

Perspectives of the ASHA Special Interest Groups

The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech --Manuscript Draft--

Manuscript Number:	PERSP-20-00202R2
Full Title:	The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech
Article Type:	Viewpoint
Section/Category:	SIG 2 Neurogenic Communication Disorders
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Funding Information:	
Keywords:	Childhood apraxia of speech; infants; research
Manuscript Classifications:	Apraxia of speech; Infants; Speech sound disorders; Speech-language-pathology
Abstract:	<p>Purpose</p> <p>This article examines the need for increased research into the prelinguistic trajectory of childhood apraxia of speech (CAS). We discuss the significant gains made in the early identification of disorders such as autism spectrum disorder (ASD), Fragile X syndrome, and Rett syndrome that have resulted through the study of early (i.e., prelinguistic) developmental behaviours of infants and toddlers at-risk for these disorders. We suggest that notable gains in understanding CAS could be made by increasing investigative focus on infants and toddlers later diagnosed with CAS or who are at-risk for it (i.e., have an older sibling diagnosed with the disorder).</p> <p>Conclusion</p> <p>Currently, there are few studies to guide clinical decision making for infants and toddlers who may have CAS. To address this gap, we present a call to action with recommendations for researchers and clinicians. We recommend more retrospective investigative designs be conducted, inclusive of retrospective parent questionnaires and retrospective home-video analysis, as well as prospective longitudinal studies of at-risk infants. We suggest that studies not be limited to exploring an affected infant's vocal output, but that efforts be made to acquire a broad view of an affected infant's early developmental trajectory (e.g., social skills, eye gaze, and imitative skills). A more comprehensive understanding of CAS will guide clinicians not only in identification of the disorder, but will inform treatment decisions as well.</p>
Response to Reviewers:	<p>To: Dr. Peter Meulenbroek and Reviewers</p> <p>We are grateful for the careful review and additional comments for improving our manuscript "The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech." In the space below, we have identified the reviewers' comments and provided our response. We look forward to hearing additional feedback.</p> <p>Sincerely, Megan Overby and Chantelle Highman Reviewer 1</p> <p>Line 57: auxiliary should be "auxiliary" RESPONSE: Thank you for pointing out this error. It has been corrected.</p> <p>Line 236: closing parenthesis missing from text, opening parenthesis missing from citation RESPONSE: We understand the reviewer's expectation here and have made the correction. However, we do observe that on page 263 of the 7th edition APA manual, it instructs that "when text and a citation appear together in a parentheses, use a</p>

semicolon to separate the citation from the text." It does not say that two separate parentheses cannot be used. Given the length of the text in this parentheses, we have opted to accept the reviewer's recommendation, though we believe a copyeditor can make a final determination.

Reviewer 4

I think the paper could be improved by briefly outlining how CAS presents differently at different ages. You state this in your introduction (line 60 page 3) but you don't really specify what you mean by this. Adding a sentence or two to specify what you mean by this would just tighten up your statement a bit.

RESPONSE: We thank the reviewer for pointing out this need for clarification. We have added two additional sentences.

I would just change "developmental trajectory" to "early developmental" trajectory on line 82 page 4.

RESPONSE: Corrected.

We respectfully submit the attached manuscript, *The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech*, for review and possible publication in the SIG 2 Neurogenic Communication Disorders division of the ASHA Perspectives journal. We confirm that this work has not been published, or is under consideration for publication, elsewhere. The purpose of this viewpoint article is to examine the importance of clinical research with infants and toddlers later diagnosed with childhood apraxia of speech (CAS). We review the substantial gains made in the early identification of autism spectrum disorder (ASD) via retrospective and prospective study of infants and toddlers at risk for the disorder and suggest that similar gains could be possible in early identification of CAS with an energized research focus on infants and toddlers at risk for CAS. We expect this topic to be of interest to the readership of the journal.

We have tried to adhere to the guidelines provided in Instructions for Authors. The current word count for the manuscript is 4485, inclusive of the abstract, text, and references.

Thank you for your consideration. We look forward to your response and comments.

Sincerely,

Megan Overby and Chantelle Highman

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**The Need for Increased Study of Infants and Toddlers Later Diagnosed with
Childhood Apraxia of Speech**

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Author Note

Conflict of Interest Statement: We have no known conflicts of interest to disclose.

Funding Statement: No funding was received for this work.

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Abstract

Purpose: This article examines the need for increased research into the prelinguistic trajectory of childhood apraxia of speech (CAS). We discuss the significant gains made in the early identification of disorders such as autism spectrum disorder (ASD), Fragile X syndrome, and Rett syndrome that have resulted through the study of early (i.e., prelinguistic) developmental behaviors of infants and toddlers at-risk for these disorders. We suggest that notable gains in understanding CAS could be made by increasing investigative focus on infants and toddlers later diagnosed with CAS or who are at-risk for it (i.e., have an older sibling diagnosed with the disorder).

Conclusion: Currently, there are few studies to guide clinical decision making for infants and toddlers who may have CAS. To address this gap, we present a call to action with recommendations for researchers and clinicians. We recommend more retrospective investigative designs be conducted, inclusive of retrospective parent questionnaires and retrospective home-video analysis, as well as prospective longitudinal studies of at-risk infants. We suggest that studies not be limited to exploring an affected infant's vocal output, but that efforts be made to acquire a broad view of an affected infant's early developmental trajectory (e.g., social skills, eye gaze, and imitative skills). A more comprehensive understanding of CAS will guide clinicians not only in identification of the disorder, but will inform treatment decisions as well.

Key Words: apraxia, infant, research

The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech

42 Childhood apraxia of speech (CAS) is typically considered a neurobiological disorder of speech
43 praxis motor control and/or planning (American Speech-Language-Hearing Association
44 [ASHA], n.d.). Prevalence in the general population is estimated to be 0.1% to 0.2% (Shriberg et
45 al., 1997). Diverse symptomatology of the disorder suggests it is not a single or unitary disorder,
46 but possibly a ‘symptom complex’ (a diversity of deficits varying in severity but consistently
47 present) (Nijland et al., 2015; Velleman & Strand, 1994) resulting from independent genetic and
48 environmental factors that, in combination, determine an individual’s particular phenotypic
49 expression (Miller et al., 2019) and accounts in part for some of the inconsistency of the
50 presentation of the disorder as the child matures. Reported phenotypic manifestations of CAS in
51 preschool and school-age children have included, for example, difficulty sequencing sounds and
52 syllables (ASHA, n.d.), inconsistent speech sound production (Iuzzini-Seigel et al., 2017), timing
53 and prosodic errors (Kopera & Grigos, 2020; Shriberg et al., 2017), and impaired literacy skills
54 (Lewis et al., 2004; Miller et al., 2019; Gillon & Moriarty, 2007). Some children with CAS have
55 morphological difficulties (such as errors on pronouns, **auxilliary** verbs, and irregular past tense
56 verbs) which cannot be directly attributed to speech motor planning deficits or sound production
57 errors (Ekelman & Aram, 1983; McNeill & Gillon, 2013; Murray et al., 2018). Unambiguous
58 identification of the disorder is challenging because CAS manifests differently as a child ages
59 and/or matures (McCabe et al., 1998; Terband et al., 2009). **For example, infants and toddlers**
60 **with CAS appear to have little vowel variation while older children demonstrate a high incidence**
61 **of vowel errors (Davis & Velleman, 2000); although syllable segregation is one of 10 behaviors**
62 **suggestive of CAS in children (Shriberg et al., 2011), it can only be present in children of**

65 sufficient age and expressive maturity to produce multisyllabic productions. Definitive diagnosis
66 of CAS is further complicated because speech characteristics of CAS may overlap with those of
67 other speech sound disorders (Allison et al., 2020).

68 Childhood apraxia of speech (CAS) has significant negative impacts on the child, family
69 and community. For example, in a sample of 192 parents of children with CAS, parents reported
70 concerns about their child's poor social communication skills and social wellbeing, as well as
71 perceived limitations in their child's ability to read, write, and in memory function (Teverovsky
72 et al., 2009). Other investigators have documented impaired reading, spelling, and academic
73 skills in individuals with persistent severe speech sound disorder (Carrigg et al., 2016) or history
74 of suspected CAS (Lewis et al., 2004; Lewis et al., 2018), with specific deficits in phonological
75 awareness. The functional impact of these social and academic problems is particularly
76 distressing for affected children and their families, and the need for intensive therapy to address
77 these issues can be associated with significant costs (financial and time) for families and
78 governments.

79 Despite the significant personal and social impact of CAS, extant research guiding
80 clinicians in the identification of CAS in the prelinguistic period is limited. Early identification
81 of the disorder would be beneficial, possibly reducing its negative impacts through the provision
82 of early treatment. In this article, we explain it is possible to use research to make progress in
83 increasing the accuracy and confidence of early identification of CAS as has been done in the
84 study of other disorders, such as autism spectrum disorder (ASD). We assert that a call to action
85 for a similarly focused research agenda on the prelinguistic period in CAS by investigators in the
86 profession of speech-language pathology could enable clinicians and researchers to obtain a
87 clearer understanding of potential early markers of CAS, ultimately describing an early

88 developmental trajectory of the disorder, thereby improving services and outcomes for this
89 population.

90 **Early Detection of CAS**

91 Even though CAS is known to present differently at different ages, currently a common
92 restriction in the study of clinical aspects of CAS has been to limit study of the disorder only to
93 children and adults capable of producing either meaningful linguistic utterances (Shriberg et al.,
94 2017) or to those who have a ‘moderate inventory of sounds’ (ASHA, 2007, p. 5). This approach
95 to the study of CAS reflects difficulties associated with identifying the disorder early in the
96 child’s life (e.g., infancy and toddlerhood) as well as the practicalities of undertaking
97 longitudinal research with such a low-incidence disorder. Nevertheless, there have been
98 significant research developments that have expanded our understanding of the disorder in older
99 children and adults, including speech features such as extended pause duration (Shriberg et al.,
100 2017) and polysyllabic production inaccuracy (Murray et al., 2015). Moreover, treatment
101 research has highlighted the efficacy of speech motor-based treatments such as Rapid Syllable
102 Transition Treatment (Murray et al., 2015) and Dynamic Temporal and Tactile Cueing (e.g.,
103 Strand & Debertine, 2000) for children with CAS.

104 However, because speech development begins long before the first word is spoken
105 (McCune & Vihman, 2001; Newman et al., 2016; Stoel-Gammon & Cooper, 1984), one would
106 expect to see evidence of motor programming/planning deficits in an affected infant’s earliest
107 speech-like vocalizations (Highman et al., 2012; Maassen, 2002). Core deficits in the speech
108 motor control system would necessarily restrict the infant’s protosyllabary, with potential
109 impacts on the process of subsequent vocal learning (Haesler et al., 2007; Pytte & Suthers,

110 2000). The continuity of prelinguistic vocal development with later speech development (Oller et
111 al., 1999) demonstrates the potential utility of the prelinguistic period in the study of CAS.

112 One approach to informing the prelinguistic period of infants at-risk for CAS is to build
113 the knowledge base of the genetic etiology of CAS and refine our understanding of which genes
114 or chromosomal regions of interest may suggest CAS. Although recent genome research offers
115 multiple new gene variants associated with the disorder (Hildebrand et al., 2020), few known or
116 putative causal genes have been identified to date (Carrigg et al., 2016; Peter et al., 2016). A
117 second approach is to examine the trajectory of speech sound development across time for
118 infants later identified with CAS (Highman et al., 2008), an approach that is of interest to
119 clinicians (Randazzo, 2019) and has the potential to assist in the very early detection of the
120 disorder (Allison et al., 2020). This approach to the study of CAS could open new paths of
121 treatment techniques, much like increased inquiry into the developmental trajectory of disorders
122 such as ASD, Fragile X syndrome, and Rett syndrome led to suggestions for their early
123 identification and, in the case of ASD, subsequent toddler treatment protocols. However, very
124 few studies exploring possible early manifestations of CAS have been published.

125 **Early Detection of Developmental Disorders**

126 The early development of infants with disorders such as ASD, Fragile X syndrome, and
127 Rett syndrome has been explored through retrospective parent reports, retrospective home-video
128 analysis, and prospective longitudinal study of at-risk infants and toddlers (i.e., siblings of
129 affected children). There is now compelling evidence that symptoms of these disorders are
130 present long before many children with such a disorder are clinically referred. Behavioral signs
131 of ASD can now be detected by 2 years of age, with notable and identifiable signs of the disorder
132 found even as early as 1 year old (Paul et al., 2011; Roche et al., 2018; Zwaigenbaum et al.,

133 2013). Detection has come from prelinguistic study of infants later identified with ASD across
134 diverse range of behaviors, such as motor development (e.g., Ozonoff, Young et al., 2008), self-
135 regulation and temperament (e.g., De Giacomo & Fombonne, 1998), repetitive interest and
136 behaviors (e.g., Ozonoff, Macari et al., 2008), language and cognition (e.g., Rogers & DiLalla,
137 1990), and social communication (e.g., Adrein et al., 1993). Developmental profiles of infants
138 and toddlers later diagnosed with Fragile X syndrome have revealed early delays in sensory-
139 motor features (Baranek et al., 2005; Zhang et al., 2017), socio-communicative skills (Marschik
140 et al., 2014), and babbling (Belardi et al., 2017), suggesting pervasive delays appear earlier than
141 previously thought (Roberts et al., 2016). For girls with Rett syndrome, early infant studies have
142 revealed atypicalities before the age of two (Kerr & Stephenson, 1986; Bartl-Pokorny et al.,
143 2013) and even in the first months of life (Einspieler et al., 2016), refuting a long-held belief that
144 features of the disorder appear only after a period of typical early development. Findings such as
145 these have decreased the mean age of diagnosis for classic Rett syndrome to around 2 ½ years
146 old, although there is a need for additional study to acquire a comprehensive description of the
147 syndrome's early development (Marschik et al., 2018).

148 Prelinguistic investigation of some developmental disorders has led to standardized
149 measures of a disorder's early development or general trajectories of its likely emergence
150 (Zwaigenbaum et al., 2013) and in some cases have led to clear changes to policy. The
151 American Academy of Pediatrics (AAP), for example, has updated practice guidelines to screen
152 18- and 24- month old toddlers for ASDs (Zwaigenbaum et al., 2015). Recent Australian national
153 autism guidelines also support early developmental screening and surveillance (Whitehouse et
154 al., 2018). No such AAP recommendations currently exist for Fragile X or Rett syndromes
155 because standardized trajectories of a disorder's early development requires extensive testing

156 across hundreds of affected and/or at-risk infants within a diverse body of researchers, a standard
157 not yet met for these syndromes.

158 **Research on the Prelinguistic Period in CAS**

159 There is comparatively little contemporaneous research on the prelinguistic behaviors of
160 infants and toddlers later identified with CAS (Table 1). Fewer than 40 infants later diagnosed
161 with CAS or at-risk for the disorder have been studied and only 30 infants have been studied
162 indirectly through parent questionnaire. Despite this small body of literature, results have been
163 generally consistent in finding that the prelinguistic development of children who later are
164 identified with CAS or are at-risk for CAS is notably different from that of typically developing
165 children.

166 Many (41%-42%) parents of children later diagnosed with CAS recall that their child
167 struggled to speak or had minimal speech (Teverovsky et al., 2009) and that babbling was
168 reduced (Aziz et al., 2010; Highman et al., 2008), containing no apparent variegated syllable
169 sequences (Highman et al., 2008). In one study, only 1 of 10 infants later diagnosed with CAS
170 achieved a canonical babbling ratio $\geq .15$ between 7-12 months old (Overby et al., 2020). A
171 limited phonetic inventory may be a possible red flag for CAS, specifically the acquisition of
172 three or fewer consonants between 8-16 months, five or fewer consonants between 17-24 months
173 of age, or acquiring the first consonant after age 1 year old (Overby & Caspari, 2015; Overby et
174 al., 2019).

175 Results from a longitudinal investigation of infant siblings of children with CAS
176 (Highman et al., 2013) confirm the possibility that a significantly restricted phonetic inventory
177 and lack of consonant-vowel babble may indicate pre-linguistic CAS. One infant sibling later

178 diagnosed with CAS produced no consonants at 9 months of age, only three consonants at 12
179 months of age (/d/, /b/, and /m/), and limited vowels, in the context of strong communicative
180 intent and use of gestures.

181 **Why Early Identification?**

182 Early diagnosis of a communication disorder takes advantage of brain neuroplasticity,
183 thereby creating opportunities for children to benefit more fully from intervention (Bruder, 2010;
184 Zwaigenbaum et al., 2013). Early intervention can empower families and impact parent self-
185 efficacy, which has a significant impact on a child's early learning and development (Bruder,
186 2010). Early intervention programs such as the Early Start Denver Model have demonstrated 18-
187 30 month old toddlers with an early diagnosis of ASD experience more growth in IQ and
188 adaptive behavior than when receiving community intervention (Dawson et al, 2010), even
189 showing evidence of EEG normalization of cortical activation (Dawson et al., 2012).
190 Furthermore, recent clinical trials of interventions commenced during infancy for children
191 showing early signs of autism have reported preliminary efficacy on parent-reported
192 communication skills (Whitehouse et al., 2019). Based on a review of 700 references on ASD
193 early intervention, a working group for the AAP concluded that early intervention for ASD
194 should begin as early as possible (i.e., before age 3; Zwaigenbaum et al., 2015), but clearly
195 implementation of any such recommendation requires early diagnosis or identification of early
196 risk features.

197 There are no early intervention studies in CAS, although a one-group quasi-experimental
198 10-week investigation of 32 children with possible CAS (Mean age = 29.7; SD = 3.44) reported
199 post-test gains in children's sound repertoires and imitative skills (Kiesewalter et al., 2017). A
200 notable component of the therapy approach was parent education and parent-child activities

201 focused on imitation of word shapes and sounds, suggesting that this therapeutic strategy is an
202 area worthy of further investigation. Other researchers propose therapy techniques for infants and
203 young toddlers to include encouraging vocalizations and communication more broadly,
204 expanding phonetic inventory, and the use of various syllable shapes (Davis & Velleman, 2000;
205 Fish, 2016). A Babble Boot Camp conducted between 2-24 months for infants with classic
206 galactosemia revealed an increase in the infants' babbling and meaningful speech when parents
207 engaged in daily reinforcement of their infant's babbling, expanding utterances, and shared with
208 their infant in joint book reading (Peter et al., 2020). Shriberg and colleagues (2011) reported
209 that children with galactosemia have higher prevalence rates of CAS (24%) compared to the
210 general population (0.1-0.2%). Despite these promising reports, the general paucity of
211 experimental intervention studies with infants and toddlers with suspected CAS is likely due to
212 the lack of any valid developmental profiles or consensus regarding the early behavioral
213 presentation of the disorder.

214 **A Call to Action**

215 We propose the following actions could provide a more comprehensive perspective of
216 CAS and potentially lead to its earlier diagnosis and treatment in affected individuals. First, we
217 believe there needs to be an increase in the publication of retrospective investigative designs,
218 including retrospective parent questionnaires and retrospective study of infant behavior via
219 home-videos. Moreover, prospective longitudinal studies of at-risk infants (i.e., those infants
220 with an older affected sibling) are crucial and will assist in the development of longitudinal maps
221 showing trajectories of symptom emergence. Second, quantitative and qualitative studies are
222 needed to address not only an infant's vocal output, but multiple aspects of an affected infant's
223 early development, such as, for example, parents' recall of details about their child's early

224 feeding, sensory and motor development, social skills and self-regulation, and first
225 sounds/words. Other areas of need include early vowel development, vocal and non-vocal
226 imitative skills, eye gaze, and social interaction/engagement. Exploring all aspects of early
227 communication, social skills, gross motor, and fine motor development will help provide a
228 comprehensive picture of the trajectory of the disorder. Third, once a critical mass of data have
229 been collected, screening criteria with high levels of sensitivity and specificity should emerge
230 suitable for use by physicians and other health professionals, similar to what has occurred for
231 ASD. Early referrals by physicians and other health professionals to speech-language
232 pathologists skilled in their understanding of CAS will aid in early identification and early
233 treatment for infants and toddlers. Fourth, ultimately there will need to be treatment studies
234 focused on the infant and toddler population. Compared to preschool and school-aged children,
235 these very young children have quite different needs and skills in attention, memory, and
236 learning style that will impact the effectiveness of the treatment they receive.

237 **Recommendations for Clinicians**

238 Clinicians and researchers can work together in these endeavours. Until more is known
239 about the genetic influences of CAS, clinicians are advised to actively monitor younger siblings
240 of children with CAS, as well as take note of infants and toddlers displaying any ‘red flags’ (e.g.,
241 lack of canonical babbling by 10 months, absence of any consonants by 12 months, less than five
242 consonants by 2 years of **age**) (Overby & Caspari, 2015; Overby et al., 2019). Getting the
243 balance ‘right’ for younger siblings, in particular, can be difficult – clinicians do not want to
244 cause undue worry for families, given that many siblings may go on to have no issues with
245 speech and language development. However, parents may want to be proactive in identifying any
246 potential speech and/or language disorder expressed by these younger siblings. Questionnaires

247 focusing on early communication development, in particular those that ask about the emergence
248 of canonical syllables and the types of consonants used by the infant or toddler, should be
249 considered [e.g. Communication and Symbolic Behavior Scales, (Wetherby & Prizant, 2002);
250 Infant Monitor of vocal Production, (Moore & Colyvas, 2008)].

251 **Conclusion**

252 In this article, we discuss how an energized research and clinical focus by the profession
253 of speech-language pathology on infant and toddler early vocalizations can lead to progress in
254 understanding and treating CAS. Due to the limited literature on pre-linguistic CAS, there is little
255 evidence to guide diagnosis of CAS in infants and toddlers until the child has sufficient speech
256 (or moderate inventory of sounds) to allow an examination for features of the disorder. Until
257 such time as a reliable predictor/s is/are identified, clinicians should use their theoretical and
258 clinical knowledge to carefully observe/monitor children displaying those differences in early
259 vocalizations reported in the literature.

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1 **Table 1**
 2 Published Research on Pre-linguistic Behaviours of Infants At-Risk or Later Identified With
 3 Childhood Apraxia of Speech
 4

First author and year of publication	Participants	Method	Main findings
Highman et al. (2008)	60 parents of preschoolers	Questionnaire about infant development	Compared to TD, sCAS less vocal, less likely to babble; later emergence of first words
	20 with children with suspected CAS (sCAS); mean age = 48 months		
	20 with children with Specific Language Impairment (SLI); mean age = 60 months		
	20 TD; mean age = 61 months		Compared to SLI, sCAS babbled less; later emergence of two-word combinations
Aziz et al. (2010)	30 Cairo-Egyptian Arabic-speaking preschoolers aged 4-6	Parent interviews about volubility of infants and toddlers	50% of parents of MPD children reported their child babbled little and with little phonetic diversity; only 30% of parents of TD infants did
	10 with multiple phonological disorders (MPD)		
	10 with CAS		
	10 typically developing (TD)		
Highman et al. (2012)	9 children (3-4 years old) who had failed a screening at 9 months	Retrospective analysis of screening performance	Two participants with features consistent with CAS showed lower expressive language and infrequent babbling
	21 TD children (3-4 years old)		
			One participant with features consistent with severe CAS showed frequent babbling

First author and year of publication	Participants	Method	Main Findings
Highman et al. (2013)	8 infants (9-months old) with family history of CAS (at-risk group) 8 TD infants (9-months old)	Evaluation of early speech and language via standardized questionnaires, inventories, and scales	At-risk siblings scored lower on expressive language, speech development, and fine motor skills
Overby and Caspari (2015)	4 preschoolers (36-54 months) later diagnosed with CAS (LCAS) 2 TD preschoolers (52-76 months)	Retrospective home-video analysis	Significant differences in volubility of resonant productions Early sound productions restricted to Early Eight LCAS preferred vowel and vowel-consonant syllable shapes
Overby et al. (2019)	10 infants LCAS 4 infants later identified with a speech sound disorder (LSSD) other than CAS 6 TD infants	Retrospective home video analysis	LCAS had fewer canonical babbles, later canonical babbling onset, and less volubility than TD
Overby et al. (2019)	7 LCAS, 5 LSSD, 5 TD infants	Retrospective home video analysis	LCAS infants had less volubility, used fewer consonants, had less diverse consonant repertoire, and acquired consonants later than TD or LSSD

5

6

To: Dr. Peter Meulenbroek and Reviewers

We are grateful for the careful review and additional comments for improving our manuscript “The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech.” In the space below, we have identified the reviewers’ comments and provided our response. We look forward to hearing additional feedback.

Sincerely,

Megan Overby and Chantelle Highman

Reviewer 1

Line 57: auxiliary should be "auxiliary"

RESPONSE: Thank you for pointing out this error. It has been corrected.

Line 236: closing parenthesis missing from text, opening parenthesis missing from citation

RESPONSE: We understand the reviewer’s expectation here and have made the correction. However, we do observe that on page 263 of the 7th edition APA manual, it instructs that “when text and a citation appear together in a parentheses, use a semicolon to separate the citation from the text.” It does not say that two separate parentheses cannot be used. Given the length of the text in this parentheses, we have opted to accept the reviewer’s recommendation, though we believe a copyeditor can make a final determination.

Reviewer 4

I think the paper could be improved by briefly outlining how CAS presents differently at different ages. You state this in your introduction (line 60 page 3) but you don't really specify what you mean by this. Adding a sentence or two to specify what you mean by this would just tighten up your statement a bit.

RESPONSE: We thank the reviewer for pointing out this need for clarification. We have added two additional sentences.

I would just change "developmental trajectory" to "early developmental" trajectory on line 82 page 4.

RESPONSE: Corrected.

Learner Outcomes to “The Need for Increased Study of Infants and Toddlers Later Diagnosed with Childhood Apraxia of Speech”

As a result of this activity, the learner will be able to:

1. identify emerging ‘red flags’ associated with the prelinguistic development of children later diagnosed with childhood apraxia of speech, and
2. summarise key issues pertaining to the importance of research into the early developmental trajectory of children with childhood apraxia of speech