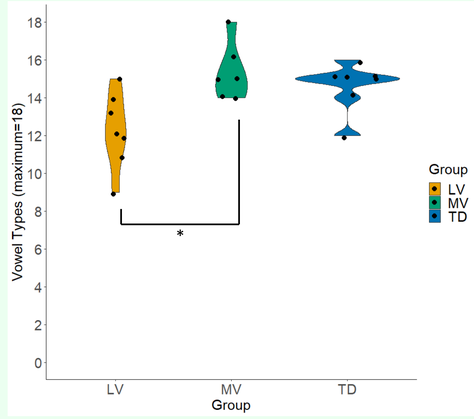
Note. Kruskal-Wallis H = 8.24, p = .016. No other group differences survived Bonferroni correction for multiple comparisons.

Figure 4. *MV > LV for Consonant Types*



Note. Kruskal-Wallis H = 11.28, p = .004. No other group differences survived Bonferroni correction for multiple comparisons.

Figure 5. *MV > LV for Vowel Types*



Note. Kruskal-Wallis H = 7.88, p = .019. No other group differences survived Bonferroni correction for multiple comparisons.

❖The **MV group exceeded the LV group** in consonant tokens, consonant types, and vowel types (**Figs. 3-5**), but not vowel tokens.

CONSONANT PLACE of ARTICULATION

Labiodental types & tokens: **MV > LV**

f v

Alveolar types & tokens: **MV > LV**

ð θ ʃ ʒ t d s z ɹ ɾ l n

Velar types & tokens: **MV > LV**

k g ɰ ŋ

No group differences in:

Bilabial types & tokens

m p b

Approximant types & tokens

j l w ɰ ɹ

CONSONANT MANNER of ARTICULATION

Plosive tokens: **MV > LV**

p b t d k g

Nasal types: **MV > LV**

m n ŋ

Fricative types & tokens: **MV > LV**

f v θ ð s z ʃ ʒ h

VOWEL BACKNESS

Central tokens: **MV > LV**

ɨ ə ɜ ɐ

Back tokens: **MV > LV**

Back types: **TD > LV**

u ʊ o ʌ ɔ ɑ

No group differences in:

Front types & tokens

i ɪ ʏ e ɛ œ æ a

High types & tokens

i ɪ ʏ ɨ u ʊ

VOWEL HEIGHT

Mid tokens: **MV > LV**

Mid types: **TD & MV > LV**

e o ə ɛ œ ɜ ʌ ɔ

Low types: **MV > LV**

æ a ɐ ɑ

DISCUSSION

- Consistent **MV/LV** differences suggest that **diversity** of consonant and vowel use is necessary for developing fluent English.
- Few **MV/TD** differences suggest that phonology may not differ solely by diagnosis; closer age-matching may also be important.
- Future directions:
  - Examine whether phonological characteristics at this timepoint predict expressive language at a later timepoint[8,9]
  - Include more participants for increased statistical power

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