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ORIGINAL PAPER

Building Family Capacity: supporting multiple family members to implement aided Language modeling

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Abstract

Family-centered capacity-building practices have been shown to benefit children and families. However, limited research explores these practices for children who use augmentative and alternative communication. This study explored an intervention to teach family members to implement an Aided Language Modeling (ALM) strategy across natural activities at home. A single case multiple probe design was used to evaluate the intervention with five family members and a girl with autism. Results showed the intervention increased family members' percentage of high-fidelity ALM strategy use and rate of ALM. Descriptively, a modest increase was also observed in the proportion of the child's communication using the speech-generating device. Social validity interviews suggested the goals, procedures, and outcomes were socially valid and supported family capacity building.

Keywords Aided language modeling · Family intervention · AAC · Telepractice

Many children with autism and other developmental disabilities experience difficulties developing communication skills (American Psychiatric Association, 2013), which can impact the quality of life for these children and their families. Although the communication skills and interaction styles of children with autism vary, it is estimated that around 30–40% make no or minimal use of speech for functional communication throughout their life (Rose et al., 2016). Effective communication interventions have been identified for children with autism who have limited verbal speech, including those involving augmentative and alternative communication (AAC; Beukelman & Light, 2020; Ganz et al., 2012). AAC refers to other ways of communicating that supplement or replace verbal speech, and can included *unaided* modes which do not require tools outside the body (e.g., gestures, manual signs, facial expressions), and *aided* modes which are external tools such as picture symbols or speech-generating devices (Beukelman & Light, 2020). Speech-generating devices (SGDs) are tablet computers or similar dedicated devices that may be text or picture-based and produce digitized speech output. A review conducted by Lorah and colleagues (2021) indicated that children with autism may prefer and communicate more effectively with SGDs compared to other modalities (e.g., picture exchange, manual sign).

Previous research demonstrates many different teaching strategies promote the communicative participation of children with autism who are learning to use aided AAC such as SGDs (Ganz et al., 2012; Kent-Walsh et al., 2015; Lorah et al., 2021). The actual strategies used to promote participation and language learning are crucial; providing access to an AAC device alone is not enough to promote effective communication (Lorah et al., 2021). One AAC intervention strategy with demonstrated effectiveness to support children's use of SGDs is aided language modeling (ALM; Allen et al., 2017; Biggs et al., 2018; O'Neill et al., 2018). ALM involves a communication partner, such as a parent or sibling, providing language input using both speech and the SGD during ongoing, natural interactions. ALM provides children with linguistic input in the same mode as they are expected to produce linguistic output (i.e., the SGD). This can be advantageous for supporting children's social

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interaction and language skills because it (a) helps children draw connections among spoken words, symbols on AAC devices, and their referents and (b) demonstrates to the child that the AAC device is a desired and encouraged mode of communication (Biggs et al., 2018). For example, a communication partner might say: "This music is fun" while selecting [music] and [fun] on the SGD as they speak. Three independent systematic reviews have found that ALM interventions can be effective in increasing children's independent communication turns and use of aided AAC including SGDs, among other communication outcomes (e.g., symbol comprehension, number of different words; Allen et al., 2017; Biggs et al., 2018; O'Neill et al., 2018). However, these reviews also highlight the need for additional research related to the implementation of these interventions by natural communication partners in everyday routines.

Federal law (IDEA, 2004), professional organizations (Division of Early Childhood, 2014), and researchers (e.g., Kaiser & Roberts, 2011; Meadan et al., 2010) note the importance of involving family members to implement communication interventions in natural environments, particularly when incorporating AAC techniques with young children. Focusing AAC interventions on natural settings and with natural communication partners can increase motivation and opportunities for the child to practice and generalize communication skills across environments. Evidence-based strategies such as ALM can be embedded within children's daily routines, activities, and social interactions (Biggs & Meadan, 2018; Coogle et al., 2013; Gevarter & Zamora, 2018). To engage family members in interventions, the Division for Early Childhood (2014) recommends using family-centered capacity-building practices. These practices draw on a number of theories including family systems (Turnbull et al., 2015), social support (Cohen & Wills, 1985), ecological (Bronfenbrenner, 1992), and empowerment (Rappaport, 1987). Family-centered capacity-building practices emphasize active family participation in decision-making processes, focus on building family members' skills and confidence supporting the child, and help families achieve the goals they have for their child and family—thereby increasing family capacity. Research indicates that these practices can benefit the child, family members, and the whole family unit (Dunst et al., 2007).

Research indicates family-centered capacity-building models can support parents in learning to implement communication strategies with fidelity (i.e., strategies carried out as intended; Biggs & Meadan, 2018; Douglas et al., 2017; 2018a; Meadan et al., 2016). However, parents are not the only important family members for children with disabilities. According to Turnbull et al. (2015) child development is impacted bi-directionally by all family members. Therefore, involving many different family members may expand the impact of AAC and other communication interventions. For example, although less common, research suggests that siblings can learn to use effective strategies to support communication (Douglas et al., 2018b; Spector & Charlop, 2018). While research involving immediate family members is common, there is a dearth of information about involving extended family members (e.g., grandparents, aunts, cousins), despite their importance to the well-being of the child and family (Prendeville & Kinsella, 2019). Our team could not locate any studies in which extended family members implemented communication interventions for children with disabilities.

One approach that might be useful when implementing family-centered capacity-building practices for the whole family unit is the cascading intervention model. A cascading intervention model includes several levels of training and coaching across stakeholders. For example, Meadan et al. (2020) used a cascading intervention model with four levels: (a) a researcher trained and provided coaching to (b) an early interventionist who supported (c) a parent who implemented communication strategies with (d) the child with communication needs. Such an approach could allow researchers to explore the feasibility and effectiveness of an intervention model in which one family member trains and coaches other family members to implement a strategy such as ALM. For example, Elder and colleagues (2011) trained and coached fathers of children with autism to use communication strategies (e.g., imitation with animation, commenting) with children with disabilities, and fathers then trained and coached mothers to use the same strategies. Both fathers and mothers increased effective use of strategies, and fathers were able to train and coach mothers without additional support from the researchers.

In the existing literature, studies involving cascading intervention models and multiple family members are rare, particularly within AAC-related research. Prior research on family-implemented AAC interventions has focused primarily on mothers (Biggs et al., 2019; Kent-Walsh et al., 2015). Limited information is available about the involvement of fathers in supporting AAC use at home (Douglas et al., 2017), even though researchers emphasize the importance of fathers' involvement in intervention for young children with disabilities (Flippin & Crais, 2011). In addition, the involvement of siblings is also important (Mandak et al., 2017), but siblings rarely have been involved in AAC intervention (Biggs & Meadan, 2018; Douglas et al., 2018b). Even more rare is the inclusion of extended family members. Training a variety of family members to effectively support the communication of children who use AAC can augment the supports children receive through professional services and result in faster language acquisition and AAC proficiency (Douglas et al., 2017). Therefore, it is important

to explore the feasibility of interventions in which more than one family member is trained and coached to use AAC intervention strategies with children with autism (Douglas et al., 2021).

Given the limited research investigating family-centered capacity-building practices for children who use AAC, this study investigated the effectiveness and social validity of an ALM coaching intervention with both immediate and extended family members. Specifically, we explored the effect of the mother acting as the trainer and coach for other family members. Our primary research question was: Is there a functional relation between a family capacity-building coaching intervention and the fidelity and rate with which family members use the ALM strategy during target routine activities? We also had two secondary research questions: (a) Descriptively, are there changes in the proportion of the target child's total independent communication that involves the SGD?; (b) How do family members perceive the social validity of the goals, procedures, and outcomes of ALM training and coaching?

Method

Participants and Setting

Following institutional research board approval at the first author's institution, participants were recruited for the study through AAC evaluation centers across a mid-western state in the United States. Families who were interested in participating contacted the first author and were screened using the following eligibility criteria: (a) had a child with complex communication needs, 4–8 years old, in the home who had access to a SGD (high-tech dynamic display) and communication skills at the unconventional communication, conventional communication, or concrete symbol level based on the Communication Matrix assessment completed by the primary caregiver (Rowland, 2004; Rowland & Fried-Oken, 2010); and (b) had at least four family members, age 8 or older (which was required for experimental control within the single-case design). We report on one family who indicated interest, qualified, and participated in this study which took place in the target child's home.

Family Participants and Target Activities

Participants were the target child, Amber, and five family members: mom, dad, brother, great aunt, and aunt. A second aunt consented to participate in the study, but stopped during baseline because COVID-19 restrictions prevented her from visiting Amber in the home. Four younger siblings, ages 5, 2, and 1 (twins) also lived in the home, but did not participate in the study due to their age. Each family participant was paired with Amber to form five dyads. Participants are described below in the order in which they participated in the intervention.

Target child. Amber was a 7-year-old White female who was diagnosed with autism (Level 3, requiring very substantial support) at age 4 and also had a rare chromosomal duplication. At the beginning of the study, Amber attended a public self-contained special education school for students with cognitive impairments where she received occupational, speech, and physical therapy. Amber communicated through sign language (approximately 20 familiar signs), common gestures (e.g., head nod, pointing), and also used a SGD. Although Amber had the SGD, she communicated primarily using sign language at home. However, the family expressed a desire for her to become more proficient in her SGD so she could communicate with unfamiliar partners. Amber's SGD, a Proloquo2go application on an iPad with SymbolStix images to represent words and phrases, had been in use for approximately 1.5 years at the start of the study. The SGD was obtained through an evaluation with a community-based SLP and funded through public and private insurance. Amber used the SGD at school and occasionally at home with mom and dad, but not other family members. The school provided technical support and periodically added necessary vocabulary to the SGD for Amber. Family members did not have any training related to modeling the SGD prior to the study and did not provide intentional models of Amber's SGD in the home. Vocabulary included high-frequency core words such as *help* and *want* (36 symbols) and content vocabulary (over 200 additional symbols) to represent basic needs (e.g., food, bathroom), common things/places in her environment (e.g., park), adjectives (e.g., pretty, little), social conventions (e.g., thank you, hello), and favorite activities and items (e.g., music, headphones). The layout of symbols allowed high-frequency vocabulary to remain visible while navigating to other pages. Results from the Communication Matrix indicated that Amber performed at the concrete symbol level related to obtaining and refusing actions and objects, but the conventional communication level (pre-symbolic) for social and information areas. Amber was able to navigate across screens in her SGD and occasionally used symbols on the SGD spontaneously to obtain her wants (food items) and needs (favorite activities such as music). However, her communication rarely included use of her SGD to engage in social interactions or gain information.

Mom. Megan was a 35-year-old, married, White woman. She had a bachelor's degree and was a stay-at-home mom. She had no formal AAC training prior to the start of the study. Megan selected shared storybook reading as her target activity, which usually took place in the living room and

used books already available in the home. Target vocabulary for the activity within the study included high-frequency words already programmed within Amber's SGD (e.g., *I, want, listen, look, see, sit, read, book, all done, more, next, turn*) and words selected by Megan before the study began and during coaching that supported communication with Amber (e.g., *first, then, after*).

Brother. Brother was a 9-year-old, White boy in the third grade with no prior AAC training. He selected playing with musical toys as the target activity, which took place in the playroom or bedroom. Target vocabulary for the activity within the study included high-frequency words available on the SGD including: *I, want, play, my turn, your turn, go, good, help*, and words selected before the study relevant to the target activity (e.g., *violin, singer, sing, headphone, cars, color, ball, wow).*

Dad. Dad was a 38-year-old, married, White man. He had a bachelor's degree and worked as a delivery driver. Dad had no AAC training prior to the study. He selected music and dancing as the target activity, which usually took place in the living room. At times he also played games and puzzles with Amber. Target vocabulary for the activity within the study included words that were already programmed in the SGD (e.g., *want, music, different, help, all done, good, different*), and words selected before the study began related to the target activity (e.g., *faster, slower, break, puzzle).*

Great Aunt. Great aunt was a 61-year-old, single, White female. Although she did not live in the home with Amber, she visited at least weekly to spend time with the family and provide respite to Amber's mom. She had a high school degree and worked as a secretary. Great aunt selected snack/mealtime as her target activity, which usually took place in the kitchen. Target vocabulary for the activity within the study included high-frequency words that were already in the SGD (e.g., *good, done, water, snack, more, eat, finished, want*), and other vocabulary selected before the study began related to Amber's favorite foods (e.g., *banana, applesauce, crackers, juice*).

Aunt. Aunt was a 26-year-old, single, White female who did not live in the home with Amber but visited weekly to spend time with the family. She had a bachelor's degree and worked as a correction officer. Aunt selected play (e.g., musical toys, blocks) as her target activity, which took place in the living room or bedroom. Target vocabulary for the activity within the study included high frequency words that were already in the SGD (e.g., *your turn, fun, want, play, again, you, try, good*), and other vocabulary selected before the study began related the activity (e.g., *music, block*).

Research Design and Procedures

This study began in early March 2020, prior to the COVID-19 pandemic, and continued during the pandemic to end in early September 2020. Prior to the start of the study (February 2020), home visits were conducted by the first and fourth author. During home visits, the research team provided further details about the study and conducted study intake, which included: (a) obtaining informed consent; (b) collecting data about participant demographics; (c) collecting copies of the child's Individualized Education Program (IEP), evaluations, medical diagnoses, and private therapy treatment plans, and (d) documenting routine activities in the home with the family participants (e.g., shared reading, play) to identify target activities.

A single case multiple probe design (Ledford & Gast, 2018) was used across five dyads to evaluate the effects of a family-centered capacity-building intervention on family member ALM implementation. This design allowed each family member to serve as their own control. Prior to the start of the study, an iPad was provided to the family with access to Zoom, a secure online video conferencing platform, which allowed us to collect data remotely in the target child's home, at times convenient to each family member. The study was conducted in three phases: baseline, intervention, and maintenance. All data were recorded through Zoom by the fourth author. Sessions occurred about once a week in baseline, twice a week in intervention, and every other week in maintenance. Interaction with the Amber occurred for a mean of 9.5 min (mom 10.2, brother 9.4, dad 9.8, great aunt 9.1, aunt 9.2).

The fourth author, a doctoral student in child development who held a master's degree in special education with an autism certificate and worked under the supervision of the first author, provided training and coaching to Amber's mom, Megan, through Zoom. Megan was provided with online training materials to use with family members. Given the focus on family capacity-building, the intervention involved Megan first meeting criterion for using ALM (i.e., 80% high fidelity), and then carrying out the role of instructional coach with the other family participants. The introduction of the intervention was staggered across family members to ensure experimental control as required by the study design. The fourth author monitored all training and coaching sessions provided by Megan via Zoom to ensure training fidelity.

Baseline

Baseline data were collected via Zoom during the selected target activity. The fourth author instructed each family participant to interact with Amber as they normally would and

did not provide any feedback before, during, or after the session. The Zoom video for the researcher was turned off during data collection to minimize distraction for Amber and family participants. Amber had her SGD available at each session. Each dyad completed a minimum of five sessions and remained in baseline until data were stable.

Intervention

Intervention consisted of training and coaching on ALM, delivered either by a researcher over telepractice (for Megan) or by Megan in-person to the other family members. The intervention was the same as in a previous study (Author, 2020), with the adaptation of Megan providing coaching to other family participants. The training included learning principles appropriate for both child and adult learners (e.g., memory aid, self-reflection, application in natural setting, coaching; Fazey, 1993; Kent-Walsh et al., 2015; Meadan et al., 2016; 2020). Training materials and the protocol used can be obtained by contacting the first author.

ALM Training. The fourth author used Zoom to provide initial training to Megan, who then provided training to each family participant. Training focused on providing ALM using the SGD during the target activity. The training consisted of oral explanation, visual slides, video examples, and discussion. The content in the training was the same for all family participants, but the language for the training was simplified for brother. Minor personal adaptations to the training were made by Megan (e.g., visual supports for brother) to support each family member in their role with Amber and accommodate individual family needs based on development and understanding of the AAC system. Training took an average of 42 min (range = 31–58 min).

Each participant, including Megan herself, was taught to provide ALM using the strategy: *Prepare, Show, Wait, and Respond*. During *Prepare*, each participant brainstormed activities or actions that would facilitate opportunities for communication and identified target vocabulary within the activity. During *Show*, participants learned how to model the SGD within natural interactions with Amber (Biggs et al., 2018). This included using the SGD to (a) provide a choice, (b) ask a question, (c) comment, or (d) respond to Amber's communication. Explanations and video models were provided to demonstrate: (a) how to place the SGD within Amber's line of sight and within reach when modeling, (b) that SGD models should be at or just above the target child's current communication level, and (c) that SGD models should be accompanied with corresponding grammatically correct spoken language. Given Amber's use of 1–2 symbols within a communication turn when she used the SGD, participants were taught to model 1–3 symbols on the SGD, although the spoken utterances could be longer. For the third step, *Wait*, participants were taught to pause for 3–5 s after each communication turn to allow Amber the opportunity to communicate. Finally, for *Respond* participants were taught to respond to Amber's communication by fulfilling requests, expanding on, or restating communication. At the end of the training, participants developed a plan specific to their target activity to implement the ALM strategy with Amber.

Intervention Implementation Support for Mom. To support Megan in training and coaching the other family participants, the fourth author provided a 35 min implementation training and follow-up coaching sessions to Megan via Zoom. During the training, the fourth author defined and gave a rationale for coaching family members to support Amber, introduced the steps of coaching, and shared materials to use for coaching and training (i.e., training slides, a training script, and coaching checklists). Implementation training with Megan occurred just before brother entered training. Brother was selected collaboratively by the research team and Megan as the next family member to start intervention because he expressed excitement to the research team and his family to learn how to support Amber's communication. The fourth author observed all training and coaching sessions delivered by Megan to record fidelity and provided supportive and corrective feedback based on the training and coaching she provided to each family participant.

Coaching. Individualized coaching began after completion of the ALM training and occurred approximately twice a week. Coaching was delivered by the fourth author to Megan, and then by Megan to each of the family participants, starting with brother. In all cases, coaching consisted of (a) pre-observation reflection and planning, (b) uninterrupted observation of the family participant interacting with Amber, and (c) post-observation reflection and feedback (Meadan et al., 2016). At the beginning of each coaching session, the coach guided the family participant in reflecting on their use of ALM since their last session, developed an action plan, and reviewed the ALM strategy. Then, the family participant engaged in the target activity with Amber for approximately 10 min. During post-observation, the coach encouraged the family participant to reflect on their use of ALM and provided positive and corrective feedback. Each family participant received coaching until they demonstrated at least 80% high-fidelity ALM strategy use across three sessions (i.e., the family member modeled the SGD multiple times, and 80% of these instances of modeling included all ALM strategy steps). Coaching sessions, including the 10 min observation, took an average of 18 min (i.e., mom 21 min, brother 20 min, dad 18 min, great aunt 15 min, aunt 17 min).

Maintenance

Maintenance sessions were conducted once every two weeks after the completion of the training and coaching. On average, maintenance sessions were approximately 10 min in length (i.e., mom 10 min, brother 9 min, dad 10 min, great aunt 9 min). The coach did not provide feedback before, during, or after the session, and turned off the video in Zoom during the activity. Five maintenance sessions were collected for mom, brother, dad, and great aunt (i.e., week 2, 4, 6, 8, 10). No maintenance data were collected from aunt given the length of the study, delays due to COVID-19, and family's desire to complete the study before the new school year.

Procedural Fidelity

A trained research assistant assessed procedural fidelity across all phases and sessions of the study using checklists. Fidelity checklists for baseline and maintenance included five steps (i.e., video recorded target child with family participant, both Amber and the family participant in view of camera, noted when recording started, interaction recorded until complete, researcher did not provide instruction). Procedural fidelity for baseline was 96% range = 80-100% (i.e., both partners were not in view of the camera for part of one session), and 100% for maintenance. The fidelity checklist for ALM training included 26 steps aligned with the content from the training (e.g., explain training format, explain strategy step, show video clip of step in action, discuss/practice strategy step). Procedural fidelity was 100% for training provided by the fourth author and 100% for training provided by Megan. The training session provided by the fourth author to support Megan in implementation with other family participants included 10 steps (e.g., rationale for coaching, explain coaching steps, provide opportunity to ask questions). Procedural fidelity for training was 100%. The fidelity checklist for coaching included 16 steps aligned with the coaching procedures (e.g., discuss use of ALM since last session, review ALM steps, observe interaction, promote reflection, provide supportive/corrective feedback). Procedural fidelity for coaching to Megan from the fourth author was 100% and for coaching sessions by Megan was 100%. Fidelity checklists can be obtained by contacting the first author.

Dependent Variables

The primary outcome was family participants' implementation of ALM using Amber's SGD, which was measured using both (a) high-fidelity (i.e., family member engaging in all of the following behaviors: SGD within Amber's line of sight and arms reach; use of SGD to provide a choice, question, response, or comment; use of the SGD just at or above Amber's communication level; message spoken verbally, using correct grammar; and pause of at least 3 s before resuming the activity) and (b) rate of behaviors per minute. This was calculated by taking the number of high-fidelity AAC models and dividing it by all AAC models during the session to obtain a rate of high-fidelity models per session. These behaviors were graphed and used for decision making within the single case design. Interest in Amber's communication was secondary to family participants' implementation of the ALM strategy. Two variables were measured for Amber. The first was the rate of independent communication per minute, which was defined as all communication acts that were not imitated or prompted by a partner (i.e., initiations and responses). The second was the proportion of independent communication using the SGD. Although we anticipated that the rate would vary across sessions and might not change as a result of the intervention, we were interested in descriptively evaluating whether Amber's communication would increase and how much was with the SGD. This would represent an important and socially valid outcome because her communication could become more consistently understood by her family members and other partners. To calculate this proportion, we measured the rate of Amber's independent communication using the SGD (i.e., any communication that met the definition for independent and involved the SGD).

Coding

Data were coded by the fourth and fifth authors for all dependent variables using a coding form and aforementioned definitions. Prior to coding, training was provided until 90% coding accuracy was demonstrated for all dependent variables (i.e., rate of and fidelity of ALM strategy use by family participants, Amber's rate of independent communication/independent communication using the SGD). Interobserver agreement (IOA) was calculated point by point for start time (within 3 s) of the behavior and by taking the number of agreements divided by the number of agreements plus disagreements and multiplying by 100. IOA was conducted on 38% of sessions, randomly selected across phases and participants (i.e., 40% baseline, 36% intervention, 40% maintenance). IOA for high-fidelity ALM strategy use had a mean of 94% (i.e., mom $M = 83\%$, range = 56-100%; brother $M = 100\%$; dad $M = 98\%$, range = 95-100%; great aunt $M = 91\%$, range = 67-100%; aunt $M = 100\%$). IOA for rate of ALM had a mean of 98% (i.e., mom $M = 94\%$, range = 88-100%; brother $M = 100\%$; dad $M = 99\%$, range = 95-100%; great aunt $M = 97\%$, range = 90-100%; aunt $M = 99\%$, range = 95-100%). IOA

for rate of independent communication by Amber had a mean of 92% (i.e., mom $M = 83\%$, range = 57-100%; brother $M = 94\%$, range = 80-100%; dad $M = 100\%$; great aunt $M = 86\%$, range = 70-100%; aunt $M = 100\%$) and 93% for independent communication with the SGD (i.e., mom $M = 70\%$, range = 50-100%; brother $M = 100\%$; dad $M = 100\%$; great aunt $M = 100\%$; aunt $M = 100\%$).

Data Analysis

Following the standards for single-case research (Kratochwill et al., 2010; Ledford & Gast, 2018), we conducted visual analysis to determine if a functional relation existed between training and coaching and family participants' implementation of the ALM strategy. Data were graphed and analyzed visually to evaluate level, trend, variability, immediacy of effect, and overlap of data (Kratochwill et al., 2010). Decisions related to moving from one phase to another were made based on the primary dependent variable (i.e., high-fidelity ALM strategy use).

Social Validity

Pre- and post-study interviews were conducted with each family participant to assess the social validity of the intervention (i.e., goals, procedures, outcomes). Social validity questions and interview protocol can be obtained by contacting the first author. All interviews were video or audio recorded for transcription. Pre-study interviews were conducted individually during the home visit and questions addressed family participants' day-to-day interactions with Amber (e.g., how they communicated, perceptions of the SGD, challenges), communication goals, desired supports, and expectations/goals related to the intervention. The post-study interview with brother was conducted via Zoom by the fourth author given her rapport with the child. The third author conducted post-study interviews with mom, dad, great aunt, and aunt via Zoom, to reduce the risk of social desirability bias as she had no direct contact with the participants during the intervention. Post-study questions addressed family participants' perceptions of the training and coaching, impact of the intervention, and relevance of the training program to other families. A post-study interview was also conducted via Zoom with Amber by the fourth author, who had rapport with Amber. Two yes/no questions were asked about interactions with each family participant (i.e., Do you like when [name] uses your device to talk with you? Would you like to keep spending time with [name] using your device?). One open-ended question was also asked: Is there anything else you want to tell me about using your device with your family? Amber used her SGD, gestures/signs, and facial expressions to answer questions. Megan was present to interpret unconventional communication. Interviews were transcribed by a research assistant and coded by the fourth and fifth authors using Wolf's (1978) social validity framework.

Results

Results from this study demonstrate a functional relation between the intervention and family participants' implementation of ALM. An increase in the percentage of high-fidelity ALM strategy use and rate of ALM was shown by each family participant (see Fig. 1). Amber also increased her proportion of independent SGD use. Participants stated the goals, procedures, and outcomes of the intervention were socially valid and supported family capacity-building.

Fidelity and Rate of ALM Strategy Use by Family Participants

Mom

In baseline, mom showed zero level of high-fidelity ALM strategy use. After training there was an immediate increase in high-fidelity ALM strategy use, with an increasing trend, some variability, and no overlap with baseline. The final three intervention sessions were over 80% high-fidelity

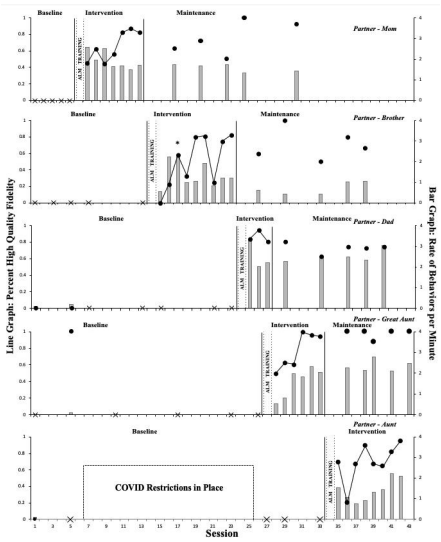

Fig. 1 Fidelity and Rate of Family Members' Use of Aided Language Modeling During Sessions. *Note.* Black circles represent the percentage of high-fidelity models by each family member. A black X indicates no modeling within the session. Brother entered the study second because he was excited to learn how to support Amber's communication. The black star in brother's intervention phase indicates when he was shown a graph of his percentage of high-fidelity modeling after two consecutive sessions of low-fidelity modeling. Gray bars represent the rate of modeling by each family member

ALM strategy use. During maintenance, high-fidelity ALM strategy use was more variable. There was an initial drop in performance (63% at 2 weeks, 72% at 4 weeks, 50% at 6 weeks), but an increase at week 8 (100%) and 10 (92%). Related to rate, mom had a zero level rate of ALM in baseline. An immediate increase in the rate of ALM occurred after coaching, with some variability. The overall mean rate of ALM during intervention was 1.94 per min. In maintenance the rate of ALM was variable and dropped over time (1.73 at week 2, 1.69 at week 4, 1.73 at week 6, 1.32 at week 8, 1.43 at week 10) with a mean of 1.58 per min.

Brother

In baseline, brother demonstrated a zero level of high-fidelity ALM strategy use. After training, there was an increasing trend, with variability and overlap noted for the first session where he had no high-fidelity ALM strategy use. Brother received 9 coaching sessions with an overall mean of 51% for high-fidelity ALM strategy use. During coaching session 3, Megan shared a graph of his data after two low sessions after which his rate of high-fidelity ALM strategy use rose. During maintenance data continued to be variable, but remained above baseline. The overall mean for maintenance was 71%, higher than the intervention mean. Related to the rate of ALM, brother demonstrated zero level during baseline. An immediate increase in the rate of ALM was noted after training with variability, but no overlap with baseline. The overall mean rate of ALM during coaching was 1.38 per min. ALM continued to be variable during maintenance, and the mean dropped to 0.67 per min.

Dad

In baseline, dad demonstrated a zero level of high-fidelity ALM strategy use. After training, there was an immediate, large increase in high-fidelity ALM strategy use and limited variability, with all 3 sessions above 80%. During maintenance, data continued at consistent levels with limited variability for high-fidelity ALM strategy use and a mean lower than intervention (73%). Related to rate, dad demonstrated low rates of ALM in baseline, with a mean of 0.04 per min and a descending trend. An immediate, large increase in rate of ALM was noted after training with a mean of 2.53 per min and some variability, but no overlap with baseline. The overall rate of ALM during maintenance was similar to intervention $M = 2.29$ per min.

Great Aunt

In baseline, great aunt demonstrated a zero level of high-fidelity ALM strategy use. After training there was an increase in high-fidelity ALM strategy use with no overlap to baseline, an ascending trend, and an overall mean of 71%. During maintenance, high-fidelity ALM strategy use continued at high levels with a mean of 89%. In baseline, great aunt's rate of ALM was 0.05 per min with limited variability. An increase in rate of ALM was noted after training, with an ascending trend and no overlap with baseline. The rate of ALM during coaching was 1.50 per min. ALM continued at a high level in maintenance ($M = 2.26$ per min).

Aunt

In baseline, aunt demonstrated a zero level of high-fidelity ALM strategy use. After training there was an immediate

Table 1 Rates and Proportion of Independent Communication Turns and Independent SGD Use by Amber

	Baseline			Intervention			Maintenance		
	Rate *M*	Rate Range	% of Total	Rate *M*	Rate Range	% of Total	Rate *M*	Rate Range	% of Total
Mom									
Total communication	2.18	2.04–2.28		1.46	0.82–2.33		1.11	0.58–1.64	
SGD use	0.25	0 – 0.82	12%	0.33	0.10 – 0.89	23%	0.18	0 – 0.27	16%
Brother									
Total communication	0.95	0.73–1.40		0.47	0 –0.85		0.94	0.41–2.06	
SGD use	0	–	0%	0.08	0 – 0.41	16%	0.21	0.10 – 0.31	23%
Dad									
Total communication	1.06	0.39–1.61		1.31	0.95–1.51		1.19	0.43–1.60	
SGD use	0.01	0 – 0.10	1%	0.04	0 – 0.11	3%	0.17	0 – 0.41	14%
Great aunt									
Total communication	1.45	0.68–2.23		0.81	0.50–1.10		1.16	0.42–2.02	
SGD use	0.17	0 – 0.54	12%	0.18	0 – 0.33	22%	0.39	0.21 – 0.67	34%
Aunt									
Total communication	1.07	0.91–1.23		1.59	0.75–3.30		–	–	–
SGD use	0.12	0 – 0.61	11%	0.18	0 – 0.44	11%	–	–	–

increase with some variability, but no overlap to baseline and a mean of 69% for high-fidelity ALM strategy use. Maintenance data were not collected for aunt. In baseline, aunt had a zero level rate of ALM. An immediate increase in the rate of ALM was noted after training with some variability and ascending trend, but no overlap with baseline. The rate of ALM during coaching was 1.42 per min. Maintenance data were not collected.

Rate of Independent SGD Use by Amber

At the beginning of the study Amber demonstrated a low proportion of independent SGD use when compared to overall independent communication in sessions with family participants ($M = 7\%$; range = 0-12%; see Table 1). However, a mean increase in the overall proportion of independent SGD was seen for all but one family participant (i.e., aunt) where the proportion remained steady during intervention implementation (M = 15%; range = 3-23%). In maintenance the mean proportion of independent SGD use continued to increase during sessions with brother (+ 7%), dad (+ 9%), and great aunt (+ 12%), but not mom (-7%).

Social Validity

Results from pre- and post-study interviews indicate that family participants found the goals, procedures, and outcomes of the intervention to be socially valid. Although she had a SGD, Amber continued to use sign language as her primary mode of communication. However, this method was challenging for those extended family members. Great aunt expressed "I'm not good at sign language so I have to ask the kids what she's saying." All family members conveyed the need to understand how to communicate effectively with Amber. Aunt described: "It's kind of like our job to help her way of communicating with us." Similarly, dad expressed his desire for the SGD "to be the primary [form of communication] because we can say so much more with it".

Family members found the procedures used during training and coaching to be socially valid and helpful to ALM implementation, while providing some suggestions for improvement. As the primary coach, mom indicated: "The whole process has been a lot of fun to be a part of and to see the growth in her and also everybody who was involved in the study." Mom also indicated that the digital training materials were accessible but she made minor adjustments to accommodate family member needs. Both aunt and great aunt indicated several times during the interviews that they were happy to now feel more confident knowing how to interact with Amber. For example, great aunt said: "It's just wonderful to be able to communicate with her." Similarly, brother expressed enthusiasm throughout the study about participating and learning new ways to communicate with his sister: "I hope it will help her talk more." However, great aunt and aunt said it would be helpful if they were able to practice with mom prior to interacting with Amber because they were less familiar with the SGD. Furthermore, great aunt suggested learning to implement the ALM strategy during other activities: "It might be good if halfway through I had picked another different activity. But I guess I can do that now that it's over, but that might be kind of helpful."

Positive outcomes for Amber and family members were also noted in interviews. When Amber was asked if she would like to keep spending time with family members using the SGD, she nodded. All family members shared that the intervention helped them communicate better with Amber. Brother said that "at first I wanted to just play with [the SGD], but now I know it has a job; it's supposed to help." Additionally, all family members indicated growth in Amber's SGD use. Aunt shared: "when we're over there she has the iPad with her and talks with it, and we kind of communicate with her more using it because we kind of know how." Mom also expressed that the intervention "opened up her communication to everybody now rather than just [immediate family]." The dad concurred: "she will grab it [the SGD] and bring it over and start the communication." The mom and the dad also indicated an increase in Amber's vocabulary because she is using the SGD more often. Family capacity-building was noted by mom who shared "I found it to be a lot of fun to be able to coach [family members] in that area and to be able to see them make changes and be able to make more of that connection with Amber." She also noted a difference in family dynamics because Amber "doesn't get upset as quickly." All family members reported they will continue using the ALM strategy with Amber.

Discussion

Family-centered capacity-building practices can improve quality of life outcomes for children with disabilities and their families by increasing family involvement, improving family member self-efficacy, improving family satisfaction with services, and improving communication and other developmental outcomes for children with disabilities (Dunst et al., 2007). Despite this, there has been a dearth of research on interventions to build family capacity for children with autism who have limited speech. It is crucial for the field to know how service providers such as speech-language pathologists can partner effectively with families for AAC intervention. Speech-language pathologists are often responsible for leading and coordinating AAC intervention with families and with other educators and service providers, but they typically report that this is challenging

to do (Mandak & Light, 2018). To address this need, our study investigated the use of a family capacity-building intervention that involved both immediate and extended family members. Results extend existing knowledge across several interrelated bodies of literature (e.g., special education, families of children with disabilities, AAC) and provide important implications for practice and future research.

One of the most important findings and contributions of this research is the demonstration of a functional relation between the intervention and family members' use of ALM as an evidence-based AAC practice. Prior research on natural communication interventions for children with autism or other developmental disabilities have primarily involved mothers, with very little research focused on the involvement of fathers, siblings, or other extended family members, even though these family members have important roles supporting children's communication (Biggs et al., 2019; Flippin & Crais, 2011; Mandak et al., 2017). In this study, multiple family members were not only able to implement ALM with fidelity after the intervention, but they expressed that the intervention was valuable to them. This research may serve as a potential model for practice. Although research on family coaching models in early intervention and early childhood special education has flourished (Dunst & Espe-Sherwindt, 2016), there has been far less focus on understanding how services for school-age children can, or should, build family capacity. Descriptive research involving parents of elementary-aged students with disabilities, even across multiple decades, suggests that parents desire family-centered practices (McWilliam et al., 1999; Dunst & Hamby, 2019). Further, the current context of the COVID-19 pandemic has only amplified the longstanding need for models in which educators and service providers can truly partner with families, particularly as children transition out of early childhood services and into elementary school (Cate et al., 2020; Neece et al., 2020). There may be an opportunity to re-imagine and implement new, more effective models for serving school-aged students with disabilities through family-centered practices that comes out of the crisis caused by the COVID-19 pandemic.

This study also extends prior research on family centered capacity-building models by demonstrating the success of the mother to coach other family members—including extended family members who were important to and close with the family. Amber's mom shared that she enjoyed this role, and the other family members who participated all indicated benefits from the intervention, demonstrating the social validity of this approach for this family. Findings suggest this intervention model holds promise as a strategic way to improve the reach of supports for other families with children with autism who use AAC, especially given the well-documented research to practice gap and need for feasible models to improve everyday practice (Nahmias et al., 2019). We suspect a number of elements were important to the success of mom in this role. Some of the most important may have been her interest in serving in this role and that support was given to her not just related to the ALM strategy, but also on training and coaching family members. This intervention approach may not be appropriate for all families. Continued research is especially needed with culturally and linguistically diverse families and families from marginalized backgrounds, such as those living in poverty. Families from different cultural, linguistic, and socio-economic backgrounds may have differing expectations of interactions with young children than the family who participated in the study, different levels and types of competing demands that could impact their time and energy to devote to this type of intervention, and varying levels of comfort with an intervention model where one family member takes on a teaching role.

Results also suggest that family members' integration of the SGD through the ALM strategy was accompanied with modest changes in the proportion of the target child's overall communication using the SGD. It is important to note the secondary nature of this data (i.e., outside experimental control within the study) and that we measured child communication in a contextually bound manner (i.e., within the intervention context), not in a generalized way. Further, variability in rate of the child's communication is expected because of the nature of the natural and unstructured measurement context within the intervention (Yoder et al., 2018). Although increases in use of the SGD were seen, the primary mode of communication for the child was still sign language within the study. Continued use of sign by Amber is not surprising given this was a method of communication that has been used and accepted within her home for years. Additionally, her family did not discourage the use of sign within the study, continuing to respond to all signs that were recognized. Yet, the increased use of SGD was seen as important to Amber's parents because they wanted her to be able to communicate with family members and individuals in the community who did not know sign language. It is important to recognize that it might take time for children to adjust to different expectations placed by communication partners, including the use a different communication mode (see Douglas et al., 2018a). Further, the goal of AAC intervention should be to add effective communication modalities and encourage multimodal communication, not to focus on only one modality at the exclusion of others (Beukelman & Light, 2020). Findings from the analysis of interviews illustrate that these modest changes were practically and socially significant, particularly because many of the family members had difficulty interpreting Amber's communication prior to the intervention due to her use of signs

and idiosyncratic gestures. It is also important to note that although the family had access to Amber's SGD for about a year-and-a-half prior to participating in this intervention study, only mom knew how to use the device, and she lacked confidence integrating it into everyday life. Research has shown that parents describe learning to integrate aided AAC technologies as time consuming, stressful, and overwhelming, particularly when they do not receive adequate training and support (Anderson et al., 2016).

Limitations

There are several limitations that should be considered. First, generalization of family members' use of the ALM strategy was not evaluated. During the social validity interviews, some of the family members suggested specifically incorporating use of the ALM strategy to other activities. Thus, future research should evaluate how adaptations to the coaching model could best support family members' generalization of evidence-based strategies such as ALM across different routines and activities. Further, assessment of maintenance was limited in this study, in part because the COVID-19 restrictions that were in place and the single case design which required staggered introduction to the intervention lengthened the duration of the study. Evaluation of long-term maintenance will be important in future investigations. Second, support for mom was provided by a research team member. An important direction for future research is to evaluate the efficacy, acceptability, and feasibility when educational team members such as special education teachers, speech language pathologists, or other service providers provide this support. Third, a strength of the cascading design is that it allowed for the evaluation of a functional relation between the coaching intervention and family members' use of the targeted evidence-based strategy. However, this design also meant that the impact on child communication was addressed as a secondary, rather than primary, research question. Future research is needed to examine children's long-term development of generalized communication skills that might result from family capacity-building interventions such as the intervention evaluated in this study. Additionally, we did not investigate whether the intervention had any impact (positive or negative) on broader outcomes for the family (e.g., family dynamics, sibling relationship, parenting practices, stress, self-efficacy, or family quality of life). Lastly, the coders in our study were not blind to the study purpose. Future research using this intervention should include coders who are naïve to the study purpose and session phase.

Directions for Future Research and Practice

There are several important future directions for research and practice. First, we recognize that all families are unique. The findings of this study highlight the reality that family-centered coaching is inherently individualized in nature, which means building on and being responsive to the strengths, needs, and preferences of different family members. In this study, we saw that mom was well-suited for supporting other members because she implemented coaching with fidelity, while also naturally adapting her support to each family member and their needs and other characteristics. Educators and service providers are often reminded that they should acknowledge parents as the experts on their child (e.g., O'Neill & Wilkinson, 2020). In this study, mom demonstrated she was not only an expert on her child, but also on her family. This leads us to wonder: how might educators and service providers best identify families for whom this model would work, and the central family member who would be skilled in this role? Future research is needed to answer these questions, particularly with families from diverse ethnic and socioeconomic backgrounds, and those who do not have a traditional structure.

There are other questions that may also be important to pursue. First, a staggered approach to introducing the intervention is required by multiple probe single-case designs, but this staggered approach may be problematic in practice. Future research should explore variations of this model, such as other family members receiving intervention simultaneously, rather than in the staggered manner. Second, important questions remain about how this model could be scaled to support efficiency and effectiveness across a larger set of families. For special education practice, this study offers implications related to the potential for and benefits of family-centered practices for school-age children. As demonstrated by this study, strategic use of telepractice (i.e., to provide training and support for mom) may be a useful tool. The COVID-19 pandemic has brought about an increased interest in the use of remote technologies to support children with disabilities and their families (Camden & Silva, 2020). Although it is difficult to predict the future, the now ubiquitous nature of these technologies may create new potential to utilize them after the pandemic to more effectively support children with disabilities and their families. This will create an important need for innovation and creativity for educators, school, and district leaders alike. Though family involvement is mandated by the Individuals with Disabilities Education Improvement Act (IDEIA), family-centered practices are not as common in the school years as in early childhood. Thus, it is important for the field to consider how family supports can become a central part of educational services for students with disabilities throughout their

education. With this, it will be important to remember that family-centered practices need to be culturally relevant and based on the needs and preferences of individual families. This means educators will need to engage with families to understand the types of supports they want, and recognize that a model like this one may not be ideal for all families.

Declarations

Conflict of interest We have no known conflict of interest to disclose

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