

Technical Report

Feasibility of a Proactive Parent-Implemented Communication Intervention Delivered via Telepractice for Children With Classic Galactosemia

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ARTICLE INFO

Article History:

Received April 5, 2022

Revision received June 16, 2022

Accepted July 6, 2022

Editor-in-Chief: Erinn H. Finke

Editor: Amy L. Donaldson

https://doi.org/10.1044/2022_AJSLP-22-00107

ABSTRACT

Purpose: This study evaluated the feasibility of Babble Boot Camp (BBC) for use with infants with classic galactosemia (CG) starting at less than 6 months of age. BBC is a parent-implemented intervention delivered by speech-language pathologists (SLPs) entirely via telepractice with the potential to increase access to early preventative interventions. We evaluated BBC feasibility based on acceptability, implementation, and practicality.

Method: We obtained data from 16 parents of infants with CG (mean age at enrollment = 3.38 months) involved in a large randomized clinical trial of BBC. BBC uses a teach–model–coach–review approach to provide parents with strategies to support their child’s communication development. Families completed, on average, eighty-one 15-min sessions over a 20-month intervention period. We drew data from surveys completed by parents at the end of the intervention period, intervention logs maintained by the SLPs, and intervention fidelity checks completed by research assistants.

Results: Data drawn from parent surveys, intervention logs, and intervention fidelity checks revealed high parent acceptability, high rates of completion and compliance, and low costs in terms of parent and clinician time.

Conclusion: Results suggest that BBC is feasible for families of infants with CG, warranting further examination of BBC across a broader range of children with CG as well as other infants who are at predictable risk for speech and language impairment.

Classic galactosemia (CG) is a recessively inherited genetic disorder that occurs in approximately one of every 30,000 live births in the United States (Fridovich-Keil & Walter, 2008). The prevalence rate is higher among individuals of Irish decent, occurring in approximately one of every 16,000 births (Coss et al., 2013). CG is caused by an inborn error of metabolism characterized by defective conversion of galactose to glucose due to a near absence of the enzyme galactose-1-phosphate uridyl transferase. It is commonly diagnosed through newborn screening, and the standard of care is a lactose-restricted diet (Berry, 2011;

Demirbas et al., 2018; Ryan et al., 2013). Even with early detection and diet restrictions, many individuals with CG experience lifelong challenges in fine and gross motor abilities as well as communication and learning impairments (Antshel et al., 2004; Karadag et al., 2013; Lewis et al., 2013; Potter et al., 2008, 2013; Timmers et al., 2011, 2012; Waggoner et al., 1990; Waisbren et al., 1983). These challenges begin very early in life with many infants not meeting cooing and babbling milestones (Highman et al., 2012, 2013). As children with CG develop, they are often late producing their first words, have slow vocabulary growth, demonstrate significant difficulties with speech production, and have difficulty with sentence production (Potter et al., 2008; Timmers et al., 2011). Although the extent of long-term outcomes are heterogenous across children with CG, an estimated 60%–85% of children with CG experience

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speech and/or language disorders (Hughes et al., 2009; Potter et al., 2008; Rubio-Gozalbo et al., 2019; Waggoner et al., 1990; Welsink-Karssies et al., 2020). The high risk of unfavorable long-term outcomes places a severe burden on parents (Welsink-Karssies et al., 2020). Thus, it is imperative that infants with CG and their families receive early speech-language interventions to help support communication development and reduce lifelong communication challenges. The known risk for speech and language disorders presents an opportunity for evaluating proactive management strategies.

Given the low prevalence of CG, few speech-language pathologists (SLPs) have experience working with children with CG and their families. One solution to ensure that families have access to clinicians with appropriate expertise is to use telepractice. Telepractice reduces barriers to regular participation in intervention due to limitations in resources such as those associated with travel, childcare, medical conditions, and work obligations. Telepractice could allow geographically distant expert clinicians to provide clinical services to families with CG. The use of telepractice for speech-language services has increased in recent years, particularly in response to the COVID-19 pandemic. Examples of special populations benefitting from access to clinicians with experience and expertise include children with fragile X syndrome (see Bullard & Abbeduto, 2021), children with childhood apraxia of speech (see Bahar et al., 2021), children with cleft palate (Philp et al., 2021), and children on the autism spectrum (see Ellison et al., 2021; Simacek et al., 2021).

Telepractice is also effective for coaching parents to use intervention strategies (Bullard & Abbeduto, 2021); however, its use with parents of very young children with communication impairment has been limited. For example, in a recent scoping review of parent-implemented communication interventions for children identified with communication or language impairment (Finestack et al., 2022), of the 59 studies identified for the review (which were required to include a parent communication outcome measure), only two studies included telepractice components (Ingersoll et al., 2016; Wainer et al., 2021). Both the Ingersoll et al. and Wainer et al. studies included families with children on the autism spectrum who were, on average, 46 and 40 months of age, respectively. While telepractice is a viable option for the delivery of parent-implemented interventions, its use with young children has not been robustly evaluated. Telepractice has the potential to allow families with a child who has CG to receive very early intervention services to support their child's communication development, leveraging the fact that the genetic risks for severe speech and language disorders are evident at birth.

A recent intervention approach specifically developed for young children with CG is Babble Boot Camp

(BBC; Peter et al., 2020, 2021, 2022). BBC is a parent-implemented intervention delivered by an SLP via telepractice with early efficacy data to support its use. In the BBC, an SLP coaches parents to use routines and activities to support the early communication of infants, including prespeech and speech sound production, receptive language, and expressive language. Results of an early efficacy study (Peter et al., 2021) revealed that prior to age 24 months, infants with CG who received BBC ($n = 20$) had higher performance than those who did not receive BBC ($n = 3$) based on prespeech measures and expressive language measures. Additionally, follow-up data on a subset of the CG children at 2.5–3.5 years of age ($n = 12$) indicated that all scored in the average range on a measure of expressive language and all but one had average articulation scores. In contrast, one of the three children with CG who did not receive BBC scored below average on articulation and expressive language measures. These results motivate further study of the use and benefits of BBC.

Assessment of feasibility of new treatment programs, such as BBC, needs to be examined to determine whether the study methods can be generalized to individuals outside of the pilot study. Bowen et al. (2009) assert that one of the primary uses of feasibility studies for a specified intervention is to “assess whether or not the idea of and findings can be shaped to be relevant and sustainable” (p. 452). The authors identified the following eight general areas of focus to be addressed by feasibility studies: acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing. See Table 1 for brief descriptions of each feasibility domain. Previous publications have demonstrated the early efficacy of BBC (Peter et al., 2020, 2021). Thus, in this study, we evaluated the feasibility of BBC based on its acceptability, implementation, and practicality. Our specific research questions were

1. Acceptability: To what extent is BBC satisfying for parents of infants with CG?
2. Implementation: To what extent can BBC be successfully delivered to parents of infants with CG based on degree of execution and resources required?
3. Practicality: To what extent can BBC be delivered to parents of infants with CG at a low cost?

Method

This study was approved by an institutional review board at Arizona State University. The feasibility study is part of a larger clinical trial evaluating the efficacy of BBC to help parents support the communication development of their children with CG. The clinical trial is

Table 1. Feasibility study domains (Bowen et al., 2009).

Feasibility domain	Description	Possible outcome measures
Acceptability	The extent to which a new idea, program, process, or measure is considered suitable, satisfying, or attractive to providers and recipients.	<ul style="list-style-type: none"> Satisfaction with program Desire for continue use Perceived appropriateness Compatibility with organizational culture Perceived impact (positive or negative) on organization
Demand	The extent to which a new idea, program, process, or measure is likely to be used.	<ul style="list-style-type: none"> Actual use by providers and/or recipients Degree of reported interest or intention to use Perceived demand by providers and/or recipients
Implementation	The extent to which a new idea, program, process, or measure can be successfully delivered to intended participants in some defined, but not fully controlled, context.	<ul style="list-style-type: none"> Extent to which program was executed Execution level of success or failure Necessary resources needed to execute Efficiency, speed, or quality of execution
Practicality	The extent to which an idea, program, process, or measure can be implemented using current resources and circumstances.	<ul style="list-style-type: none"> Positive/negative effects on target participants Participants' ability to complete intervention activities Cost analysis Similarities of original and new outcomes
Adaptation	The extent to which an existing idea, program, process, or measure can be performed when changes are made for a new format or with a different population.	
Integration	The extent to which a new idea, program, process, or measure can be integrated within an existing system.	<ul style="list-style-type: none"> Perceived sustainability Costs to organization and policy bodies
Expansion	The extent to which a previously tested program, process, approach, or system be expanded to provide a new program or service.	<ul style="list-style-type: none"> Fit with organizational goals and culture Extent expansion disrupts current system
Limited efficacy	The promise of the new idea, program, process, or measure being successful with the intended population, even in a highly controlled setting.	<ul style="list-style-type: none"> Effects of program or process on primary outcome measures Effect-size estimation of program Maintenance and generalization of program effects

registered at ClinicalTrials.gov under Beate Peter and at Open Science Framework (OSF) under <https://osf.io/sy3en/>. Before enrolling in the study, parents consented for themselves and their child to participate.

Participants

The present feasibility analyses examined the data gathered from the participants with CG who enrolled when they were between 2 and 6 months of age and randomly assigned to the BBC early speech and language intervention. To be eligible for the study, the infants had to have a confirmed genetic diagnosis of CG during the neonatal period with no evidence of other sensory, chromosomal, or medical conditions. Additionally, at least one parent needed to have completed at least eighth grade. All participating parents completed high school or earned their general education diploma (GED), and the majority of parents had earned a bachelor's or graduate degree. Participating families resided in the United States ($n = 14$) or the United Kingdom ($n = 2$) and spoke English as their primary language. Access to Internet was required and already in place in all cases, and all participating families already owned computers. We report on 16 children with CG (sex assigned at birth: $n = 9$ female and $n = 7$ male) who enrolled in the study at less than 6 months of age and completed the full BBC speech

and language intervention until 24 months of age. All parents identified their child as being White and not Hispanic; one parent did not indicate ethnicity. The prevalence rate of CG in the Irish population is consistent with this racial and ethnic profile among the participants. Table 2 includes information regarding participant demographics.

Table 2. Participant demographics.

Demographic variable	BBC early intervention ($N = 16$)
Child age (months)	
<i>M</i>	3.38
<i>SD</i>	1.67
Min-max	1-6
Mother highest level of education	
High school diploma/GED	1
Associate's degree	4
Bachelor's degree	3
Graduate degree	8
Father highest level of education	
High school diploma/GED ^a	2
Associate's degree	2
Some college	1
Bachelor's degree	7
Graduate degree	4

Note. BBC = Babble Boot Camp.

^aGED = General Educational Diploma.

Intervention

A certified SLP with over 30 years of experience working with young children served as the interventionist for all participants who received BBC. Before the intervention sessions commenced, the SLP conducted an orientation session. During this session, the SLP provided an overview of typical prespeech, speech, and language milestones through the first 2 years of life as well as an overview of the BBC components. The targeted intervention dosage was a weekly, 15-min session commencing after the parents completed an orientation session and ending on the child's second birthday. The targeted number of sessions for each participant varied depending on the age of enrollment; however, given that participants enrolled prior to 6 months of age, we anticipated that participants would complete a minimum of 67 sessions (18 months \times 4 weeks – 5 holiday weeks). The interventionist attempted to reschedule sessions as needed, with minimal missed sessions due to holidays and vacations. All sessions were designed to be delivered via telepractice using HIPAA-compliant software, Zoom Version 5.9.3; however, due to scheduling constraints, a portion of sessions were conducted via e-mail. The SLP conducted sessions for individual children, with scheduling determined by the parents' timing needs and availability.

The SLP used a teach–model–coach–review approach (Roberts et al., 2014) to provide parents with strategies to support their child's communication development. A foundational strategy taught to parents was to scaffold their child's language development by considering the child's zone of proximal development (ZPD; Vygotsky & Cole, 1978), that is, skills that the child cannot do independently but can do with support. The components followed a developmental sequence beginning with prelinguistic components (e.g., engaging in eye contact to support bonding, responding to infant vocalizations to increase vocalization behaviors and to build dyadic interactions, and eliciting and reinforcing babble to increase babble complexity) then moving to vocabulary development (e.g., labeling objects to expand the child's vocabulary and modeling word productions to increase the child's phonemic inventory), followed by syntactic development (e.g., recasting and expanding simple sentences slightly). On the OSF for BBC site (<https://osf.io/yzht4/>), the Babble Boot Camp Activities and Routines document lists all of the intervention goals along with corresponding activities and routines to support goal development and anticipated child ages at which the goals will be targeted.

Prior to each intervention session, the parents were instructed to submit two videos up to 3 min in length of a parent and child engaged in an activity or routine of the parents' choosing, such as tummy time, snack time, or a play activity. The parents used personally owned recording

devices, such as smartphones, iPads, or laptop computers, to video-record the interactions and share the videos with the SLP. The SLP reviewed the videos before each session and then used the videos to guide the intervention session. During the sessions, the SLP first asked the parents to share their observations of their child since the last session. The SLP then discussed with the parents the child's current skill levels and ways current skills could be strengthened or expanded to encourage communication skill development. Specific weekly activities were determined by the SLP based on the child's current and emerging skills, as well as family-specific dynamics and experiences. Examples of weekly activities and age targets include responding to child's non-reflexive sounds by imitating the sound (~2–4 months); creating a photo book or folder of important people, places, and objects in your family and look at it with your baby (~8–16 months); and expanding the child's short utterance by repeating it in a longer sentence (~14–24 months). See OSF website (<https://osf.io/yzht4/>) for more details.

The SLP guided the parents to target activities that were just beyond the child's current skill level so that the child can master them with minimal, fading levels of parent support (ZPD). Each child proceeded through therapy at their own pace, consistent with a highly personalized framework. For sessions conducted via e-mail, the SLP asked the parents to e-mail observations of their child's development along with the videos. After reviewing the shared videos, the SLP provided written feedback and then offered suggestions for targets and activities.

Feasibility Measures

Parent Satisfaction Survey

At the end of the intervention period, researchers asked the parents to complete a satisfaction survey. The original survey included a single yes/no question (*Overall, the Babble Boot Camp has been a good experience*) with space to explain the response along with two open-ended questions (*Some of the most important things I learned while participating in the Babble Boot Camp were...* and *To make the Babble Boot Camp better, I offer the following suggestions...*). To gain more in depth information regarding families' experiences and satisfaction with BBC, we revised and expanded the original survey to include four items with 5-point Likert rating scales, two items with 3-point Likert rating scales, and five open-ended questions. Tables 3 and 4 include the fixed-scale and open-ended questions included in the survey, respectively. The parent satisfaction survey was used to measure acceptability.

Intervention Session Logs

The SLP maintained logs of intervention sessions completed by the participating parents. The logs included

Table 3. Parent satisfaction survey items and parent responses on closed-ended questions.

Survey item	Response (original: <i>n</i> = 3; revised: <i>n</i> = 8)
Respondent role	Mother: 91% Father: 9% Other: 0%
My child with galactosemia is my first and only child.	Yes: 45% No: 55%
Overall, the Babble Boot Camp has been a good experience. ^a	Yes: 100% No: 0%
Overall, how satisfied were you with the Babble Boot Camp? ^b	Very satisfied: 100% Satisfied: 0% Neutral: 0% Unsatisfied: 0% Very unsatisfied: 0%
Overall, how satisfied were you with your child's progress after participating in the Babble Boot Camp? ^b	Very satisfied: 100% Satisfied: 0% Neutral: 0% Unsatisfied: 0% Very unsatisfied: 0%
Overall, how effective was the speech-language pathologist? ^b	Very satisfied: 100% Satisfied: 0% Neutral: 0% Unsatisfied: 0% Very unsatisfied: 0%
How clearly was the information about your child's progress and your assigned activities presented by the speech-language pathologist during the weekly Babble Boot Camp meetings? ^b	Very satisfied: 100% Satisfied: 0% Neutral: 0% Unsatisfied: 0% Very unsatisfied: 0%
What did you think of the time invested on your part to participate in the Babble boot Camp (ex: meeting with SLP, LENA recordings, questionnaires, etc.)? ^b	Just the right amount of time: 100% Too much time: 0% Not enough time: 0%
In your estimation, how much did your child benefit from participating in the babble Boot Camp? ^b	No benefit: 0% Unsure: 0% Definite benefit: 100%

Note. SLP = speech-language pathologist; LENA = Language ENvironment Analysis.

^aItem only included on the original parent satisfaction survey. ^bItems only included on the revised parent satisfaction survey.

session attendance and modality (i.e., Zoom or e-mail). Requirements of e-mail attendance included an e-mailed update of parents' observations of their child's development since last session in addition to sharing videos. If parents did not provide an update on their child's development, the session was not counted as attended. The intervention session logs were used to evaluate implementation success and practicality.

Additionally, the SLP rated session compliance on a 2-point scale with one point assigned if a video was submitted and one point assigned if the parent demonstrated follow through on targeted intervention activities and recommendations as judged by the SLP. The session compliance ratings were used to evaluate implementation success.

Fidelity Checks

The SLP video-recorded the intervention session for fidelity purposes. The BBC fidelity team randomly selected videos to evaluate fidelity, with at least one check completed for each participant (min-max = 1-11). The BBC fidelity team consisted of trained research assistants, graduate and

undergraduate students in speech and hearing science, and undergraduate honors students in other sciences (e.g., microbiology, biomedical engineering, and global health). Assistants coded each video for the presence or absence of the following four key intervention components:

- Review: SLP asks parent to report on their observations of the child's development since the last session, and the SLP discusses observations from the videos with the parent
- Teach: SLP provides information to the parent or describes a new parent behavior
- Model: SLP demonstrates or gives examples how to implement a parent behavior
- Plan: SLP makes recommendations for the following week to strengthen/support current skill or move child forward in a new skill

Research assistants trained to greater than 90% reliability before independently completing fidelity checks. The fidelity checks were also used to evaluate implementation success.

Table 4. Parent satisfaction survey items and parent responses on open-ended questions.

Survey item	Responses
<p>1. Overall, the Babble Boot Camp has been a good experience because (<i>n</i> = 3)</p>	<p>Information</p> <ul style="list-style-type: none"> • “Structure and focus on how to develop child’s speech.” • “A great benefit was knowing whether development was on track, or if certain areas needed help and how to do this.” <p>Support</p> <ul style="list-style-type: none"> • “Having one regular person was greatly beneficial as they got to know the family over time.” • “Regular contact encouraged us as a family to work on speech and communication.” • “We were not alone. With galactosemia being such a rare condition, very little support is there beyond dietary advice with ‘wait and see’ being a commonly adopted approach. Coming off the back of such a traumatic first few weeks of life, the urge to help our child is overwhelming and this programme is the only non-diet one we are aware of. The impact and support this has given me is wider than just the aims of the programme, it helped me come to terms with the condition with a focus on how to move forward. We will never know to what extent the programme benefitted our child, but hopefully as the trial carries on statistically significant data will be found. Being part of the programme gave valuable additional support to the whole family.” • “We loved being a part of research, but also to get free advice and direction for our child—was amazing.”
<p>2. Please share any comments about your child’s benefit: (<i>n</i> = 7)</p>	<p>Program design</p> <ul style="list-style-type: none"> • “I liked the structure of the calls and the video uploads.” • “We loved meeting with [SLP]! She was so helpful with any question we had.” <p>Strengthened speech and language development</p> <ul style="list-style-type: none"> • “I sincerely believe that participating in this early intervention program has contributed to my daughter’s success. She constantly receives compliments about her speech, which when you think about our initial concerns and her diagnosis is amazing! I’m forever grateful.” • “[Child] has had another recent language burst. He seems way further along than my older child was at this age. People around us can understand him as well.” • “We see no evidence of delays with [Child]. She is doing great, very communicative.” • “People comment all the time about how well she talks and that she sounds older than she is.” • “She seemed to only thrive from participation. I just wish the program would have gone a little past two to keep her on track.” <p>Uncertain of benefits</p> <ul style="list-style-type: none"> • “[SLP] was incredible and gave us stuff to work on weekly, but I am unsure if it was all her work with her or if she did have an issue with speech. She also has an older sister (2 years older) who talks very well & she followed in her footsteps. By NO means am I discounting all the work we did because defiantly think it was beneficial!!” • “I almost said ‘unsure’ only because since we started BBC at 2 months old, and my child progressed just the way he was supposed to. Is it because of BBC or would he have had speech issues without the therapy? I would like to think BBC definitely helped. I know he was paying attention, I still use phrases that the speech pathologist would say and he will reply back with ‘oh, [the SLP]!’”

(table continues)

Table 4. (Continued).

Survey item	Responses
<p>3. Some of the most important things I learned while participating in the Babble Boot Camp were (<i>n</i> = 9)</p>	<p>Information on speech and language development</p> <ul style="list-style-type: none"> • “Not to get frustrated if something has not happened [yet], especially when understanding the limits a child should be able to do at a certain age.” • “[Watching] out for development, which may not have been identified without assistance.” • “There are SO many levels of communicating, that I did not realize.” • “What to expect at various stages of speech development—I had no idea.” <p>Strategies to support speech and language development</p> <ul style="list-style-type: none"> • “Guidance on how to work on certain sounds and communication.” • “Talk, talk, talk and then when you are tired of talking talk some more!” • “Alternative ways to work with [Child]—new ideas/exercises.” • “The weekly exercises, especially when she was 6–18 months.” • “Persistence is key!” • “How to help [Child] specifically.” • “What to do when [Child] just didn’t seem to be making progress and how to help him through that.” • “Use language for everything, throughout my normal day activities. Children are listening even when we don’t think they are.” • “The homework was great to help us to continue moving forward.” • “To copy a baby’s babbling to try to get them to say more and keep going.” • “Letting your child talk but then repeating the word you think they are saying correctly and try to get them to repeat that and fix their mispronunciation.” • “I learned how to communicate better with my child especially at such a young age and feel better equip to help her be successful even after ending the program.” • “Where to focus our energy each week to make the best progress.” <p>Other comments</p> <ul style="list-style-type: none"> • “Having outside influence was great—she could track new things we may not notice.” • [SLP] was amazing.
<p>4. My favorite things about the Babble Boot Camp were: (<i>n</i> = 7)</p>	<p>Weekly sessions</p> <ul style="list-style-type: none"> • “Weekly meetings and feedback on her progress.” • “Seeing [SLP] weekly :)” • “The weekly calls with the speech pathologist.” <p>Progress</p> <ul style="list-style-type: none"> • “Seeing her progress weekly.” • “Being proud and excited to show [SLP] her progress.” • “Seeing weekly progressions with [Child’s] speech. [SLP] gave us specific tasks to complete each week that seemed to be on target with her weekly growth.” <p>Goals</p> <ul style="list-style-type: none"> • “Having goals/things to work on.” • “Knowing what to look for/‘what’s next’ for her development.” <p>Support</p> <ul style="list-style-type: none"> • “Having a support group.” • “It was helpful to know that there was an active attempt to mitigate the potential effects of CG, rather than taking this passive ‘wait and see’ approach. That, in of itself, helped with our anxiety to know that we were doing everything we could to support her right at the beginning. It was empowering.” <p>The speech-language pathologist</p> <ul style="list-style-type: none"> • “[SLP]!!! She connected so well with [Child] and our whole family. So encouraging and insightful.” • “The speech therapy.” • “[SLP]. She is such a great clinician and human.” <p>Resources</p> <ul style="list-style-type: none"> • “We now have a whole library of delightful videos of [Child] thanks to the weekly homework.”

(table continues)

Table 4. (Continued).

Survey item	Responses
5. To make the Babble Boot Camp better, I offer the following suggestions: (<i>n</i> = 7)	<p>Duration of intervention</p> <ul style="list-style-type: none"> • “I would definitely extend the program past age two. I feel like two is when they really start chatting and able to hold attention better during meetings.” <p>Written resources</p> <ul style="list-style-type: none"> • “Quite often, especially as our child got to 18 m+, the calls became quite hectic, with one parent handling the child and the other speaking. We attempted at various times to write down the suggestions each week to help us remember to do them. A more formal process for doing this would have been helpful—either the parent or speech pathologist writing a short two-three sentence email summarizing the suggestions for the week. Or perhaps using software such as Google Keep to update each week what is being focused upon.” • “A handbook to accompany the sessions would be helpful—going over the basics of speech development, links with physical development, generic ways to help development, tips to help on certain issues, what to do beyond the age of two.” <p>Additional video resources</p> <ul style="list-style-type: none"> • “We tried to capture various aspects of speech and communication development in the videos, playing with toys, reading books together, interacting with other children. The initial YouTube videos were helpful in seeing how a child may be babbling at certain ages; examples of older (> 1 year) may have helped us develop. The videos probably being of more help for parents than the children.” • “Some video modeling examples of language for play would be helpful for families who don’t have teaching experience (I do this as a special education preschool teacher for the families I work with).” <p>System to track child’s words</p> <ul style="list-style-type: none"> • “We tried at some points to make lists of new words, how words were changing and when. We never found a satisfactory way of doing this, perhaps some templates in Google Keep or similar.” <p>Improved Processes</p> <ul style="list-style-type: none"> • “Just have the recorders arrive on time. I know it’s tough when you only have so many, but sometimes we got over a month behind and I’m sure that affects research.” • “The questionnaires are tedious and time consuming. If they could come on the computer questionnaire where you select things rather than pencil in circles, I think that would be helpful. Or even an app.” • “The paper surveys were sometimes hard to fill out due to poor printing.” <p>Nothing</p> <ul style="list-style-type: none"> • “Nothing.” • “I think it was an incredible resource!” • “I cannot think of anything I would change.”
6. If you have any additional comments, please provide them here: (<i>n</i> = 3)	<p>Gratitude</p> <ul style="list-style-type: none"> • “I wanted to thank the whole BBC team for their support and efforts with [Child]. [Child] wouldn’t be where she is today with the team and [SLP]. [Child] is now 26 months and is talking SO well. She blows ‘normal’ 2+ kids out of the water. We are very proud of her. When we found out the news, we were devastated, confused and many other emotions- but finding this study when she was just 5 weeks old really helped us cope and we knew we weren’t alone. So thank you!!!” • “Thank you for studying the importance of early intervention and shedding light to the immense plasticity and potential of the brain to develop despite hurdles. :) What a wonderful contribution to science (and our kids).” • “Very thankful to have participated. Thank you!”

Results

Study Question 1: Acceptability

Eleven of the 16 participants completed the satisfaction survey: Three completed the original survey, and eight completed the revised survey. Table 3 includes the responses to the fixed-scale questions. All but one of the respondents were mothers. Of the respondents, 45% indicated that the child participating in BBC was their first and only child. All of the respondents indicated that they were very satisfied with BBC, their child's progress, the SLP, and the information presented. All respondents judged the time investment was just the right amount of time, and all respondents reported that their child benefited from participating in BBC.

The open-ended questions varied somewhat across surveys, and not all respondents answered each of these questions. Table 4 lists each of the open-ended questions and the number of respondents for each item. Table 4 also includes the parents' responses to each item organized by identified themes. For Question 1 ("Overall, the Babble Boot Camp has been a good experience because..."), parents reported that BBC was a good experience because of information and support received as well as the overall program design. For Question 2 ("Please share any comments about your child's benefit"), parents commented that their child's speech and language development was strengthened because of the intervention, whereas two parents were uncertain of direct benefits from the intervention. For Question 3 ("Some of the most important things I learned while participating in the Babble Boot Camp were..."), parents reported that through the intervention, they gained information on speech and language development and strategies to support speech and language development. For Question 4 ("My favorite things about the Babble Boot Camp were..."), parents listed several aspects of BBC that they liked, including weekly sessions, seeing their child progress, having goals to work on, feeling supported, the SLP who delivered the intervention, and gaining resources. For Question 5 ("To make the Babble Boot Camp better, I offer the following suggestions..."), parents offered several suggestions to improve the intervention, such as extending the duration of the intervention, including written resources, providing additional video resources, and improving general study processes and logistics.

Study Question 2: Implementation

To evaluate the implementation of BBC, we first examined the number of intervention sessions parents completed with the interventionist using the session logs. Parents attended, on average, 92.8% ($SD = 5.6\%$; min-max: 76.9%–100%) of possible sessions. The average number of sessions attended was 81.4 ($SD = 6.4$; min-max = 70–94) out of an average of 87.8 possible sessions ($SD = 6.4$; min-

max = 77–96). The intervention duration was, on average, 19.8 months ($SD = 1.6$; min-max = 17–21). Of the sessions completed, on average, 7.51% ($SD = 3.95\%$; min-max = 1.1%–12.6%) were conducted via e-mail.

Second, we examined parents' compliance for recording and sharing a video for each session attended. On average, parents uploaded videos for 79.8% ($SD = 18.7\%$; min-max = 52.4%–100%) of sessions attended. Of sessions conducted via e-mail, on average, parents uploaded videos for 79.4% ($SD = 26.4$; min-max = 0%–100%) of sessions. Of sessions conducted via Zoom, on average, parents uploaded videos for 79.6% ($SD = 19.0$; min-max = 52.6%–100%) of sessions.

Third, we examined parents' follow through and commitment to intervention activities and recommendations. On average, parents demonstrated follow through in 99.5% ($SD = 1.2\%$; min-max = 96.5%–100%) of sessions attended. Of sessions conducted via Zoom, on average, parents demonstrated follow through for 99.5% ($SD = 1.2\%$; min-max = 96.3%–100%) of sessions. Of sessions conducted via e-mail, on average, parents demonstrated follow through for 99.6% ($SD = 1.8\%$; min-max = 92.9%–100%) of sessions.

To date, 57 of 1,310 videos from the 16 participants included in this study have been reviewed (4%). Of the 57 videos randomly selected for review, six were incomplete due to technical issues. Fidelity for the remaining 51 videos was as follows: review = 98.5%, teach = 98.5%, model = 85.1%, and plan = 100%.

Study Question 3: Practicality

To evaluate the practicality of BBC, we examined cost based on the SLP's and parents' time. To implement a single intervention session required approximately 40 min of the SLP's time: 10 min to schedule session and provide parents with appointment reminders, 15 min to retrieve and review shared parent-child videos, and 15 min to videoconference with parents. Total average SLP time across participants was 54.3 hr ($SD = 4.3$; min-max = 49.3–62.7), which averaged 2.75 hr per month ($SD = 0.20$; min-max = 2.2–3.0) per participant. Each intervention session required approximately 30 min of the parents' time: 15 min to record and share their parent-child videos and 15 min to videoconference. Total average parent time across participants, excluding time spent actually implementing the new activities and routines, was 40.7 hr ($SD = 3.2$; min-max = 35.0–47.0), which averaged 2.1 hr per month ($SD = 0.15$; min-max = 1.7–2.2) per participant.

Discussion

This study evaluated the feasibility of BBC, a telepractice parent-implemented intervention, for use with

infants with CG beginning at less than 6 months of age. While early efficacy studies support the use of BBC (Peter et al., 2020, 2021), in this study, we focused on other aspects of feasibility. Specifically, we examined the extent to which BBC is satisfying for parents of infants with CG (acceptability), the extent to which BBC can be successfully delivered to parents of infants with CG (implementation), and the extent to which BBC can be delivered to parents of infants with CG at a low cost (practicality).

Overall, parent-reported acceptability of BBC was high. We evaluated acceptability using a parent satisfaction survey completed by 11 parents at the end of the 17- to 21-month intervention period. All respondents indicated that they were very satisfied with BBC, their child's progress, the SLP, and the information presented. Parents indicated that they thought the time investment was just the right amount of time. Additionally, parents reported that BBC was a good experience because of information and support received as well as the overall program design and felt that their child benefited from participating in BBC. Parents offered several suggestions to improve the intervention, such as extending the duration of the intervention, including written resources, providing additional video resources, and improving general study processes and logistics. These minor adjustments will be implemented to ensure increased acceptability and satisfaction with the BBC intervention.

Implementation success was high based on parent completion and compliance and the SLP's adherence to the intervention protocol. We evaluated implementation using session logs and fidelity checks. Parents completed, on average, 93% of all possible sessions, 8% of which were conducted via e-mail. Parents shared videos for 80% of the sessions, whether via Zoom or e-mail. Additionally, parents demonstrated follow through on intervention recommendations for 99% of both Zoom and e-mail sessions. The SLP successfully implemented each intervention component in 85% or more of the sessions. The SLP reviewed observations, taught parents a new behavior, and made implementation recommendations in nearly all of the sessions reviewed. The high rates of completion, compliance, and fidelity provide evidence that BBC is readily implementable.

Analyses of time reveal that BBC is practical. Each session required an approximate total of 40 min of the SLP's time and 30 min of the parents' time. Because sessions are delivered entirely via telepractice, additional resources are not required for transportation, minimizing resource requirements. Parents were able to use existing technology for sessions. Perhaps the greatest practical benefit is the fact that almost all children with CG who completed the BBC intervention tested within normal limits in speech and language skills at follow-up, which may relieve them of the lengthy conventional treatment during the

preschool and school years that most children with CG require.

It will be important to continue to monitor the feasibility of BBC based on the components included in this study (i.e., acceptability, implementation, and practicality) as more participants complete the intervention. With a larger sample size, analyses should be conducted that examine feasibility across families that vary based on race, levels of education, income, or other personal/demographic factors. Regarding race, however, note that due to reasons related to population genetics, CG occurs most frequently in individuals of Irish origin, and it may be challenging to conduct fully powered studies investigating aspects of race. It is possible that BBC, as a telepractice intervention, is not equally feasible across all populations, requiring modifications using an individualized approach.

Results from this feasibility study also support the use of telepractice to implement caregiver-implemented interventions, more generally. Our high levels of parent acceptability, high rates of completion and compliance, and low associated costs in terms of parent and clinician time suggest that telehealth is a feasible option for families with young children who may have complex medical conditions. Findings from our study support and motivate further evaluation of early interventions delivered via telepractice.

There are several limitations of this work. First, although telepractice alleviates some potential barriers, it may create or enhance others. For example, certain families may have less access or familiarity with technology required for telepractice services. Second, although we observed high levels of acceptability and high rates of completion and compliance, the study sample was relatively homogeneous, representing highly educated, White families. Further evaluation of the feasibility of BBC with families of different races and education levels is needed. Third, satisfaction evaluation could be expanded to include other, possibly objective or performance/outcome driven, methods. For example, surveys or member-checking could be administered throughout the interaction periods in addition to the end of the intervention period. A wider range of metrics could be considered to evaluate feasibility in other dimensions not explicitly considered here. Fourth, in this study, a single SLP provided all intervention and telepractice services. Including a varied cohort of professionals may give insight into details of service delivery and the generalizability of feasibility.

Future investigations might also consider other aspects of feasibility not addressed in this study, such as its demand; adaptability to other populations, including other populations at high risk for speech and language impairment; integration into current service delivery models and systems; and expansion to other service delivery approaches, such as in-person one-on-one and in groups.

Conclusions

There is existing early efficacy evidence supporting BBC for use with infants with CG who are at high risk for speech and language impairment. This study provides further evidence supporting the feasibility of BBC delivered exclusively although telepractice. Data drawn from parent surveys, intervention logs, and intervention fidelity checks revealed high parent acceptability, high rates of completion and compliance, and low costs in terms of time and financial resources. These results suggest that BBC is feasible for families of infants with CG, warranting further examination of BBC for additional children with CG as well as infants with other early detected predictable risk factors for speech and language impairment.

Author Contributions

Lizbeth H. Finestack: Conceptualization (Equal); Formal analysis (Lead); Methodology (Supporting); Writing – original draft (Lead); Writing – review & editing (Lead). **Nancy Potter:** Funding acquisition (Supporting); Writing – review & editing (Supporting). **Mark VanDam:** Writing – review & editing (Supporting); Funding acquisition (Supporting). **Jennifer Davis:** Methodology (Supporting); Validation (Supporting). **Laurel Bruce:** Validation (Lead); Writing – review & editing (Supporting). **Nancy Scherer:** Methodology (Supporting); Writing – review & editing (Supporting). **Linda Eng:** Project administration (Lead). **Beate Peter:** Conceptualization (Equal); Funding acquisition (Lead); Writing – review & editing (Supporting).

Data Availability Statement

The data sets generated during and/or analyzed during this study are available in anonymized form from the corresponding author on reasonable request.

Acknowledgments

This research was funded by Eunice Kennedy Shriver National Institute of Child Health and Human Development R01 5R01HD098253 to B. Peter, N. Potter, and M. VanDam; Arizona State University Institute for Social Science Research to B. Peter; private donations to the College of Health Solutions Babble Boot Camp Gift fund at the Arizona State University Foundation; Arizona State University New Faculty Startup Fund award to B. Peter; and the National Science Foundation Social Behavioral and Economic Resource Implementations for Data Intensive Research 1539133, Washington Research Foundation

to M. VanDam. The authors extend gratitude to all of the parents and children who participated in this study.

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