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Final Report
American Speech-Language-Hearing Foundation

Project Title
Prelinguistic vocal behaviors in infants at risk for cerebral palsy under 24 months

Abstract

As many as 80% of children with cerebral palsy (CP) also have speech motor involvement (SMI) which can significantly impact lifelong social participation and quality of life. However, the early and accurate detection of later SMI remains challenging in CP given its wide heterogeneity. This progress report summarized the results of two studies conducted with support from the ASHFoundation. We investigated the relationship between infant and child vocal characteristics with later SMI from two perspectives to conduct preliminary analyses to test our working hypothesis that children with greater SMI at older ages produce less developmentally complex vocalizations in infancy. Study 1 found moderate associations between SMI at five years with vocal complexity and consonant diversity at 12 months in a group of 13 infants at risk for CP. Study 2 revealed limited vocal complexity and consonant diversity across a sample of 42 four-year old children with CP and anarthria. Children across our two samples with greater SMI exhibited less complex vocal characteristics in infancy and older childhood. These data offer preliminary support for our hypothesis that children with greater SMI will demonstrate lower vocal complexity in infancy. Additional research with larger, more diverse samples is necessary to validate these findings and to explore additional factors influencing communication outcomes in children with CP. Future work in this area has the potential to detect vocal biomarkers for communication impairment for the purposes of enhancing early intervention planning to support long-term communication outcomes.

Narrative Description of the Research Study

As many as 80% of children with cerebral palsy (CP) present with communication impairments, which can greatly impact social participation, academic achievement, and emotional wellbeing across the lifespan (Mei et al., 2020; Parkes et al., 2010). Early intervention is known to enhance communication outcomes; however, predicting speech developmental trajectories in children with CP to support targeted interventions remains challenging due to the condition's established heterogeneity (Andersen et al., 2010). Current prediction methods typically start at 24 months when children begin speaking, leaving a critical gap in understanding vocal development before this age. Exploring infant vocal development, potentially as early as 6 months, remains an underexplored area in clinical research for infants at risk of CP. This research has the potential to support the early detection of vocal biomarkers for speech motor involvement (SMI) which can aid early intervention planning to support communication outcomes. Recent studies have identified preliminary differences in the vocalizations of at-risk infants, including lower canonical babbling rates and smaller consonant inventories (Long, Eichorn, et al., 2023; Long & Hustad, 2023; Ward et al., 2023). To date, we do not yet know the extent to which these variables may be associated with later speech motor outcomes in this population. With financial support from the ASHFoundation, we have had the unprecedented opportunity to examine these relationships from two perspectives.

Research objectives

Study 1 examined the association between vocal complexity, volubility, and consonant diversity of children at risk for CP in infancy and their speech motor impairment classification in later childhood.

1. What is the relationship between infant **vocal complexity** and later SMI at five years in children prospectively at risk for CP?
2. What is the relationship between infant **volubility** and later SMI in children prospectively at risk for CP?
3. What is the relationship between infant **consonant diversity** and later SMI in children prospectively at risk for CP?

Study 2 described the vocal characteristics of a cohort of children with CP and anarthria in early childhood to establish data-driven hypotheses about the range and capacity for advanced vocal forms likely to be observed in these children in infancy.

1. Describe the vocal complexity, volubility, and consonant diversity of young children with CP and anarthria.

Across both studies, we hypothesized that children prospectively at risk for CP exhibiting characteristics indicative of less vocal developmental complexity, lower volubility, and reduced consonant diversity in infancy would demonstrate greater SMI compared to children with less SMI in later childhood. These preliminary explorations set the stage for generating data-driven hypotheses in future research aimed at enhancing the early detection of SMI in children with CP from the earliest stages of development.

Study 1: Method

This study was approved by the institutional review board for social and behavioral sciences at the University of Wisconsin-Madison (IRB #2018-0580). Written consent was obtained from caregivers prior to participation.

Participants

13 children (7 female, 6 male) prospectively recruited for a risk of CP based on a birth history of CP risk factors were included in the present study. Participating children were selected from a larger longitudinal cohort of children (n = 51; active data collection ongoing) examining early speech and communication development in young children at risk for CP.

The selection criteria of children from this larger cohort required: 1) a laboratory visit at approximately 12-months of age (“Time 1”) with a naturalistic, ~10-minute, caregiver-child interaction session, and 2) a laboratory visit at approximately 60 months of age (“Time 2”) to classify later speech motor production. A formal diagnosis of CP was not required for the present study because we were interested in examining the longitudinal relationship between vocal and speech production based on a risk classification for neurodevelopmental impairment. Our database included 13 children who met these criteria at the time this study was conducted.

Table 1 outlines participant demographics. Our sample includes a noted overrepresentation of White children relative to the 75% White demographic in the recruitment area of Madison, WI.

Table 1. Demographics

Variable	**N = 13**
Time point	Average age (SD)
Time 1	M = 12.5 mo (1.5)
Time 2	M = 61.2 mo (4.8)
Sex at birth	
Male	7
Female	6
Race/Ethnicity	
White/Caucasian	13
Birth conditions for CP risk status	Preterm birth = 8 Neonatal seizures = 3 Multiple birth (twin) = 2 Hypoxic ischemic encephalopathy (HIE) = 2 Periventricular leukomalacia (PvL) = 1 Neonatal stroke = 2 Meningitis = 1 Genetic condition = 2
CP Diagnosis by Time 2	
Yes	5
No	8
VSS level by Time 2	
I	3
II	5
III	3
IV	2

Recording Material at Time 1

Infant vocal characteristics at Time 1 were analyzed during laboratory-based, caregiver-child (PC) interaction sessions, with a mean duration of 12.0 minutes (SD = 1.7). During these sessions, caregivers were asked to interact and engage with their child naturally using toys or interactive books. Video and audio from these sessions were extracted from full laboratory visits lasting 1- to 1.5 hours in length that included other tasks such as parent interviews and dynamic assessment.

Coding Procedure

Two graduate student research assistant coders[1] were trained by the PI of this project on classifying speech-like infant vocal characteristics using the *Stark Assessment of Early Vocal*

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[1] Student coders funded and equipment purchased (noise-cancelling headphones) with ASHFoundation funds

Development-Revised (SAEVD-R; Nathani et al., 2006). All training and formal coding was conducted using the *Action Analysis Coding Training* software (AACT; Delgado & Oller, 1999)[2]. Formal coding began only after their coding reliability with the primary trainer (first author) exceeded 85% during training. Both student coders were blind to child age, child speech outcomes, and the research questions of the present of this study.

The SAEVD-R is a coding scheme of 23 vocal types categorized across five levels (Table 2) corresponding to five stages of infant vocal developmental complexity originally described by Stark (1980). Coders labeled each infant utterance produced during the laboratory video recordings as the corresponding vocal type and level of complexity. Only the highest level was designated for utterances containing syllables able to be classified across more than one level. Coders maintained a copy of the SAEVD-R level descriptions nearby during coding for fidelity.

Table 2. Stark Assessment of Early Vocal Development-Revised (Nathani et al. 2006)

Level	Expected onset age	Vocalization types
Level 1: Reflexive	0-2 mo	Vegetative sounds (burp, cough, etc.), crying, fussing, grunt-like sounds with muffled resonance
Level 2: Control of Phonation	1-4 mo	Vowel-like sounds that are not fully resonant, vowel-like sounds with closant, raspberries, trills, clicks, laughs
Level 3: Expansion	3-8 mo	Fully resonant vowel sounds, glides, ingresses, squeals, marginal babbling with slow formant transitions between consonant and vowel (CV)
Level 4: Canonical Syllables	5-10 mo	Single CV syllable, reduplicated and variegated babbling, whispers, and CVC or CVCV syllable structures
Level 5: Advanced Forms	9-18 mo	Complex, multisyllabic strings (e.g., VC, CCV, VCVC), canonical babbling with varied intonation patterns (i.e., jargon), diphthongs with rapid vowel formant transitions

Vocal measures at Time 1

Vocal Complexity: Ratios of vocalizations within each level were calculated as the total number of utterances coded within each level divided by the total number of all utterances produced by the child at Time 1. The largest ratio across the five levels for each child was calculated as their *Highest Level* as a measure of each child's most frequent vocal type across the five levels. The highest level with a ratio $\geq$0.10 and $\geq$0.15 were calculated for each child as their *Established Level*. Although a large body of work has primarily used a criterion of 0.15 to indicate onset of a specific vocal stage, the developers of the SAEVD-R coding scheme utilized a 0.10 criterion because "it was expected that trained listeners would identify the emergence of new vocal types earlier than parents" (Nathani et al., 2006, p. 358). Recent work using the SAEVD-R coding scheme has used the 0.10 criterion given this suggestion from the developers (Ward et al., 2023). However, this lower criterion was not validated against parent-reported onset in the original study to the same extent as prior work using the 0.15 criterion (Nyman et al., 2021; Oller et al., 1998). Thus, the present study compared children's Established Levels using both criteria with

[2] AACT Software purchased with ASHFoundation funds

later SMI as an exploratory investigation for determining the best criterion to use in future work. The original SAEVD-R paper reported that the Highest Level (overall) for typically developing children between 9-15 months was Level 3, and Level 4 by 16-20 months. The Established Levels for both the 0.10 and 0.15 criteria for children between 9-15 months was Level 4, and Level 5 by 16-20 months (Nathani et al., 2006).

Volubility: *Vocal Rate* was calculated as the number of utterances per minute. The total number of all utterances was tabulated and divided by the minute duration of each child's interaction recording. Prior work has established in typical development an average vocal rate of 4-5 utterances per minute for infants across the entire first year of life (Oller et al., 2019).

Consonant Diversity: Student coders were also instructed to mark the consonants produced in utterances containing canonical syllable forms during coding. A *Consonant Inventory* was then calculated for each child as the total number of different true consonants produced at least once. Vihman et al. (1985) defines a true consonant as having supraglottal articulation, excluding glides and glottal stops, that is perceived as intentionally produced by the child. Prior work has established in typical development an inventory of 6-8 acquired consonants by the end of the first year (Morgan & Wren, 2018).

SMI at Time 2

The level SMI of each child was classified at Time 2 (M = 60.4, SD = 4.7) using the Viking Speech Scale (VSS; Pennington et al., 2010). The VSS (Table 3) is a four-level, ordinal perceptual rating scale used to describe speech motor production abilities in children with neurological SMI, ranging from Level I (less involvement) to Level IV (greatest involvement). The VSS is validated for use with children 48 months of age and older. Two research speech-language pathologists independently classified all children at Time 2 using this scale based on their speech production during a video-audio laboratory recordings of a naturalistic caregiver-child interaction session and a sentence repetition task from the Test of Children's Speech+ (TOCS+, Hodge et al., 2009), depending on each child's speech ability. Disagreements were settled through consensus (no ratings differed by more than one level).

Table 3. Viking Speech Scale (Pennington et al. 2010)

VSS Level	Description
VSS I	Speech is not affected by a motor disorder
VSS II	Speech is imprecise but usually understandable to unfamiliar listeners
VSS III	Speech is unclear and not usually understandable to unfamiliar listeners out of context
VSS IV	No understandable speech

Reliability

We randomly selected 5 recordings each (38%) for inter- and intra-rater reliability analysis using the intraclass correlation coefficient (ICC, Shrout & Fleiss, 1979) with descriptive interpretations from Koo & Li (2016). We used a single score, absolute agreement, two-way random effects model for both reliability analyses. There was good inter-rater reliability between the two coders, ICC (2, 1) = 0.85, 95% CI [.82, .89], $p < .001$, and excellent intra-rater reliability for the primary coder, ICC (2, 1) = 0.91, 95% CI [.90, .93], $p < .001$.

Analyses

Two-tailed, Spearman's rank-order correlations (Spearman, 1904) were selected as a nonparametric correlation statistic to assess the relationship between children's VSS level at Time 2 with each of the three vocal measures at Time 1.

Study 1: Results

A total of 1048 utterances were coded and analyzed. Spearman correlation coefficients and *p*-values are tabulated in Table 4.

Vocal Complexity

Children's Highest Level at Time 1 had a moderate correlation with VSS Levels at Time 2 (rho = -0.657, $p = 0.015$). There were no significant correlations between later VSS Levels and children's Established Level at either the 0.10 or 0.15 criterion; although there was a marginally significant moderate correlation at the 0.10 criterion level ($p = 0.052$). These results indicate that children in our sample with greater SMI produced lower rates of developmentally complex vocal types at 12 months compared to children with less SMI.

Volubility

The number of children's utterances per minute at Time 1 was not correlated with their VSS Level at Time 2 ($p = 0.242$). These results indicate that vocal rate at 12 months was variable across children in our sample with different levels of SMI at older ages.

Consonant diversity

Children's consonant inventories at Time 1 were moderately correlated with VSS Levels at Time 2 (rho = -0.623, $p = 0.023$). Seven out of eight children with a VSS Level I and II at Time 2 (88%) produced at least one consonant at Time 1. Only one out of five children at VSS Levels III and IV (20%) at Time 2 produced any consonants at Time 1. These results indicate that children in our sample with greater SMI did not produce, or rarely produced, consonants by 12 months.

Table 4. Spearman correlation coefficients

Vocal measure	**Spearman's rho**	***p*-value**
Highest Level	-.657	.015 *
Established Level (≥ 0.10)	-.549	.052
Established Level (≥ 0.15)	-.352	.238
Vocal Rate	-.349	.242
Consonant Inventory	-.623	.023 *

Study 2: Method

This study was approved by the institutional review board for social and behavioral sciences at the University of Wisconsin-Madison (IRB # 2013-1258). Written consent was obtained from caregivers prior to participation.

Participants

42 children with CP and anarthria (17 female, 25 male) were included in the present study. Participating children were selected from a larger longitudinal cohort of children (n = 139) examining speech developmental trajectories in children with CP.

The selection criteria of children from this larger cohort were: 1) a classification of anarthria, and 2) a laboratory-based caregiver child interaction video session at approximately 50 months of age (~4 years) to examine vocal characteristics.

Table 5 presents the participant demographics. Racial demographics somewhat approximate the demographic of the recruitment region of Madison, WI.

Table 5. Demographics

Variable	**N = 42**
Average age (SD)	51 months (SD=1.8)
Sex	
Male	25
Female	17
Race	
White/Caucasian	38
Black/African American	3
White and Asian	1
CP Type	
Spastic	25
Spastic/Dystonic	3
Hypotonic	2
Spastic/Dyskinetic	1
Dyskinetic/Athetoid	1
Not reported	10
Co-diagnoses	
Seizures	32
Cortical visual impairment (CVI)	18
Unspecified visual impairment	9
Astigmatism	2
Blind	2
Autism	2
Agenesis of corpus collosum	2
Hearing loss	2
FOXG1 syndrome	2
Oculomotor apraxia	1
Bipolar disorder (BPD)	1
ATRX syndrome	1

Spontaneous coronary artery dissection (SCAD)	1
Esotropia	1
Lissencephaly	1
Ventricular septal defect	1
Lennox-Gastaut syndrome	1
Mitochondrial disorder	1
Wieacker-Wolff syndrome	1
Apraxia of speech	1
Short Bowel Syndrome (SBS)	1
Pulmonary atresia	1
None reported	3

Anarthria Classification

All children participating in the larger longitudinal project were previously classified into one of four Speech-Language Profile Groups (SLPG, Hustad et al., 2010) to describe their speech and language ability during intelligibility and linguistic assessment tasks (Hustad et al., 2017, 2018; McFadd & Hustad, 2013). In this prior work, children were previously classified as anarthric if they produced fewer than five words or word approximations based on parent report and clinical observation during laboratory sessions.

Recording Material

Child vocal characteristics were examined during laboratory-based, caregiver-child (PC) interaction sessions, with a mean duration of 13.7 minutes (SD = 3.9). During these sessions, parents were asked to interact and engage with their child naturally using toys or books. Sessions were extracted from full laboratory visits lasting 1- to 1.5 hours in length that included other tasks such as parent interviews and dynamic speech and language assessment.

Vocal Coding Protocol

The coding procedure described in Study 1 was also used for Study 2. The same two graduate student research assistant coders[3] conducted all coding for Study 2. For Study 2, both coders were blind to child age and the hypotheses of this study; however, neither coder was blind to the anarthria classification of children.

Vocal Measures

The same vocal measures described in Study 1 were used for Study 2. Specifically, we calculated their highest level (highest ratio overall) and established level (highest ratio $\geq$0.10) as measures of *vocal complexity*, vocal rate (utterances per minute) as a measure of *volubility*, and consonant inventory (number of different true consonants) as a measure of *consonant diversity*.

Reliability

We randomly selected 10 recordings each (24%) for inter-rater reliability analysis using the intraclass correlation coefficient (ICC, Shrout & Fleiss, 1979) with descriptive interpretations from Koo & Li (2016). We used a single score, absolute agreement, two-way, random effects model and found good reliability between the two raters, ICC (2, 1) = 0.83, 95% CI [.71, .90], $p < .001$.

[3] Student coders funded and equipment purchased (noise-cancelling headphones) with ASHFoundation funds

Analyses
Descriptive statistics were used to report the vocal complexity, volubility, and consonant diversity of our sample of children with CP and anarthria. These trends have the potential to be used to develop data-driven hypotheses about potential perceptual biomarkers for future studies examining vocal predictors of SMI in children with CP.

Study 2: Results

Of the 42 children in our sample, three children (7%) produced <5 utterances. Prior work has suggested removing children with <5 utterances because of the potential overinflation of developmental complexity levels for children (Oller et al., 2019). These children were hereafter excluded from the subsequent results; however, the implications of 7% of children in our sample producing <5 utterances are reviewed in our Discussion, and thus not removed from our study altogether. In the remaining 39 children, a total of 2,836 utterances were identified for analysis.

Vocal Complexity
Highest Level: For the 39 children who produced ≥ 5 vocalizations, Level 1 was the Highest Level for 59% of children (n = 24). Level 2 was the Highest Level for 37% of children (n = 15). No children had a Highest Level at Level 3, Level 4, or Level 5.

Established Level (> 0.10): For the 39 children who produced ≥ 5 vocalizations, Level 1 was the Established Level (> 0.10) for 15% of children (n = 6). Level 2 was the Established Level (> 0.10) for 44% of children (n = 17). Level 3 was the Established Level (> 0.10) for 36% of children (n = 14). Level 4 was the Established Level (> 0.10) for one child (3%). Level 5 was also the Established Level (> 0.10) for only one child (3%).

Established Level (> 0.15): For the 39 children who produced ≥ 5 vocalizations, Level 1 was the Established Level (> 0.15) for 21% of children (n = 8). Level 2 was the Established Level (> 0.15) for 56% of children (n = 22). Level 3 was the Established Level (> 0.15) for 23% of children (n = 9). No children had an Established Level (> 0.15) at Level 4 or Level 5.

Volubility
The mean vocal rate of the 39 children who produced ≥ 5 vocalizations was 5.23 utterances per minute (SD = 4.40), with a median of 4 utterances per minute. The range was 0.49 to 22.39 utterances per minute.

Consonant Diversity
Of the 39 children who produced ≥ 5 vocalizations, 11 children produced at least one true consonant. Specifically, 3% of children (n = 1) produced three different true consonants, 3% of children (n = 1) produced two different true consonants, and 23% of children (n = 9) produced one true consonant. 72% of children (n = 28) did not produce any true consonants. The total inventory of true consonants across children was: [b], [d], [t], [g], [n]. Out of the 11 children who produced at least one true consonant, [b] was represented in the consonant inventory of 55% of children (n = 6), [d] was represented in the consonant inventory of 27% of children (n = 3), [t]

was represented in the consonant inventory of 9% of children (n = 1), and [d] and [g] were represented in the consonant inventory of 18% of children (n = 2, each).

Discussion

The two studies reported here aimed to comprehensively examine the relationship between early vocal characteristics and later speech motor outcomes in children with or at risk for cerebral palsy (CP) from two perspectives using two different datasets. Study 1 showed that children in our small sample of children with greater SMI by five years produced lower rates of advanced vocal forms. This was also observed in Study 2, where the largest percentage of children with CP and anarthria at four years also produced very low rates of complex vocal types corresponding to more advanced levels of vocal complexity. Our data offers initial support for our working hypothesis that children with greater SMI produce less complex vocal characteristics during infancy.

These findings align with prior trends showing reduced rates of complex vocal types with mature, adult-like consonantal features and limited consonant diversity in infants and young children at risk for CP with speech motor impairments (Long, Christensen, et al., 2023). Notably, all but one child in Study 1 with little to no SMI had an established level of vocal complexity at or above Level 3 and produced at least one true consonant in infancy. Conversely, all but one child with greater SMI had lower levels of vocal complexity and consonant diversity.

There is a growing discussion around whether low rates of advanced vocal forms are predictive of later dysarthria in the context of CP, especially in the production of marginal syllables (i.e., Level 3) as “imprecise” consonant-vowel syllables (Long & Hustad, 2023; Ward et al., 2023); thus, future studies with larger samples sizes could explore the predictive nature of this relationship using more robust analyses. Notably, all children in our sample produced very low rates of canonical syllables (Levels 4 and 5) irrespective of outcome, which has also been found in this prior work. Thus, delays in marginal babbling are trending as a more relevant variable of interest than canonical babbling in the early detection of *specific* levels of SMI in CP.

Our differential findings with Established Levels using the 0.10 vs the 0.15 criterion as a measure of vocal stage onset offers an additional layer of complexity to our interpretations. Study 2 showed a greater spread across Established Levels using the 0.10 criterion (at least one child had achieved each level), compared to the 0.15 criterion, where over half of the sample had reached Level 2 and no children had reached either Levels 4 or 5. The vast majority of prior work has utilized the 0.15 criterion although recent work has criticized its validity (Lee et al., 2018; Lieberman et al., 2022; Nyman et al., 2021). Furthermore, the 0.10 criterion was suggested by the SAEVD-R developers; however, its predictive validity was not reported (Nathani et al., 2006). Our findings offer initial support for stronger associations with later SMI using the 0.10 criterion; however, the statistical power of these criteria using this coding scheme require more robust statistical testing to confirm.

Both studies revealed small consonant inventories in children with the greatest SMI. We interpreted this as a reduced ability to produce precise consonants in adult-like consonant-vowel syllables. Future work may examine this relationship more in-depth across reduplicated and variegated patterns of consonant-vowel syllables within utterances, and in place, voice, and manner patterns of consonants to examine the extent to which infant vocal characteristics can also inform differential diagnosis or the early detection of childhood apraxia of speech given its estimated population prevalence in 17% of children with CP (Mei et al., 2020).

Neither study showed remarkable differences in vocal rates among the children. In Study 1, there was large variability in the vocal rates of children, particularly in those later classified in the two middle VSS levels. Of note, the two children later classified as a VSS Level IV (greatest SMI) at Time 2 had two of the lowest vocal rates in our sample and the children later classified as VSS Level I were comparable to ranges expected for typically developing children, between 4-5 utterances per minute (Oller et al., 2019). Yet, Study 2 revealed an average vocal rate at this expected range in the older sample of children with anarthria which is substantially different from the expected speech rate of 50-month old children at 4-5 word sentences with ~80% intelligibility (Hustad et al., 2012, 2021). These rates may indicate unique complexities associated with either positioning considerations or variably impacted subsystems limiting our ability to conduct developmental comparisons with respect to volubility. This variability, alongside the prior mixed findings on volubility differences in this population, ultimately limits our confidence in whether volubility is an appropriate or useful measure for early detection and prediction. Future work using dense sampling of all-day home recordings may explore the extent to which volubility differences can be detected from more naturalistic settings to examine its association with other speech motor subsystems like respiratory support for phonation.

Several limitations of these studies presently exist. First, Study 1 is preliminary in nature given its small sample size and can presently only be used to drive hypothesis development for future, larger studies. Ongoing work in this area could explore intellectual, language, and other cognitive system differences to improve our understanding of specific communication profiles of children across the population of CP. Also, both samples are over-represented with a White/Caucasian demographic, even beyond what is expected for the recruitment region. Future work should increase the racial and socioeconomic diversity of samples to support additional considerations surrounding social determinants of health associated with differences in caregiver-child interaction that may influence infant vocal characteristics in this context. Despite these limitations in the present studies, ongoing work in this area has direct potential to support differential diagnosis through the early and accurate detection of a need to prioritize augmentative and alternative communication supports.

Conclusion

In summary, our research offers preliminary support for the trending hypothesis that children with cerebral palsy (CP) with greater SMI may produce less complex vocal characteristics in infancy. Ongoing work in this area is necessary to address study limitations such as sample size and demographic representation. Overall, our research supports the notion that infant vocal developmental delays in children with or at risk for CP have the potential to be used to drive clinical referrals to communication specialists. This work also underscores the importance of early detection of communication impairments in this population to inform tailored intervention approaches to support communication development in children with CP.

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Grant Funding Documentation

Financial Progress Report of Spending December 1, 2022 – November 30, 2023 on Award MSN265441

STATEMENT OF ACCOUNT

University of Wisconsin - Madison
OFFICE OF RESEARCH & SPONSORED PROGRAMS
Phone: 608-262-3822 Fax: 608-262-5111
Fed Tax ID # 39-6006492

Award Period:	FINAL	UW Account Number
12/01/2022 - 11/30/2023		MSN265441
Report Period:	**AMERICAN SPEECH-LANGUAGE-HEARING FOUNDATION**	Your Reference No.
12/01/2022 - 11/30/2023		

Award Title: **Prelinguistic vocal behaviors in infants at risk for cerebral palsy under 24 months**

PI: **LONG, HELEN**

Expenditures:

	Budget	Actual	Variance
Research Assistants – Vocal Coding Costs	$ 3,000.00	$ 5,299.06	$ (2,299.06)
2 Desktop Computers	$ 2,190.00	$ -	$ 2,190.00
2 Noise Cancelling Headphones	$ 160.00	$ 175.95	$ (15.95)
1 External Hard Drive	$ 150.00	$ -	$ 150.00
AACT Coding Software	$ 4,500.00	$ 4,325.00	$ 175.00
Workstation Updates (Adjustable Desk)	$ -	$ 199.99	$ (199.99)
Total Expenditures This Period	$10,000.00	$ 10,000.00	$ (0.00)

CASH RECONCILIATION

Cash Receipts to Date	$ 10,000.00
Expenditures to Date	$ 10,000.00
Cash Balance	$ -

Presentations and Publications

Presentations

Preliminary descriptive results from this study were presented as a poster at the 2023 ASHA Convention in Boston, MA. Early statistical analyses from this study were accepted for presentation as a talk at the 2024 Motor Speech Conference in San Diego, CA. The citations for these presentations are below:

1. **Long, H. L.,** & Hustad, K. C. (2024, February). Infant vocal characteristics and SMI in children with cerebral palsy [Seminar]. Motor Speech Conference, San Diego, CA.
2. **Long, H. L.,** & Hustad, K. C. (2023, November). Vocal production of children with cerebral palsy and anarthria [Poster]. American Speech-Language Hearing Association Convention, Boston, MA.
3. **Long, H. L.,** Sandgren, C., Mabie, H., & Hustad, K. C. (2023, November). An examination of early vocal production and speech-language outcomes in infants at risk for cerebral palsy [Poster]. American Speech-Language Hearing Association Convention, Boston, MA.

Publications

Two manuscripts are planned for submission for publication. Study 1 is planned to be submitted for publication to the *American Journal of Speech-Language Pathology* as part of a special issue forum for the 2024 Motor Speech Conference. Study 2 is planned for submission to either the *Journal of Speech, Language and Hearing Research* or *Folia Phoniatrica et Logopaedica*.

1. **Long, H. L.** & Hustad, K. (in preparation). A preliminary prospective cohort study of the relationship between infant vocal characteristics and later speech motor impairment in children at risk for cerebral palsy.
2. **Long, H. L.** & Hustad, K. (in preparation). An examination of vocal characteristics of non-speaking children with cerebral palsy to inform the early detection of anarthria.