Siblings Supporting the Social Interactions of Children who Use Augmentative and Alternative Communication

American Journal of Speech-Language Pathology

Accepted: January 2023

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We have no conflict of interest to disclose. Correspondence concerning this article should be addressed to Rebecca E. Hacker, Juniper Gardens Children's Project, University of Kansas.

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Funding Statement

This work was supported in part by funding from the Office of Special Education Programs, U.S. Department of Education: Project IMPACT (H325D150036). The views or opinions presented in this manuscript are solely those of the authors and do not necessarily represent those of the funding agency.

ABSTRACT

Purpose: The purpose of this study was to examine the effectiveness of a training and coaching program aimed to increase the use of the aided language modeling (ALM) strategy by siblings to support the social interactions of children with disabilities who use augmentative and alternative communication (AAC) in the natural environment.

Method: A single-case multiple-probe design including a training and coaching intervention was implemented to teach 4 typically developing siblings to use the ALM strategy with high-fidelity with their sibling who used AAC. In addition, a second research question investigated the rate at which siblings used the ALM strategy with the child.

Results: Results revealed that the sibling training and coaching was (a) effective in increasing high-fidelity of the siblings' implementation of the ALM strategy, and (b) participants and family members found the intervention to be impactful and meaningful.

Conclusions: The changes observed throughout this study demonstrate the need for more sibling and family-centered training to increase the use of AAC in the natural environment. Families were satisfied with the goals, procedures, and outcomes; however, they also expressed their need for additional support.

Siblings Supporting the Social Interactions of Children who Use Augmentative and Alternative Communication

Communication is a process that occurs between at least two individuals with the purpose of exchanging information and ideas. Communication skills are affected by several individual and environmental factors and are a core aspect of people's quality of life, as they are needed for engaging in social interactions, building friendships, and creating a meaningful support system (Cohen, 2004). Starting at birth, children acquire language through observational learning from those in their immediate environments, beginning with their parents. The impact parents have in supporting children's communication and language development depends on the amount and quality of (a) parent-child interaction, (b) parent responsiveness to the child, (c) language input, and (d) language support strategies (Roberts & Kaiser, 2011). Using effective communication skills and social interactions, individuals can begin to form meaningful social relationships and friendships, which could promote positive psychological states (e.g., happiness and self-efficacy; Cohen, 2004). Typically developing children learn these skills through experience; however, for children with disabilities the process can be much more difficult, and they may not be able to learn communication skills using the same strategies.

Individuals with Complex Communication Needs

Communication skills are essential because they provide opportunities to interact with others in meaningful and functional daily contexts (Roberts & Kaiser, 2011). All people have the fundamental need and right to communicate; however, individuals with disabilities who have complex communication needs (CCN) often face challenges in communicating with those around them in effective and efficient ways (Biggs et al., 2019). The National Joint Committee for the Communication Needs of Persons with Severe Disabilities (NJC; 2016) noted that all

people with disabilities, regardless of the extent or severity of their disabilities, have the basic right to communicate and fully participate in all daily interactions. All communication partners need to have effective communication skills (e.g., initiating, responding, commenting) to engage in meaningful social interactions, and children with disabilities who have CCN may struggle to develop these skills. Without effective communication skills, individuals with CCN may have difficulty developing social relationships and friendships.

Individuals with disabilities who have CCN have impairments in speech, language, reading, and/or writing and can benefit from the use of augmentative and alternative communication (AAC). Augmentative communication methods include those that supplement speech, whereas alternative communication methods include those that take the place of spoken language. Approximately 1.3% of individuals (i.e., 4 million Americans) are unable to communicate through speech to achieve daily needs (Beukelman & Miranda, 2013) and various forms of AAC can support these individuals. AAC includes both unaided communication (e.g., gestures, signs, facial expressions, and vocalizations) and aided communication (e.g., communication boards, and speech-generating devices [SGDs]) which provide external support to aid the individual. Communication and language learning are critical from early stages of development and with the use of AAC, individuals with disabilities can develop functional communication, cognition, and social skills (Drager et al., 2006).

For individuals with CCN who have intensive support needs, it is important to consider the expertise that is needed to provide meaningful communication interventions in natural environments. While research with AAC interventions has predominately focused on increasing expression, some have included comprehension goals as well. Augmented input (e.g., pairing spoken model and an AAC model) interventions have been implemented and shown to be

effective in supporting individuals with disabilities who use AAC (Binger & Light, 2007; Cafiero, 2001; Drager et al., 2006). For children who use aided AAC, without seeing others model, the learning process can be unnatural and make observational learning challenging. By providing a natural language-rich environment, children who use AAC can observe and imitate the model provided to them. Researchers suggest that the use of aided-input AAC may reduce input-output asymmetry for individuals and increase their communication skills (O'Neill et al., 2018).

Aided Language Modeling

One strategy that is supported widely in the research is aided language modeling (ALM; Drager et al., 2006; Kasari et al., 2014; O'Neill et al., 2018; Quinn et al., 2020; Romski & Sevcik, 1996). This strategy includes a communication partner who models both verbal language and aided AAC during natural interactions. A number of systematic reviews have found that ALM interventions are effective in increasing communicative acts using aided AAC, yet in the reviewed studies interventionists are primarily researchers and less often include natural change agents (Allen et al., 2017; Biggs et al., 2018; O'Neill et al., 2018; Sennott et al., 2016). With a natural communication partner (e.g., parent, teacher, peer, or sibling) and natural opportunities, the ALM strategy can be used throughout the child's daily routine.

The use of ALM is supported by the naturalistic developmental behavioral interventions (Schreibman et al., 2015). In addition, children learn through observation and imitation, and often from those to whom they feel they can most relate (e.g., parents, teachers, peers, and siblings), specifically noting the importance of natural environments with natural opportunities. Naturalistic approaches draw upon aspects of traditional behavioral approaches while embedding natural opportunities for meaningful communication. These types of naturalistic approaches must

include natural environments and routines, responsiveness to all child communication acts, models to the child, reinforcement for the communication, and natural shaping of the communicative behavior (Ingersoll, 2010).

Siblings as Interventionists

Home is a natural environment for young children and their parents are natural communication partners who can provide language interventions and support children's communication skills. Extensive literature supports parent-implemented communication interventions as these interventions primarily focus on young children with disabilities and target both verbal and nonverbal communication (Meadan et al., 2009; Roberts & Kaiser, 2011) and AAC (Binger et al., 2007; Kent-Walsh et al., 2015; Romski et al., 2010) outcomes. Researchers have reported that after receiving training and coaching, parents can implement specific strategies with fidelity, and use them across different daily routines (Akamoglu & Meadan, 2018; Douglas et al., 2021, 2022). In addition, research has been conducted including peers as interventionists for school-aged children with disabilities who use AAC (Therrien et al., 2016) and this research has been replicated and adapted to meet the needs of siblings. However, research focused on siblings of children with CCN as communication facilitators is scarce (Wright & Benigno, 2019).

Theories to support siblings research are not common and researchers suggest this can be directly related to the number of sibling relationship structure possibilities (e.g., twins, gender, age, interests, and stepsiblings) and the diverse types of relationships siblings may have (Treffers et al., 1990). Most theoretical research on sibling relationships noted that these relationships are directly related to marital quality and parent-child relationships and are built off family hierarchies between both dyads and triads of family members (Whiteman et al., 2011).

Researchers suggested that considerations should be made to support siblings of children with disabilities by including other family members as guides to the goals and outcomes of the intervention (Mactavish & Schleien, 2004). Researchers also have suggested that interventions should be designed to ensure that relationship dynamics remain constant throughout the intervention by learning about both siblings and their individual characteristics (e.g., age, gender, interests, and abilities) to limit hierarchical concerns (Wright & Benigno, 2019).

Given that the home environment provides consistent opportunities for children to interact with constant communication partners, (family members, including siblings), siblings are ideal interventionists to support social interactions and increase the independence of children who use AAC (Kent-Walsh et al., 2014). Most children grow up with at least one sibling, and sibling relationships stand apart from other peer relationships due to their enduring nature that lasts across various stages in one's lifetime (White & Hughes, 2018). Sibling relationships are unique and lifelong, while growing and developing as individuals age. Thus, siblings can play a significant role in the development of communication and social interactions for children with CCN. As young children, siblings spend a considerable amount of time with one another, however, researchers have found that as children transition to adulthood there is an increase in independence and decrease in intimacy between siblings (Orsmond & Seltzer, 2007). While many individuals grow up with siblings, current theoretical frameworks to guide sibling relationship research is limited. Whiteman and colleagues (2011) discussed the theoretical frameworks that support sibling relationships across the lifespan, noting that relationships cannot be accounted for by one perspective in isolation. In addition, using the ecological systems theory, researchers have noted the importance of a focusing on a family-centered approach for AAC learners to maximize intervention effectiveness (Biggs & Hacker, 2021; Coburn et al., 2021;

Mandak et al., 2017). The family systems theory (Bowen, 1974) examines the dynamics within and between family members. These roles within and between family members, such as siblings, change over time and can be affected by other dynamics such as parent relationships, parent-child relationships, number of siblings, genders, and ages (Whiteman et al., 2011). These findings can suggest the importance of strengthening sibling relationships from an early age and continue to support these throughout life stages.

While the current literature supports the effectiveness of the ALM strategy to promote communication skills of children who use aided AAC in schools (Biggs et al., 2018; O'Neill et al., 2018), there is limited research on the use of this strategy with children with disabilities and their typically developing siblings. Natural communication agents take an active and critical role in the learning of children who use AAC, and it is also important that family members learn to interact with AAC. Given that research is primarily conducted with parents, teachers, and peers in schools, and that siblings play an important role in supporting each other's development, it is warranted that sibling research should be further explored. Through the lens of the naturalistic approaches and family systems theory (Bowen, 1974), a framework for a sibling social interaction intervention was used as a guide to guide the current study.

There has been only one study (Douglas et al., 2018) that specifically focused on AAC and siblings. The training components included a pretest, two live training sessions with a quiz, role-playing (e.g., sibling and researcher practicing with different scenarios), and self-reflection. Siblings were taught the strategy Play, Talk, Wait, and Respond. Douglas et al.'s (2018) results showed that this intervention can increase the frequency of siblings' communication supports and communication acts for children with CCN. The authors noted that while typically developing siblings did not perform as adult participants in previous research, sibling research is

relevant and important to focus on (Douglas et al., 2018). The researchers emphasized the need for specific training of typically developing siblings that is age appropriate (e.g., short and engaging) with an added component of coaching to support the typically developing siblings to promote engagement of their siblings with disabilities (Douglas et al., 2018).

Telepractice Intervention

Telepractice and telecoaching is becoming a viable option to deliver interventions to parents and their children (Heitzman-Powell et al., 2014; Machalicek et al., 2016; Meadan et al., 2016; 2020; Neely et al., 2017; Snodgrass et al., 2017). Telepractice employs technology to connect people from a distance and this support can be provided to those in classrooms, homes, and other community settings. Telepractice services can be synchronous (e.g., audio or video conferencing) or asynchronous such as self-paced training (Chung et al., 2020). Although much of the literature addresses telepractice with caregivers of children who are deaf or hard of hearing (e.g., Behl et al., 2017; McCarthy et al., 2019) and children with autism (e.g., Ingersoll et al., 2016; Meadan et al., 2016; Vismara et al., 2013), it has also been used to support parents with language and communication interventions (e.g., Akemoglu et al., 2020; Snodgrass et al., 2017). In addition to the ability to reach underserved populations, telepractice is a heightened need to support families of children with disabilities due to the COVID-19 pandemic (ASHA, 2020).

A study was completed a study using the implementation of this intervention with family members via telepractice, and this study was adapted to meet the needs of younger siblings via telepractice (Douglas et al., 2021, 2022). Therefore, the purpose of this study was to examine the effectiveness of a training and coaching intervention aimed to increase the use of ALM strategy by siblings who support the social interactions of children with disabilities who use AAC in the natural environment through telepractice. The following research questions guided this study:

1. Is there a functional relation between training and coaching on the aided language modeling (ALM) strategy, via telepractice, and high-fidelity and rate at which typically developing siblings use the ALM strategy with children with disabilities who use AAC?
2. What are the perspectives of caregivers, siblings, children, and other family members of the goals, procedures, and outcomes of the intervention?

Method

Participants and Setting

A training and coaching intervention was implemented using a single-case, multiple probe design across sibling dyads. After obtaining Institutional Review Board (IRB) approval, a flyer describing the study was shared with local parent, special education teacher, and speech-and-hearing organizations. The flyer and study information were also shared on social media. To participate, the typically developing sibling had to be between 7 and 12 years old with no disabilities or delays, based on parent report. The child with a disability had to (a) have a developmental or intellectual disability, as reported on their Individualized Education Plan (IEP); (b) use a high-tech aided AAC device as their primary form of communication; (c) be an emerging symbolic communicator (i.e., beginning to use shared forms of messages with a communication partner using symbolic forms of communication); and (d) be between the ages of 6 and 12 years. The sibling and child must also be within 3 years of age of each other. The parent/caregiver had to be a primary caregiver to the sibling and child and speak English fluently.

All participants were recruited from one Midwest state in the US. In total, six families completed the online screener; one family was not eligible due to the child's advanced communication level and two families did not reply when they were contacted to schedule the

preintervention interview. Four child-sibling dyads participated in the study; two dyads were from the same household with the same child and different siblings. Siblings ranged from 8-12 years old, and children ranged from 7-9 years old. The first family consisted of Naomi and Michael, Michael was a 7-year-old with Down Syndrome and Naomi was his 9-year-old typically developing sister. In the second family, there were two dyads. Connor was a 9-year-old male with Angelman Syndrome and both his sister Elizabeth, and his brother Luke participated. The third family consisted of 7-year-old twins, Ella, who was diagnosed with autism and Steven, her typically developing brother. For demographic information see Table 1.

Procedures

Similar to Douglas and colleagues' study (2021, 2022), all aspects of this study were completed via telepractice using a HIPPA-compliant videoconference software. Participants completed the Communication Matrix (Roland, 2004) prior to baseline. The Communication Matrix focuses on a pragmatic approach to communication development by viewing what an individual can achieve through their use of behaviors outside of traditional speech. Caregivers completed the Communication Matrix about their children with CCN at the beginning of the study during the preintervention interview. A preintervention interview with each family, conducted via Zoom, focused on understanding the specific needs of the child-sibling dyad as well as the best activities to promote opportunities for their interactions during the intervention, it also included an overview of the study and completing consent for participation.

Baseline

Using information from the preintervention interviews, dyads had choices at the start of each session about what activities they were going to engage in. Siblings were asked to keep the AAC device in proximity of the children for every session. Caregivers were given instructions to

keep children and siblings within the camera frame and not to intervene unless challenging behaviors arose. After the activity was determined, a 10-min observation was recorded for each baseline session via Zoom. Instructions such as, “Play as you normally would” or “I’m going to watch you play with your sibling, I will see you in 10 minutes” were provided. Observations were uninterrupted and the observer’s/ researcher’s camera and microphone were turned off to limit distractions. All videos were between 10-12 minutes long. After there was stable baseline data with at least five data points, the first participant dyad moved into the intervention phase. This continued until all dyads were in the intervention phase.

Intervention

When the preceding dyad demonstrated a treatment effect by using the ALM strategy with high-fidelity, the following dyad who maintained a stable baseline, moved into intervention. The participants engaged in two parts of the intervention: training and coaching. As part of the ALM strategy, each sibling was trained and coached to use a variety of language models when using the AAC. These included providing a choice, asking a question, commenting, responding to the child’s communication. Training sessions were completed prior to coaching sessions and included detailed information about the goals and purpose of ALM, how to use the strategy, and role playing with the coach. Whereas, during the coaching session, the coach was there to help support and strategize how to use the ALM strategy with the activity the sibling had chosen and then provide feedback based on their performance.

Sibling Training. The initial portion of the intervention phase included two training sessions with the sibling. Research indicated that peer communication training should include various components such as strategy instruction, focusing on naturally occurring activities, and be taught to use choices, questions, and comments (Douglas et al., 2018). The training sessions

ranged between 12 min 19 s to 22 min 22 s (*M* = 16 min 38 s). The training sessions were conducted by the first and third author, and only with the siblings present. For two of the participants (i.e., Luke and Steven) their parents were nearby during the training while the other two siblings (i.e., Naomi and Elizabeth) were alone. In the first training, the ALM strategy was introduced using PowerPoint slides and video examples of desired behaviors (modified from Douglas et al., 2021, 2022) along with an ALM visual. The first training session consisted of: (a) the goal and purpose of ALM strategy, (b) how ALM strategy can be used to support children who use AAC, and (c) the ALM strategy components (described in Observational Data section). The second training session was held within 5 days of the first training, and it consisted of (a) reviewing of the ALM strategy, (b) role playing using the ALM strategy, and (c) reviewing and answering questions. All training sessions were synchronous and recorded via Zoom. Immediately following the training sessions, the first session of coaching began.

Sibling Coaching. All coaching sessions were conducted and recorded via Zoom by the first and third author. Coaching consisted of (a) 5-minute preobservation planning, (b) 10-minute observation of the child and sibling engaging in an activity, and (c) 5-minute postobservation reflection and feedback (Douglas et al., 2021, 2022; Meadan et al., 2016; 2020). During the preobservation, the sibling and coach discussed their action plan for the chosen activity. The coach provided support and ideas on how to implement the ALM strategy given the activity and encouraged them to practice pairing their spoken words with the AAC device. Additionally, the ALM strategy components were reviewed using a visual support which included the ALM steps, if needed. Then there was an uninterrupted 10-min observation of the child and sibling engaging in the chosen activity. While watching the live interaction, the coach noted aspects of the strategy that the sibling was doing correctly and areas that could be

improved to provide meaningful feedback. The postobservation included sibling reflection on their use of the ALM strategy during the activity as well as supportive and corrective feedback from the coach. Videos were then re-watched and coded using a behavioral coding handbook. The siblings participated in coaching sessions until their performance demonstrated the use of all five ALM steps (i.e., high-fidelity implementation) for 80% of the opportunities for three consecutive sessions. When the sibling met the performance criterion, they were moved to the maintenance phase. For all aspects of the intervention, caregivers were asked not to intervene or support the communication between child and sibling.

A fidelity checklist was used to ensure that all aspects of the training and coaching were completed. Implementation fidelity was measured for two aspects of the intervention. During each training session, a fidelity checklist was completed by the trainer/coach. During coaching sessions, fidelity checklists were used by the coach to ensure all coaching aspects were completed. To assess reliability of the fidelity measures, a research assistant reviewed the recorded training sessions and completed the fidelity checklist for 100% of the training sessions and 30% of the coaching sessions for each dyad. All training and coaching sessions showed 100% implementation fidelity, except the second training session for Steven in which a recording error occurred.

Maintenance

The purpose of the maintenance sessions was to assess the extent to which the siblings continued to implement the ALM strategy and to assess the target child's communicative behaviors. After intervention was complete, maintenance data were collected on average every 2 weeks, for up to 8 weeks. Similar to baseline sessions, during the maintenance sessions, participants were given an instruction such as, "Play as you normally would" or "I'm going to

watch you play with your sibling; I will see you in 10 minutes."

Observational Data

The ALM strategy involves a communication partner providing a communication opportunity (i.e., simultaneous speech and aided AAC). During the 10-minute observation, each time the sibling used the ALM strategy, it was counted as an occurrence and was rated for fidelity of use. The ALM strategy includes these components: prepare, show, wait, and respond (Douglas et al., 2021, 2022), these components are broken down into five steps. The independent variable (IV) for this study included both training and coaching. We measured and coded two dependent variables (DV) for the siblings. The primary DV was the fidelity of siblings' implementation of the ALM strategy use which was coded on a scale from low to high-fidelity (i.e., 0 to 1). Implementation fidelity was scored using a 0-1 scale per opportunity. With there being five ALM steps, siblings would have been able to score 0, 0.2, 0.4, 0.6, 0.8, or 1. Each step of the ALM strategy the sibling completed correctly in order was worth 0.2. Step descriptions can be found in Table 2. We coded each session and calculated the percentage of high-fidelity (score of 1) ALM strategy use. Steps to reach high-fidelity included (a) the AAC device is within reach of the child and the sibling; (b) the sibling provides a natural stimulus (i.e., choice, question, response, or comment); (c) the use of the SGD model is within the child's current communication level, (d) a spoken model is provided by the sibling immediately before, after, or while using the SGD, and (e) the sibling waits before resuming the activity (approximately 3-5 s, predetermined prior to beginning the study, depending on the child's needs; Douglas et al., 2021, 2022). To reach high-fidelity all five steps had to be completed correctly. In addition to the overall score of the fidelity of each strategy use occurrence, the type of model (i.e., choice, question, comment, response and other) was also coded. Models labeled "other" included

communicative directives or questions with a correct response or that the child already knew (e.g., “Show me ‘blue’ on your talker” or “What color is this?”) and while these other models did not meet the fidelity criterion, they were still coded as an attempt to use the ALM strategy.

The secondary DV was the rate at which the siblings used the ALM strategy (Douglas et al., 2021, 2022) throughout the observation. After each session was coded, data were calculated to determine the rate at which the siblings used the ALM strategy during the activity. We recorded the frequency (i.e., the number of strategies used), then divided that number by the number of minutes in the recorded session. Rate data included strategy use with all levels of fidelity per minute. In addition, observational data were recorded on the child’s communication acts throughout the intervention. These acts included communication mode (i.e., verbal speech, AAC, signs, gestures, vocalizations, multimodal) and level of independence (i.e., prompted, unprompted). Additional information can be found on Table 2. The child’s independent communication modes and rates were also calculated for each session. Although all communication modes were coded, only independent communication modes (i.e., independent initiation and independent response) were analyzed. The child’s independent communication rate was calculated by counting the number of independent communication occurrences and then dividing it by the recorded time of the intervention. When the child had an independent communication occurrence, the frequency of mode for each session was recorded. When a child engaged in more than one communication mode simultaneously, a hierarchy was used: verbal speech, AAC, and sign; considering symbolic communication (e.g., verbal speech, AAC, and sign) as more complex than non-symbolic communication (e.g., vocalizations and gestures). For example, if the child communicated using verbal speech and a gesture, verbal speech was represented in the data as it is more symbolic than a gesture. If the child engaged in gestures and

vocalizations simultaneously, it was considered multimodal communication. However, if the child engaged in a communication mode that was more symbolic, the more symbolic acts were coded.

Interobserver Agreement

All behavioral observation videos were coded by a primary coder and at least 30% of the videos from each phase and for each dyad were randomly selected and coded by a second coder. Coders met before the intervention phase to discuss the coding manual and coding procedures, neither coder was blind to the conditions of the study. Coding categories included (a) a time stamp, (b) sibling model type, (c) ALM fidelity, (d) child's communicative mode, and (e) child's level of independence. During training, coders coded videos independently to reach agreement. All disagreements were discussed, and then new videos were coded to reach agreement. Videos used in training were not used for interobserver agreement (IOA) coding. Training continued until a minimum of 80% IOA in each DV category was achieved.

Disagreements addressing fidelity were only considered if one coder coded high-fidelity (1) and the other coder coded low fidelity (0 – 0.8). If fidelity was not the same, but they were both noted as low fidelity, it was considered an agreement. For all IOA calculations, agreement ranged from 69% to 100%. In total, 29 videos were randomly coded for IOA with an average of 94.7% agreement: 98.00% for the sibling behaviors and 92.53% for the child's communication. For Family 1, the overall agreement was 97.33%, for Family 2a, the overall agreement was 94.33%, for Family 2b, the overall agreement was 92.13%, and for Family 3, the overall agreement was 95.00%.

Social Validity Interviews

Social validity data were collected through pre- and postinterviews with the caregivers,

siblings, and children. Other family members in the home who did not participate in the study (i.e., grandparents), were asked to complete an in-depth interview at the end of the study. The purpose of the postintervention social validity interviews was to determine the overall satisfaction with the goals, procedures, and outcomes of the intervention and to elicit participants' perceptions and observations about changes in the target sibling and child's behavior (Kazdin, 2011). The social validity interviews were conducted by a graduate student who was naïve to the study and had no previous contact with the participants.

After interviews were completed, the first and third authors independently coded the transcribed interviews, and then met to discuss agreements and disagreements. To develop a more contextualized and in-depth understanding of the social importance of the intervention, interviews were transcribed and analyzed into categories and themes and were reviewed using the social validity framework (Wolf, 1978; goals, procedures, outcomes).

Results

Single-case multiple probe design across participants was used to determine the effectiveness of a sibling training and coaching intervention to implement the ALM strategy with high-fidelity with their siblings who used AAC. In Figure 1, the high-fidelity use of the ALM strategy is represented by closed circles and the rate at which siblings used the ALM strategy is represented by the bar graph. The time in which training took place is designated by two solid black lines and the dashed line is between the coaching and maintenance phases.

Sibling Aided Language Modeling Use

Family 1: Naomi and Michael

During the baseline phase, Naomi did not use the ALM strategy. After the two training sessions, during her first coaching session, her high-fidelity immediately increased to over 65%,

followed by a decrease to 44%, but then gradually increased. The coaching phase lasted seven sessions for Naomi to reach the performance criterion of three consecutive sessions of over 80% high-fidelity use of the ALM strategy. While there was a decrease during the last three sessions of coaching, she continued to reach over 80% high-fidelity use of the ALM strategy. During maintenance phase Naomi reached 100% high-fidelity use of the ALM strategy during the first session, then decreased to 75%, and then increased to 82%. Then, during the fourth and final maintenance session, only 60% of Naomi's attempts to use the ALM strategy had high-fidelity.

Rate of ALM strategy included any attempt at using the ALM strategy, regardless of fidelity. During the baseline phase, Naomi's rate was 0 per min. After training, during the coaching phase, her rate of attempts varied between 0.9 and 2.6 times per min (M = 1.3). During the maintenance phase's first session, when Naomi's fidelity was high, her rate was much lower (0.4 per min); however, for the second and third maintenance sessions, her rate increased, and then slightly decreased during the last session.

Family 2a: Elizabeth and Connor

During the baseline phase, Elizabeth did not use the ALM strategy. After the two training sessions, her high-fidelity use of the ALM strategy increased to 28%, and gradually increased over the next three sessions, until she reached the performance criterion. While the coaching phase lasted for seven sessions, Elizabeth reached performance criterion within six coaching sessions. This extra data point was due to the seventh coaching session being conducted prior to the sixth coaching session being coded. The seventh coaching session decreased to just below 80% high-fidelity use; however, because she had reached the performance criterion, she moved on to the maintenance phase. During the maintenance phase, Elizabeth maintained over 70% high-fidelity use of the ALM strategy. During her first session her high-fidelity ALM strategy

use was at 70%, the second session was at 92%, and the third was at 88%. During the baseline phase, Elizabeth did not use the ALM strategy, then after training, during the coaching phase, her rate of ALM strategy attempts ranged from 1.3 to 3.1 (M = 2.24) times per minute. During the maintenance phase, her rate ranged between 1.7 and 2.6 (M = 2.1) times per minute.

Family 2b: Luke and Connor

During the baseline phase, Luke did not use the ALM strategy. After the two training sessions during the coaching phase, his high-fidelity use of the ALM strategy immediately increased to over 53%, and gradually increased over the next four sessions, reaching performance criterion by session 6. While during the last coaching session Luke showed a decrease in percentage of high-fidelity (from 83.87% to 76.92%), he still met the performance criterion to move to the maintenance condition. During the maintenance phase, Luke maintained over 80% high-fidelity use of the ALM strategy, the first session being at 100% and the second session being at 83%. Related to rate during the baseline phase, Luke did not use the ALM strategy; then, after training, during the coaching phase, his rate of ALM strategy attempts ranged from 0.8 to 1.8 times per min (M = 1.35). Luke participated in two maintenance sessions, the first session with a rate of 0.9 per min and the second session with a rate of 1.2 per min.

Family 3: Steven and Ella

During the baseline phase, Steven did not use the ALM strategy. During the first coaching session, Steven used the strategy once, but with low fidelity and during the second coaching session, he did not use it at all. During the third coaching session, while Steven did show 100% high-fidelity use of the ALM strategy, he only used it once. Beginning with the fourth coaching session, Steven had 64.29% high-fidelity use; this decreased for sessions 5 and 6, but then increased gradually until he reached the established performance criterion. During the

one maintenance session, Steven showed 90% high-fidelity use of the strategy. Related to rate, during the baseline phase, Steven did not use the ALM strategy; then, after training, during the coaching phase, his rate of ALM strategy attempts ranged from 0.8 to 1.8 times per min (M = 1.35). During the maintenance phase, Steven used the ALM strategy at a rate of 2.1 per min.

Primary Dependent Variables Across Dyads

Visual analyses within dyads and across dyads were used to determine functional relation between the IV (i.e., training and coaching of the siblings) and the primary DV (i.e., high-fidelity use of ALM strategy). Visual analysis within dyads indicated there were changes in the level and trend between baseline and intervention phases, which then continued during the maintenance phase. There were immediate effects and no overlap between the baseline and intervention phases for the first three participant dyads which suggest basic effects of the intervention at three different points in time. There were also clear changes in the level and trend between baseline and intervention phases for the fourth dyad. Vertical analysis across dyads revealed that when the intervention was introduced to the first dyad and there was a clear change in the first sibling's behavior, there were no changes in the other three siblings' behavior. This was true across all dyads. Overall, visual analysis reveals functional relation between the IV and the DV. As shown in the graphic display, this study meets the WWC (2020) standards without reservations; it includes a probe session immediately before introducing the IV and a minimum of six phases with at least five data points per phase.

In addition to the visual analysis, the effect size of the training and coaching on the high-fidelity implementation of the ALM strategy was measured using the Non-overlap of All Pairs (NAP). The NAP of each dyad calculated based on the proportion of pairs of one observation from each phase in the baseline phase to the intervention phase. For the first dyad, the effect size

estimate was 1.00 with a standard error of 0.02. For the second dyad, the effect size estimate was 1.00 with a standard error of 0.01. For the third dyad, the effect size estimate was 1.00 with a standard error of 0.01 and for the fourth dyad, the effect size estimate was 0.90 with a standard error of 0.07.

Sibling Models and Child Independent Communication

During intervention the average across all siblings of language models were 56.50% comments, 24.60% choices, 18.0% questions, and less than 1% were responses. The children who used AAC used a variety of independent communication modes. These included verbal speech, AAC, gestures, vocalization, and signs. Findings indicated that prior to intervention, across all children, the average communication modes were 8.9% verbal speech, 6.5% AAC, 7.1% sign, 17.5% vocalization, 35.5% gestures, and 24.6% multimodal. Then after intervention, communication modes changed to 4.5% verbal speech, 30.5% AAC, 7.8% sign, 8.4% vocalizations, 27.0% gestures, and 21.9% multimodal. In addition, the average rate of the children's independent communication acts using AAC per minute during baseline were between 0 to 0.9 (M = 0.06). During intervention and maintenance, the average rate was between 0 and 2.1 (M = 0.42).

Social Validity

All household individuals were asked to participate in interviews focusing specifically on the goals, procedures, and outcomes of the study. This included parents, grandparents, and siblings living in the home. For Family 1, the mother, father, Naomi, and Michael participated in the interviews. Family 2 included the grandmother, grandfather, mother, father, Elizabeth, Luke, Connor, and an older sibling. Family 3 included the mother, father, Steven, and Ella. All family members were interviewed individually. For the children, modifications were made as needed on

an individual basis to support their communication. For example, Michael's mother asked him the questions prior to meeting on Zoom as she mentioned he would be unlikely to participate on camera. Connor's grandmother expressed a similar interest and posed the questions to Connor prior to meeting with the graduate student and relayed the responses during the interview. Ella's mother prompted her during the interview to help her answer the questions.

Social Validity of the Goals

All families shared that the intervention was socially important. Specifically, regarding the goals, families discussed the importance of supporting their children's social interactions throughout their natural routines. Caregivers and participants expressed that they had learned various ways to support communication in the natural environment. At the end of the study, Naomi's mother confirmed that these goals had been met and that "she [Naomi] can understand him better and that really benefits him." The grandmother of Elizabeth and Luke shared at the beginning of the study how she was hoping the children would have more guidance on how to use the AAC device to support Connor in more advanced ways. All caregivers expressed that the AAC device was often used in school, but that using it at home was difficult and they hoped to be able to use it more throughout natural routines in their homes. When discussing the children's communication, caregivers and siblings reported at the beginning of the study that while most times they knew what the children were trying to express, they also had a hard time understanding their communication to meet their needs. The participants also explained that families are not likely to use the AAC devices and that they are mostly kept for the times the children are in school or speech therapy. Ella's mother also expressed her thoughts using the AAC device: "I had never really thought about doing that and using that.... I've always kind of used the talker as hers, and for her to use and hadn't really used it as a tool for us."

Social Validity of the Procedures

Categories related to the social validity of the procedures included (a) coaching experience, (b) the feasibility of using ALM strategy and AAC device, and (b) comfort with telepractice/Zoom. Both caregivers and siblings alike expressed their satisfaction with the coaching experience. Steven's mother explained, "They were really good; both kids looked forward to it and were excited to do it and that is not always the case, so that was good." Naomi added that she appreciated the "screen share" to help her learn the steps of the strategy. Specially noting the feasibility of the ALM strategy and AAC device, the siblings who participated in the study expressed their appreciation for the opportunity to participate because it increased their knowledge on how to support their siblings to communicate and gave them dedicated time to interact with their siblings one on one. Caregivers and family members agreed that using AAC is not something they often do outside of helping with school, but this strategy has pushed them to be more intentional about using children's AAC devices and being patient and waiting for the children to respond. Lastly, given that this study took place during the COVID-19 pandemic, families were very familiar with how to use Zoom and the technology needed for this study. All participants confirmed that the technology was easy to use and understand. Elizabeth stated that she preferred meeting via telepractice rather than in person: "When you turn off your camera and stuff. I feel like in person, that'd be awkward because you just sit there and watch us the whole time."

Social Validity of the Outcomes

Categories that emerged and focused on social validity of the outcomes included (a) children's social interactions, (b) siblings' behaviors, and (c) family member relationships. All participants and other family members said they observed an increase in the children's social

interactions throughout the study. Families expressed that after their participation in the study, they noticed an increase in the children's communication. For example, Connor's mother commented, "He is more proactive in some of the communicating. That's something that he didn't do before. So maybe he's getting more knowledgeable about what's going on and what he wants and how to communicate that." Not only did the family members note that there were changes in the children's communication, but they also observed changes in the siblings' behaviors. Connor's grandfather expressed, "Luke will help with some things but not really hands on. So, jumping in with both feet... I'd say probably 12 weeks since this study. Luke has kind of come out of his shell a little bit as far as playing with Connor." In addition to the changes caregivers and families members noticed in the social interactions of the children as well as the behaviors of the siblings, participants reported that overall relationships between family members improved. Ella and Steven's mother described a recent interaction that Ella had with another family member: "Ella kind of looked at him and said, 'Daddy singing,' and then named the song. We don't usually get that kind of interaction." Connor's mother discussed how this experience affected all the children involved, even the older brother: "I think he and his older brother do a lot more, together; I think, I just think, their bond together is even stronger." In addition, Naomi and Michael's mother expressed, "I think the more bond you have between siblings, the stronger the family bond."

Discussion

The purpose of this study was to evaluate the effectiveness of a training and coaching intervention to increase the use of the ALM strategy by siblings to support the social communication of children with disabilities who use AAC. The results revealed that the sibling training and coaching were effective in increasing high-fidelity of the siblings' implementation

of the ALM strategy. In addition, participants and family members found the intervention to be impactful and meaningful.

Effectiveness of Sibling Intervention

It is evident from the observational data that there was a functional relation between training and coaching typically developing siblings and their high-fidelity use of the ALM strategy with the children who used AAC. Based on the methodological rigor and findings, this study meets the WWC standards and various SCR quality indicators (Horner et al., 2005). All siblings achieved the performance criterion and increased their high-fidelity ALM strategy use during training and coaching. Furthermore, they maintained high-fidelity strategy use after the coaching sessions were complete. The current study replicates and extends Douglas et al.'s (2021, 2022) study that focused on training and coaching family members to implement the ALM strategy with high-fidelity via telepractice. The current study focused solely on siblings across three different families and contributes to the limited research on siblings' interventions, specifically those that include children who use AAC devices. Researchers have found that augmented input is effective in supporting individuals who use AAC (Binger & Light, 2007; Cafiero, 2001; Drager et al., 2006); however, this study extends the existing research as it is specifically focused on supporting siblings as communication partners. Overall, the current study demonstrates that siblings can learn how to use evidence-based strategies, such as the ALM strategy, and implement them with high-fidelity with children who use AAC.

Sibling Language Models and Child Independent Communication Modes

While the siblings' high-fidelity use of the ALM strategy increased, the children who used AAC demonstrated high variability in the rate and type of independent communication modes used throughout the study. Due to the inherent nature of communication as a reciprocal

process, when a child communicates at a lower rate, it is likely that their communication partner will communicate less as well (Brady et al., 2016). These findings pose interesting questions that can be further explored in research on the types of language models that are provided and if those are related to children's independent communication modes. Although no clear relation between the siblings' and children's communication were identified, noteworthy findings that could be related to the intervention were discovered. For example, overall, the children's use of AAC increased from 6.5% during baseline to 30.5% during intervention. This could be further examined in future studies.

Family Relationships

During the post intervention interviews, parents reported changes in family and siblings' relationships following the intervention. According to family systems theory (Bowen, 1974), dynamic and diverse relationships occur between family members, and these can vary based on factors such as age, gender, and interests. In the current research, there were diverse sets of siblings in terms of gender and age. In each dyad, the typically developing sibling was older than the child who used AAC. Additionally, the siblings' ages ranged from 7-12 and the children's ages ranged from 7-9 years old. Three dyads had opposite-gender individuals and one dyad included two boys. Sibling and child relationships also can be affected by other factors in the family dynamics such as parent relationships, parent-child relationships, and other siblings' relationships (Whiteman et al., 2011). These relationships can be formed through experiences, shared interests, or outside variables that can be ever-changing within the family.

Researchers have noted the importance of including a variety of family members to help guide the goals and outcomes of interventions (Mactavish & Schleien, 2004). Caregivers emphasized in the pre- and postintervention interviews how important this intervention was and

how they not only saw an increase in the children's communication but also positive changes in the families' relationships. According to the caregivers, family bonds and relationships were strengthened between the child and their siblings as well as the child and other family members who did not participate in the intervention (e.g., other siblings, parents, grandparents). This study offers an initial investigation of how social communication interventions can potentially improve meaningful relationships between family members. These findings might also lead to more longitudinal studies which could provide more details about how to strengthen family relationships when there is a child with a disability who uses AAC. Not only do these findings support the use of siblings as implementors, but it can also suggest that relationships between siblings become stronger and interactions increased following the intervention.

Feasibility of Telepractice

Through prior research, telepractice has been found to be an acceptable and feasible way to implement interventions in natural environments (Machalicek et al., 2016; Meadan et al., 2016; 2020; Neely et al., 2017). While this type of intervention delivery has been primarily used with adults (e.g., parents, teachers, and caregivers), this study aimed to understand the viability of telepractice to train and coach school-aged siblings. With the COVID-19 pandemic, the timing of the need to remotely support all family members aligned with the goal of this intervention. Given the effectiveness of this training and coaching intervention, telepractice could be used as a viable way to train siblings to implement the ALM strategy with children who use AAC. At the time of the study, those who participated in the dyads were in the process of transitioning back to in-person learning. Therefore, participants were familiar with online learning and using the Zoom platform.

Except for Elizabeth, all participants and family members expressed they would like to

see aspects of this training and coaching intervention conducted in person. Many expressed that while it was convenient and there were aspects of the telepractice they appreciated, they would have liked to experience the training and coaching in person. Although studies found the outcomes are similar between research conducted in-person and via telepractice, researchers should consider combining the use of in-person and remote learning (Hacker et al., 2022).

Limitations and Implications

There are several limitations in this study that should be considered and discussed. First, two dyads (e.g., Luke and Connor; Steven and Ella) had long baseline data collection periods. Luke and Connor's grandmother set up twice-a-week meetings and Steven and Ella's mother asked for sessions three times a week. After multiple data collection sessions, both caregivers continued to inquire about how long it would be until they could begin training. Prolonged baseline phase could potentially have changed the participants' experience during the intervention phase. In addition to the prolonged baseline phase, the maintenance phase was short for these two dyads. Furthermore, while a variety of activities were used during each of the sessions, limited generalization was observed, and it was not observed across routines. Similarly, it should be noted that Connor did not generalize his AAC use between Elizabeth and Luke.

Second, the goal of this study was to include siblings and children within 3 years of each other's ages. However, in several of the end of the study interviews, the caregivers said they wished other family members also participated due to the positive changes observed in the relationships between the siblings. With a more family-focused approach, this could have positively impacted all family members rather than just selected individuals.

Third, throughout the study, there were interruptions in video chats due to technology glitches. At certain times there were connectivity issues both from the coach and the participants.

As Luke noted during the postintervention interview, he was frustrated with the Zoom features on his iPad. The Zoom app would shut down anytime his iPad received a text or call, requiring him to re-enter the session. While minor, this interrupted the flow and naturalistic approach to remote data collection. In another instance, Steven and Ella were preparing to participate in a coaching session when the battery died on the AAC device. This limited their opportunity to interact and communicate, interrupted the coaching session, and no data collection could occur. Lastly, all families came from middle-class backgrounds and there was limited diversity. All participants came from two- parent households with at least one caregiver at home with the children all the time. To get a more diverse sample of individuals and generalize to other individuals who use AAC to communicate, it would be important to attract families who come from different cultural, linguistic, and socio-economic backgrounds.

Implications

Results from this study can lead to future research that can support various AAC intervention delivery methods. First, family members expressed a desire to be included in the research to better support the communication of their children who used AAC. Therefore, more research is needed to study the effectiveness of the ALM strategy use with a variety of family members. Such a study was recently completed by Douglas et al. (2021, 2022). Alongside the inclusivity of family members, like Douglas et al.s' approach, using a cascading model approach could narrow the research-to-practice gap. In the current study, families noted the challenges of trying to learn the ALM strategy through siblings. Future research could investigate the successfulness of both teaching an adult the ALM strategy and showing them how to train other families members. In addition to this, a longitudinal approach could be beneficial to see if using the ALM strategy for a longer intervention period would increase the child's independent

communication using AAC. For example, by increasing the length of time in coaching or including all family members, it would be interesting to observe if there is an increase in the independent communication of the children, if the modes of communication become more sophisticated (e.g., symbolic communication), and if the children would then generalize between communication partners or across routines. This research could potentially strengthen the relationships for individuals who use AAC with natural communication partners throughout their environments, both within and outside the home.

To better understand if there is a relation between the language models the siblings provided and the children's independent communication modes, a sequential analysis of the observational data could be completed, focusing specifically on the type of sibling model and the child's communication. This analysis could provide a more detailed explanation regarding the changes in the modes of child communication. It would be important to investigate how (or if) various language models can potentially change or elicit a specific respond from the child. Two factors can be further investigated based on these findings: (a) if this was related to the rate at which the ALM strategy was used, or (b) if this was related to the type of language model that the sibling used. Using a sequential analysis, conclusions may be drawn to better design future research focused on supporting communication partners who are interacting with children who use AAC, and even more broadly, language development. While much of the research on individuals who use AAC has been conducted in classrooms, siblings and families in general require more training. Utilizing sibling relationships, this study supports the roles of siblings as effective implementors of AAC interventions. Whole-family interventions can be individualized to meet each family member's needs and enhance more meaningful interactions within the home.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Table 1

Participant and Activity Descriptions

	Family Members	Sibling; Age	Child; Age	Child's Disability	AAC Device	Items/Activities
Family 1	Mother Father	Naomi; 8	Michael; 7	Down Syndrome	iPad; Proloquo2Go	• trains • building blocks • basketball • hammer and balls • pretend play
Family 2	Mother Father Grandmother Grandfather Brother	Elizabeth; 12	Connor; 9	Angelman Syndrome	Accent 1000; CoreScanner	• cookie counting • shapes and color matching • Simon • book reading • basketball
		Luke; 11	Connor; 9	Angelman Syndrome	Accent 1000; CoreScanner	• cookie counting • shapes and color matching • pegs and pegboard • book reading
Family 3	Mother Father	Steven; 7	Ella; 7	Autism	Accent 800; LAMP Words for Life	• matching game • Legos • action figures/dolls • slime

Table 2

Operational Definitions

Sibling's Aided Language Modeling Fidelity	
Interactive Context	Communication partner is face-to-face at the child's level and speech generating device (SGD) is in line of sight and within arm's reach of both the communication partner and the child.
SGD Initiation	Communication partner presses one or more symbols on the SGD (i.e., with sufficient pressure to produce speech output) within of the four types of interactions (i.e., choice, question, comment, response).
Aided Language	Communication partner uses aided language at or one level above child's assessed level
Spoken Language	Communication partner immediately follows or precedes use of SGD with corresponding spoken language.
Pause	Communication partner looks at the child and pauses at least 3 seconds before resuming play/the activity, or taking another communication turn OR the child responds before 3 seconds elapses
Child's Level of Independence	
Prompted	Child's communication follows a prompt (visual, verbal, communicative directive, physical) from the partner.
Imitated	Child's communication imitates all or part of the partners immediately preceding message, occurs within 3 seconds of that message, and does not expand on the message.
Independent Initiation	Child's communication is non-prompted, non-imitated, and independent from the partner's previous communication (unrelated content, or 5 seconds or more from the partner's communication).
Independent Response	Child's communication is non-prompted, non-imitated, and in response to the partner's previous communication (includes expansions).

Note. The definitions and descriptions have been adapted to meet the individuals of the current study (Douglas et al., 2021, 2022).

Figure 1

Single-Case Graphic Display of Results