

# AACeSSTALK: Fostering Communication between Minimally Verbal Autistic Children and Parents with Contextual Guidance and Card Recommendation

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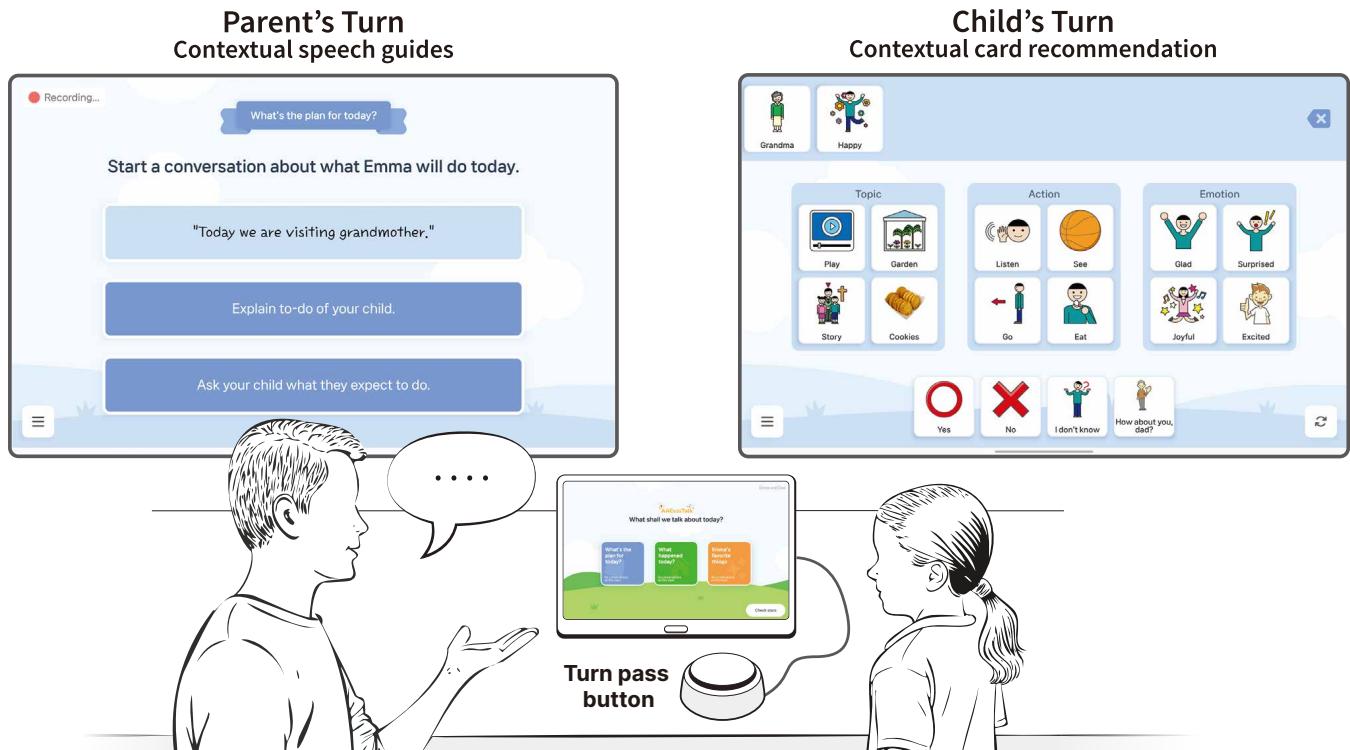


Figure 1: AACeSSTALK is a communication mediation system that runs on a tablet device accompanied by a hardware button (Bottom). AACeSSTALK shapes a turn-taking conversation, and the button is used to switch turns. On the parent's turn, the system displays guide messages and example utterances that the parent can refer to when responding to the child (Left). On the child's turn, the system recommends a set of vocabulary cards that the child can select to convey their message (Right).

\*Dasom Choi conducted this work as a research intern at NAVER AI Lab.

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## Abstract

As minimally verbal autistic (MVA) children communicate with parents through few words and nonverbal cues, parents often struggle to encourage their children to express subtle emotions and needs and to grasp their nuanced signals. We present AACeSSTALK, a tablet-based, AI-mediated communication system that facilitates meaningful exchanges between an MVA child and a parent. AACeSS-TALK provides real-time guides to the parent to engage the child in

conversation and, in turn, recommends contextual vocabulary cards to the child. Through a two-week deployment study with 11 MVA child-parent dyads, we examine how AACeSSTALK fosters everyday conversation practice and mutual engagement. Our findings show high engagement from all dyads, leading to increased frequency of conversation and turn-taking. AACeSSTALK also encouraged parents to explore their own interaction strategies and empowered the children to have more agency in communication. We discuss the implications of designing technologies for balanced communication dynamics in parent-MVA child interaction.

## CCS Concepts

- Human-centered computing → Accessibility systems and tools; Empirical studies in accessibility.

## Keywords

Parent-child interaction, autism, minimally verbal, AAC, large language model, LLM, artificial intelligence, conversational guidance

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## 1 Introduction

Minimally verbal autistic (MVA)<sup>1</sup> children engage in communication mainly with nonverbal cues, non-speech vocalizations, or a small repertoire of words or fixed phrases [61]. Regardless of the form, communication with parents is just as essential for autistic children's emotional and social development as it is for non-autistic children [14]. However, parents often shoulder the significant responsibility of driving this communication, initiating conversations by asking questions, interpreting nuanced communicative signals, and constantly responding to encourage the child's participation [34, 79]. As parents manage these interactions with little cooperation from their children, they experience feelings of isolation and frustration [36].

To encourage the child's participation in communication, many parents have adopted Augmentative and Alternative Communication (AAC) systems, such as symbol cards, that children can use instead of verbalizing their message [16]. While these tools enable MVA children to express themselves by selecting visualized symbols of words, they are often criticized for failing to capture the child's authentic thoughts and feelings as the symbols tend to prioritize functional communication over the user's personal context and true intent [32, 122]. Most AAC systems are pre-programmed with "necessary words" chosen by service providers and, in most cases, by parents [6, 88]. As a result, children's messages are often limited to the boundaries set by parents rather than reflecting children's unique experiences and perspectives.

<sup>1</sup>In this work, we choose to use identity-first language (e.g., autistic children) rather than person-first language (e.g., child with autism). This decision aligns with the preferences of autistic individuals [63] and recent academic trends [20].

Previous studies have examined how MVA children can take a more active role in communication with their parents. Parent training, often conducted with therapists in face-to-face settings [76, 128], remotely [10, 115], or self-guided by video materials [33, 55], have equipped parents with strategies to encourage their children to communicate [59, 91]. Research in special education and HCI also proposed conversational storyboards based on behavioral data [19, 118], or customizable AAC systems that generate vocabularies based on geographical data [37, 95] or photographs [44, 45]. However, previous attempts have primarily considered education-oriented language-learning contexts that target either parents or children, lacking an integrated approach to empower both parties in everyday communication on the fly.

In this work, we aim to support the agency of both parents and MVA children in reciprocal communication by designing and developing an intelligent system that mediates their conversational interaction<sup>2</sup>. To that end, we conducted formative interviews with nine autism experts and five parents of MVA children to better understand communication challenges between parents and MVA children and glean insights from professional practices to enhance communication. The interviews revealed that parents exert significant control over the structure and topics of conversation, underscoring the need to support turn-taking between parents and children around mutually engaging subjects.

Based on these insights, we designed and developed AACeSSTALK (Figure 1), a communication mediation system that fosters meaningful exchanges of ideas and emotions through mutual contribution between MVA children and their parents. AACeSSTALK runs on a tablet accompanied by a hardware button (Figure 1, bottom) for taking turns, providing an environment for explicit turn-taking conversations. On the parent's turn, the app provides guide messages on what and how to respond to the child (Figure 1, left). On the child's turn, the app curates a set of vocabulary cards relevant to the conversational context (Figure 1, right). To accommodate a range of in-situ, daily topics, AACeSSTALK leverages large language models (LLMs) to generate parental guidance and card curation, based on the parent's voice input transcribed in text and the child's input in selected cards.

To examine how parents and MVA children interact with AACeSSTALK and how the system impacts their communication, we conducted a two-week home deployment study with 11 parent-child dyads in South Korea. Our results show a considerable level of participant engagement in conversation through AACeSSTALK, carrying out 232 conversation sessions in total. During these interactions, parents incorporated AACeSSTALK's parental guidance in 78% of their turns, and children selected a total of 2,244 AAC cards recommended by the system. The debriefing interviews and daily surveys revealed that AACeSSTALK alleviated parental pressure to have MVA children produce complete sentences and provided the children chances to express their communicative intent. Furthermore, using AACeSSTALK motivated parents to depart from brief and instructive dialogue, turning conversations with their MVA

<sup>2</sup>In this work, we use the term *communication* to denote the holistic interaction between parents and MVA children, embracing not only exchanges of words and utterances but also emotional connections and behaviors [68, 127]. Also, we use the term *conversation* to denote a specific subset of communication characterized by a structured and reciprocal exchange of messages between two individuals [101].

children into daily routines focused on empathy and understanding. The contribution of this work is fourfold:

- (1) Findings from a formative study with nine autism experts and five parents of MVA children, revealing the unique challenges in communication between MVA children and their parents, along with the current best practices in the field.
- (2) The design and implementation of AACeSSTALK, an AI-driven communication mediation system that supports turn-taking conversations, offering parental guidance to parents and recommending AAC cards to the child, encouraging mutual participation in parent-child communication. The source code of AACeSSTALK is publicly available at <https://naver-ai.github.io/aacesstalk>.
- (3) Empirical findings from a two-week deployment study involving 11 parent-MVA child dyads, demonstrating how parents and children leveraged AACeSSTALK for communication and how this experience influenced parents' perceptions towards communicating with MVA children.
- (4) Design considerations for communication technologies that foster parental reflection on interactions with MVA children, thereby promoting the inclusion of neurodiverse children as active conversational partners.

## 2 Related Work

In this section, we cover the related work in the areas of (1) technology support for communication with neurodiverse children, (2) parenting technology support, and (3) AAC for MVA children.

### 2.1 Technology Support for Communication with Neurodiverse Children

In parent-child communication, a child's self-expression is fundamental in establishing a shared understanding, which allows parents to address the child's unique needs and challenges effectively [74]. However, forming this shared understanding is often challenging within neurodiverse dyads—comprising MVA children and non-autistic parents [141]. This is because, first, MVA children often have lower intrinsic motivation to communicate [103], and thus reveal less of their inner selves to their parents. Second, they tend to express their needs and opinions through various modalities beyond verbal language, such as touch, sound, pointing, and gestures [124]. Even their nonverbal vocalizations can hold emotional and self-expressive information [60], yet parents often struggle to interpret these subtle communication cues [34]. While communication difficulties in these neurodiverse dyads stem from differences in how they perceive and express the world, many educational and technological efforts have focused on teaching and supporting verbal communication to MVA children [25, 64]. For example, systems that visualize audio in real-time to promote vocal imitation [15, 52, 53] and virtual tutors to train spoken word production in autistic children [78] have been developed and assessed for use in clinical speech-therapy settings.

The field of HCI has contributed numerous assistive communication technologies aimed at empowering MVA children to have a "voice." Importantly, these recent efforts redefine having a "voice" not just as the ability to speak, but as enabling MVA children

to represent themselves by having a communicative agency [4]. This paradigm shift also aligns with the Ability-Based Design approach [138, 139], which focuses on individuals' abilities rather than limitations, encouraging MVA children to engage in communication on their own terms. For example, Wilson *et al.* developed a personalized interactive dictionary that taps into MVA children's special interests to motivate self-expression [132]. Researchers have also proposed tangible devices that enable MVA children to express themselves through sound, light, touch, and body movement [110, 134], AAC tools with symbolic images or photos [44, 45], and VR/AR letterboards [1, 2, 86]. Some have even involved the children as design partners in creating these technologies [45, 133].

While previous studies have facilitated more independent self-expression in MVA children, there has been relatively less focus on how parents engage in communication with MVA children. Communication inherently involves *interdependent* actions that require mutual effort from all parties. Bennett *et al.* [13] applied the concept of *interdependence* from Disability Studies to the design of assistive technology (AT), proposing that AT needs to support collaborative efforts among people with disabilities, those they interact with, and their surrounding environments. Through the lens of interdependence, current communication technologies for MVA children-parent dyads predominantly focus on facilitating access for MVA children. This unilateral targeting can inadvertently overlook neurotypical parents' accessibility to engage in conversations with their neurodiverse child, potentially leading to frustration and feelings of alienation [36]. Thus, we see a critical opportunity in designing AT that assist communication by accommodating the needs of both MVA child and the parent. Specifically, our work integrates previously separated communication supports for parents and MVA children into a unified system to mediate real-time interactions among them.

### 2.2 Parenting Technology Support

There has been a growing emphasis on family-centered support for autistic children, highlighting the need for parents to actively engage in setting goals, making decisions, and implementing interventions at home to improve interactions with their children [18]. This led parents to learn new modes of communication, adapt their interaction styles, and modify their home environments [3, 7]. Moreover, for the successful integration of those changes and interventions, including AAC, parents are required to have specialized training to learn effective strategies [23, 38, 47, 49, 89, 99]. Despite these efforts, the visibility of improvements or responses from autistic children to these interventions can vary significantly [96], making it challenging for parents to reflect on and adjust their parenting and communication strategies.

The HCI researchers have explored real-time interventions to assist parents in interacting with their children. Several studies aim to facilitate parental reflection by providing direct access to interaction data. For example, the Dyadic Mirror [66], a wearable mirror worn around a child's neck, shows parents live views of their own face, increasing their awareness of emotional states. SpecialTime [57] utilizes a predefined set of guidelines derived from

Parent-Child Interaction Therapy (PCIT) to track parent interactions and provide auto-labeled feedback after conversation. Another tool, TalkLime [112], employs real-time visualizations to analyze the number of utterances, initiation ratios, and turn-taking between parents and children.

Building on advances in multimodal sensors and AI automation, recent studies offer more direct feedback and contextual guidance by analyzing conversation dynamics between parents and children. TalkBetter [58] monitors conversations between parents and language-delayed children, triggering alerts when parents show undesirable language habits, such as interrupting, speaking too quickly, or not waiting. Captivate! [71] focuses on play sessions with language-delayed children, identifying objects of joint focus and displaying related phrases on a tablet. TIPS [56] offers context-responsive recommendations of American Sign Language (ASL) for hearing parents of Deaf and Hard of Hearing (DHH) children. While numerous technological attempts have demonstrated the potential of at-home parental guidance, most focus on general or behavioral-level support, such as improving social interactions or communicative intent. For MVA children, however, effective guidance demands detailed speech-level support, grounded in expert linguistic and interaction strategies, to help parents navigate conversations tailored to their unique communication characteristics [62, 100]. Thus, our work extends this line of research by developing parental guides that incorporate professional strategies tailored to MVA children.

### 2.3 AAC for MVA children

Symbol-based AAC tools, which allow users to select symbolic images representing specific objects or concepts, have been widely adopted by MVA children to facilitate their self-expression and social participation [73]. While the effectiveness of AAC in learning language and requesting needs has become evident [116], several barriers persist in its implementation for everyday conversation [32]. Low-tech AAC in the form of paper cards, often used in the initial stages of adoption, is time-consuming for parents to prepare [27] and has limited portability when carrying many images [54]. As for high-tech AAC devices, such as tablets, children often struggle to navigate numerous cards to find those suitable for specific communication purposes [30, 80]. Although these tools commonly support configuring a preset of the AAC vocabulary in advance for that reason, the presets are not flexible to cover serendipitous topics that arise in real-time, everyday conversations [27, 51, 117]. Moreover, the vocabulary presets are often selected by others, mostly parents, which makes it uncertain whether they truly reflect the child's intentions [6, 88].

A large body of research on AAC technologies has focused on recommending appropriate vocabulary or symbols, primarily aimed at enabling AAC users to participate in communication more efficiently. Early work employed rule-based algorithms to predict relevant words or similar symbols based on the user's input of alphabets or symbols [119, 125]. Subsequently, several works analyzed the speech of a conversation partner with Natural Language Processing and suggested context-appropriate noun phrases to users [136, 137]. Recently, the introduction of AI and Large Language Models (LLMs) has allowed for the recommendation of relevant sentences based on

users' abbreviated text entry [24, 120, 121]. Furthermore, Vargas *et al.* [44, 46] have developed AI-driven AAC boards, which create narrative stories with vocabulary cards based on photos provided by users. Neamtu *et al.* [87] also proposed LIVOX, an AI-based system that recommends pictograms based on the user's geographic location and time data.

Although existing systems have shown a promising avenue for AI-driven AAC technologies, they rarely target communication with MVA children, which calls for consideration beyond the quick navigation of cards. Many of these children tend to exhibit a significant gap between receptive and expressive language [26], which means they may know specific words and phrases but struggle to recall them when needed. In this context, building on prior research on AI-based AAC recommendations, we aim to explore how AI can act as a stimulus to prompt expressions in MVA children, potentially their vocabulary.

## 3 Formative Study

To inform the design of AACeSTALK, we conducted 14 semi-structured interviews with autism experts and parents of MVA children. We aimed to understand the challenges in communication between MVA children and their parents and identify professional practices and parental efforts to enhance communication. We tailored the interview protocols for each group—experts and parents—and conducted the interviews separately to better elicit their unique experiences and perspectives. Both interview studies were approved by the Institutional Review Board.

### 3.1 Procedure and Analysis

The interviews were conducted either in-person or remotely depending on the participant's convenience and availability.

**3.1.1 Interviews with Autism Experts.** We recruited nine autism experts (E1–9) by distributing flyers to local private psychiatry hospitals and child development centers. The participants included two child psychiatrists, two child development specialists, two speech-language pathologists, one child psychotherapist, one elementary special education teacher, and one behavioral therapist. The experts had an average of 15.56 years of experience (ranged 8–25 years), and all of them had clinical experiences with MVA children in promoting their language and behavioral development.

We first asked about the communication challenges MVA children and their parents have, the patterns of AAC adoption and usage within these families, and the strategies experts used to understand the intentions of MVA children and facilitate reciprocal conversations. Following this, we presented a video prototype to prompt experts to grasp the concept of an AI-driven communication mediation system. This prototype served as an early proof of concept for integrating parental guidance and AAC technology to facilitate meaningful conversations between parents and MVA children. The video depicted a scenario in which a parent and an MVA child discuss "what happened today," with the AI providing conversational guides to the parent and AAC symbols to the child. The scenario was developed based on the counsel of one of the authors, an expert in autism communication strategies, drawing from her extensive counseling and clinical experience. We asked the experts about the clinically desired direction of conversations,

principles of parental guidance, potential opportunities for AI integration, and any potential risks. The interviews lasted about 1 to 1.5 hours. We offered a 100,000 KRW (approx. 80 USD) gift card as compensation.

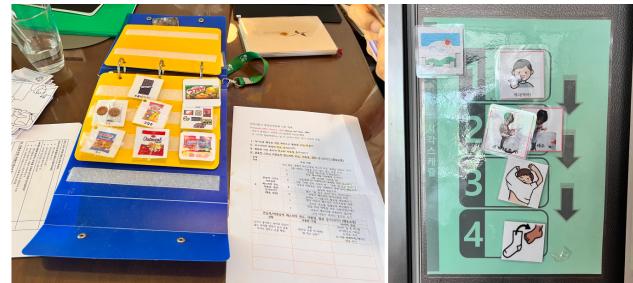
**3.1.2 Interviews with Parents of MVA Children.** We recruited five parents (F1–5) of MVA children by snowball sampling and the internal network of one researcher, who is both an autism specialist and a parent-child counselor for autistic families. The participants included four mothers and one father, with an average age of 44.2 years (ranged 36–51,  $SD = 5.11$ ). Four of the parents had sons, and one had a daughter, with their average age being 9 years (ranged 6–14,  $SD = 2.83$ ). Three families actively used low-tech AAC with paper symbol cards at home and in educational settings, while the other two had been advised to adopt AAC but not yet tried.

The interviews, which lasted about an hour, began by discussing the communication characteristics of MVA children and the parents' experiences with AAC adoption and application. To better capture the nature of current interactions between parents and their MVA children in everyday conversation, we provided a comic strip (See Figure 2a) with images of a parent and a child and blank speech bubbles. Parents were asked to fill in the bubbles with examples of enjoyable or challenging conversations they had with their child. We then asked about the efforts parents had made to enhance communication with their child, including the resources and tools used at home (See Figure 2b), the strategies that led to successful outcomes, and any difficulties they encountered in the process. Finally, we explained the basic concept and capabilities of LLMs and invited parents to share their expectations regarding the potential role of AI in supporting parent-child communication. We offered a 50,000 KRW (approx. 40 USD) gift card as compensation.

**3.1.3 Analysis.** All interviews were audio-recorded and later transcribed. Applying Thematic Analysis [22], one researcher open-coded the transcript to identify emerging themes. The entire research team then finalized the themes through multiple rounds of discussions. In the following, we present the findings from the formative study.



(a) Recalling conversations on comic strips



(b) Parental guidance and AACs participants are using

**Figure 2: Photos taken from the parent interviews from formative study:** (a) A parent writing down conversations they had with their child on the comic strip, and (b) parental guidance materials received from the therapy sessions and coated paper-based AAC cards used at home.

## 3.2 Finding 1: Parent-Led Conversations

Both our expert and parent participants pointed out that conversations between MVA children and their parents are often led by parents, where the parent's level of engagement is markedly higher than that of the child. This was particularly evident in two aspects: the conversation structure and the content of the conversation.

**3.2.1 Control over the Conversation.** We found that most parents had a significant level of control over the entire conversation with their MVA children. For example, all conversations were initiated by the parent, as MVA children often have challenges in making spontaneous communication attempts [107]. The parent also determined when to conclude the conversation upon noting nonverbal signals from the child getting overwhelmed or disengaged. Even during conversations, when the child remained silent or slow to respond, parents would steer the interaction by asking continuous questions to prevent the conversation from coming to a halt. As a result, most interactions involved minimal turn-taking, typically only 0 to 1 exchange.

When conversing with children unfamiliar with self-expression and social interaction, it is natural and encouraged for the parent to guide the conversation [28]. However, some experts pointed out that such asymmetric dynamics could limit the child's opportunities to learn that communication is an effective means to convey their intentions, leaving them as passive participants. Experts suggested that for meaningful conversations that enhance parent-child bonding, the system should support reciprocal exchanges between the child and parent. E7 remarked: *"Both the parent and the child need to learn that a conversation isn't something you do alone. It's back-and-forth. But because one person (the parent) is speaking and the other (the MVA child) isn't, they participate in asymmetrical ways, so they've had fewer chances to really build this skill."*

**3.2.2 Teaching Speech instead of Communication.** Parent participants reflected that their conversations with their MVA children at home often focused on repeatedly teaching essential words for daily life, with an emphasis on producing correct sentences. F1 mentioned, *"As my child grows older and has to go to preschool or school without me, they need to at least know how to say things like 'bathroom' or 'water'. It feels urgent to make sure they can say those basic words."* Experts noted that parents can become so absorbed

in honing their child's speech that they mistakenly believe a few spoken words mean they're having a conversation. E4 said: "Autistic kids often repeat the same word over and over throughout the day. So the parents take that as a chance to ask questions. But the kid just keeps saying the same word. In the end, there's nothing shared between them." They propose that instead of teaching what the parent believes necessary, it's important to establish a shared interest between the parent and child and provide rich resources and stimuli that can enable the child to express their thoughts and feelings.

### 3.3 Finding 2: Lack of Actionable Parental Guidance

Regarding parents' challenges in improving conversations with their MVA children, most parent participants mentioned difficulty in applying key principles and strategies from parent training in day-to-day conversations. Considering the broad spectrum of characteristics displayed by autistic children, the communication guides currently available to parents are often too general and impractical. F3 remarked: "After my child was diagnosed with autism, I bought these huge, thick books, watched every YouTube video by doctors, and got all sorts of pamphlets from the therapy sessions on how to guide conversations. I know what's important now. But all that material is really broad. When I try to use it with my child, I just freeze, and the words don't come out right." Similarly, F4 recalled, "My child's speech therapist once told me, 'Most of your conversations with your child are just questions. You need to diversify your interactions.' It was a huge revelation. But then I realized I have no idea what to say if I'm not asking a question."

Some parents (F2 and F4) closely observed how the therapist conversed with their child during clinic sessions and then practiced the therapist's phrases at home. However, they pointed out that it's impossible to collect examples for every situation and topic. Additionally, secondary caregivers, who spend less time with the child and have fewer opportunities to observe examples from the clinic, often lack confidence in guiding interactions. It sometimes led secondary caregivers to avoid conversations with their children, ultimately weakening their bond.

### 3.4 Reflection: Opportunities for AIs as Communication Mediators

To address the challenges mentioned above, parent participants have implemented various professional supports and workarounds. Most of them (F1, F3, F4, and F5) attended parent training sessions led by therapists, and some (F1, F2, and F3) created customized AAC cards using photos of objects, people, and activities from their child's daily life. However, they noted that these approaches are not always readily available and impose significant time and cost burdens, raising concerns about their long-term sustainability. This led participants to express the expectation that AI could provide low-cost, accessible at-home guidance for parents and AAC card curation for MVA children. F5 remarked, "I heard AI can make drawings now. The first thing I thought was, it'd be great if it could make AAC cards for my kid. My child's growing up, but I can't keep up with making the cards. So lately, I feel like they're not really useful anymore." Experts also recognized the potential of AI to broaden the range of expression and interaction in parent-child

conversations. However, they emphasized that the parent and child should remain the primary drivers of the conversation, with AI's suggestions serving only as a point of reference.

## 4 AACessTALK

Informed by the formative study, we designed and developed AACessTALK, a communication mediation system for both parent and MVA child. In this section, we discuss our design rationales from formative interviews and literature, user interface and system components of AACessTALK, description of generative pipelines, and implementation details.

### 4.1 Design Rationales

**DR1. Structure Turn-taking through Expressive Cues.** From the formative interviews, experts stressed the importance of MVA children having more control throughout the conversation process, thereby inviting them to engage in back-and-forth exchanges with their parents. Given that autistic children are often visual learners [67], we decided to provide visual and behavioral cues to make them better understand the flow of conversation and effectively express their intentions through actions. To this end, we set the system on a tablet device so that both the parent and child can visually track the conversation while jointly focusing on the screen. When starting a conversation, the parent and child are guided to select a topic together. Finally, a shared turn pass button (Figure 1, bottom) serves as a turn-switching signal, reinforcing the concept of turn-taking in a tangible way.

**DR2. Contextualize Parental Guidance.** Considering the parents' needs for immediately applicable conversation guides, we designed two types of context-aware guidance based on the formative interviews with experts on general principles of parental guidance. First, **conversational guides** provided in general conversations assist parents in diversifying the forms of interaction. Drawing on strategies from the Hanen More Than Words program [128], we identified 12 parent response types to promote communication with MVA children (see Table 2). These guides are provided along with relevant examples. Second, **feedbacks** alert parents to be aware of negative interaction dynamics. Based on the principles of an evidence-based intervention, Parent-Child Interaction Therapy (PCIT) [40], we outlined three types of negative conversational patterns that parents should avoid (see Table 3). When such responses are detected during conversations, the corresponding feedback is shown in the next turn to avoid disrupting the conversation between parents and children. Such delayed delivery was designed to stimulate parents to reflect on the direction of the conversation themselves. Therefore, rather than instructing parents not to make specific remarks, the feedback informs parents about the potential impact and risks on conversations with their child. The categories and detailed instructions for LLM prompting for both conversational guides and feedback were developed based on formative interviews and reviewed by an expert author.

Upon the experts' concerns about parents' overreliance on AI suggestions, we implemented two safeguards. First, we limited the number of guides presented to three, allowing parents their own room to ideate proactively. Second, the example utterances would not appear automatically; instead, parents must tap guides

to reveal the examples. In doing so, we intended to encourage parents to internalize the guidance and implement it in their own words. All guides, examples, and feedback are presented in a concise, glanceable format to minimize disruption during conversation.

**DR3. Prioritize MVA Children's Vocabulary.** MVA children often struggle to retrieve the appropriate words, even when they have something to express [130]. Generating a variety of AAC cards using LLMs can help the MVA child to recognize unmet needs and boost self-expression. Considering the age and vocabulary of MVA children, we simplified the AAC board into a more accessible format. We structured the AAC board into four categories: **Topic**, **Action**, **Emotion**, and **Core**. This setup provides balanced exposure to various linguistic components. Topic and Action words are contextually generated by the LLM, whereas Emotion words are curated from a predefined set of 12 basic emotions—which were crafted in consultation with experts—specifically aimed at autistic children who struggle to grasp complex and subtle emotions [5]. Existing AAC boards typically provide **Core** words—a fixed set of vocabularies frequently used to express users' basic needs—that are consistently displayed on the screen for easy access [17, 41]. We employed **Yes** and **No** as Core words, both of which are highly frequent in existing core vocabulary lists and are easily understood by MVA children [72]. Based on an expert's feedback, we expanded them to include **I don't know**, which allows children to avoid habitual, non-meaningful responses, and **How about you, mom/dad?** to facilitate mutual exchange in conversations. To reduce cognitive load, each category presents only four cards at a time, resulting in a total of 12 AI-recommended cards and four default options on the screen. A refresh button is also provided, allowing children to request new recommendations if the initial ones do not meet their needs, ensuring they are not forced to choose a word that doesn't align with their intent. Moreover, for children who struggle with symbol recognition, photos of familiar people, places, and objects are pre-uploaded and used as custom AAC symbols.

## 4.2 User Interface and Interaction with AACeSSTALK

Figure 3 illustrates the overall use scenario of the AACeSSTALK. Users first select a conversation topic (Figure 3-①), then the interface moves to the parent's turn, displaying three *Conversational guides* on the screen (Figure 3-②). By starting with the parent's turn, we aimed to gather contextual hints from the parent's speech to recommend suitable AAC cards. Once the parent completes their turn, it transitions to the child's turn, showing the AAC board (Figure 3-⑤). This process repeats with several exchanges between the parent and child. Additionally, if a negative conversational pattern is detected in parent's speech, AACeSSTALK provides *Feedback* to the parent during their next turn, alongside two *conversational guides* (Figure 3-⑧). Finally, the parent or the child can conclude the conversation session whenever they want (Figure 3-⑨).

Here, we illustrate a hypothetical scenario of a MVA child-parent communication with AACeSSTALK. Every evening, Daniel and his 5-year-old autistic daughter, Emma, share a special moment to talk about their day. Tonight, they sit at Emma's bedside table and launch the AACeSSTALK app on a tablet with a set of turn pass button in front of them. The AACeSSTALK displays three topic cards on the

main screen (Figure 3-①): (1) **What to do today?** (Plan)—sharing the day's schedule to reduce the child's anxiety about unexpected events [70], (2) **What happened today?** (Recall)—discussing the day's experiences to support the parent and child in processing and reflecting on what happened [83], and (3) **Emma's favorite things** (Interest)—talking about a topic the child enjoys to increase their motivation to participate in the conversation [135]. Daniel is curious about Emma's experience during the job exploration field trip at kindergarten. So, among the three conversation topics on the main screen, he selects the "What happened today" topic.

The AACeSSTALK then transitions to the parent turn screen (Figure 3-②). When the parent's turn begins, recording starts automatically to transcribe Daniel's speech, with an animated recording indicator appearing in the top left corner. In the center of the screen, three conversation guides generated by LLMs are presented as cards to help Daniel to start the discussion about today's event. Daniel skims through the options and picks one that starts with: "Remind Emma of the important events from today." He pauses briefly, considering how to make it engaging for Emma. Then he taps on the guide, and an example phrase pops up. Inspired, Daniel says, "*Emma, did you see the firefighter you like at the job trip today?*" and then presses the turn pass button to signal the end of his turn.

AACeSSTALK now switches to Emma's turn (Figure 3-⑤). In the center of the screen, each of the three sections, labeled Topic, Action, and Emotion, displays four AAC cards related to firefighters. Emma carefully looks through the cards and taps on the **Firetruck** card. Then the card appears in the selected card area at the top of the screen, and the app voices, "firetruck" Emma then touches the refresh button in the bottom right corner to receive new card suggestions. She then selects **Ride**, **Fire hose**, and **Happy**. After a pause, she looks up at Daniel. Daniel says, "*Emma, if you're done, do you want to press the button? Then it'll be Daddy's turn.*" When Emma presses the turn pass button, AACeSSTALK switches back to the parent screen.

After a couple more exchanges, Emma's turn arrives again. But instead of selecting a card, she repeatedly presses the turn pass button. Daniel smiles and says, "*Emma, that was so much fun. How about we call it a day here?*" Emma agrees by selecting the **Yes** card on the screen. Daniel then ends the conversation session through the menu button (Figure 3-⑩) on the app. The system displays a cheerful message and also shows how many turns they have had with star icons, celebrating their achievement before going to bed (Figure 3-⑨).

## 4.3 Generative Pipelines

The system generates contextual guidance for both parents (Figure 4) and children's (Figure 5) turns, considering the dialogue messages as an input. To build text-based dialogue data (e.g., Ⓐ in Figure 4 and ⓐ in Figure 5), the system treats the transcript of the parents' utterances as the parent messages, and the list of the selected AAC card labels as the child messages.

**4.3.1 Generating Parental Guidelines.** When a parent turn starts, the **inspector** (Ⓑ in Figure 4) first checks the previous parent message if it falls under any of the three feedback categories: (1) *blame* (the parent criticizes or negatively evaluates the child), (2) *correction* (the parent is compulsively correcting the child's response

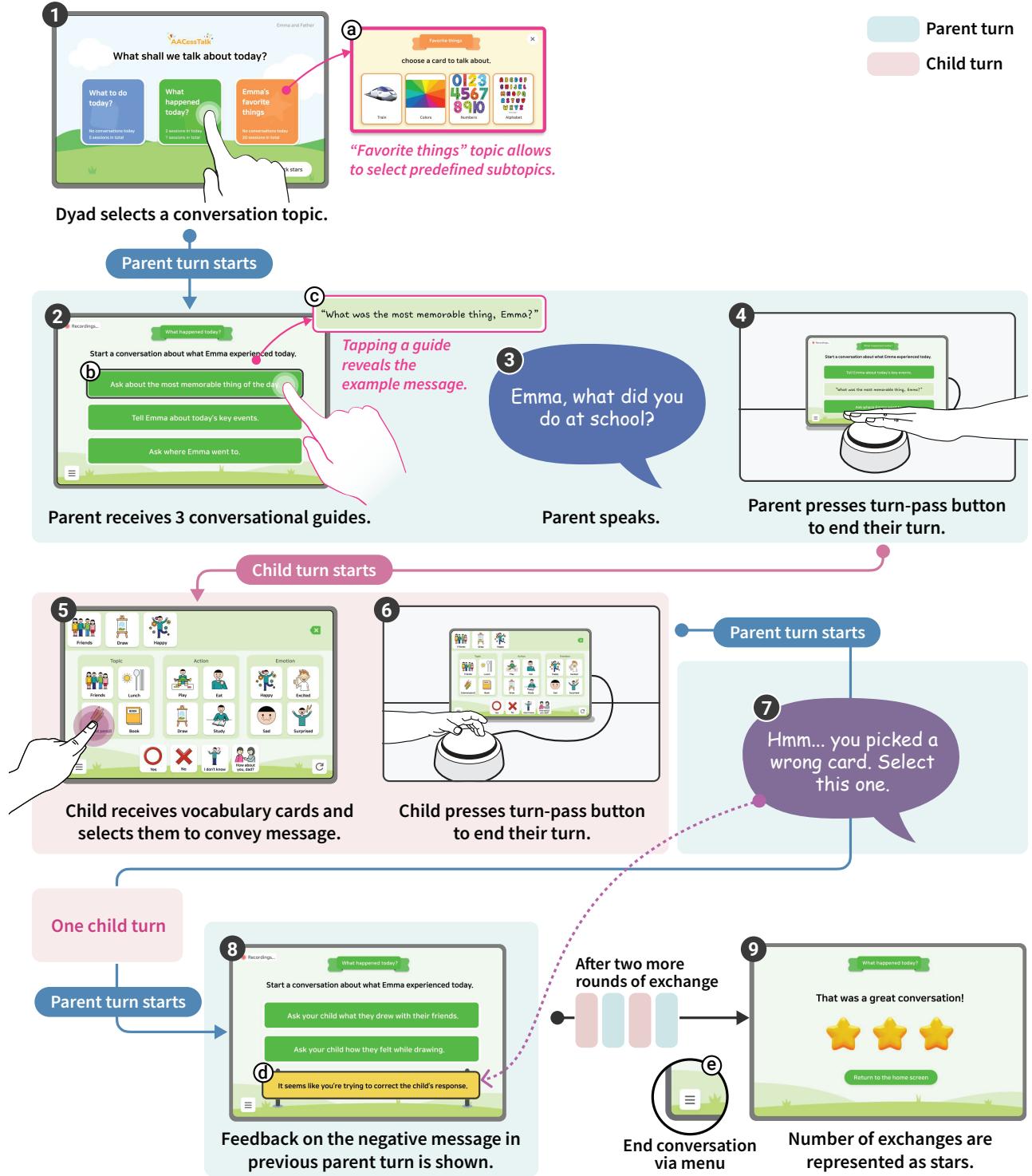
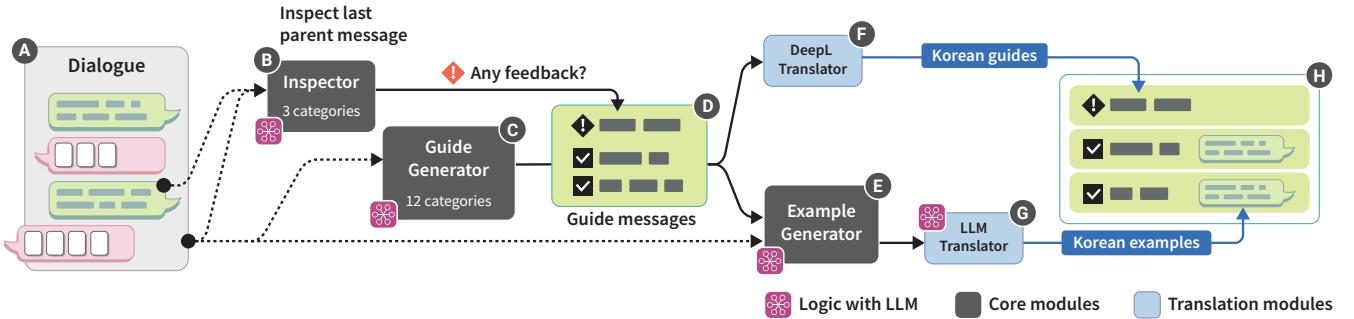


Figure 3: Main screens and usage flow of AACessTALK: ① The home screen, where users select conversation topics. Selecting 'Plan' (Blue) or 'Recall' (Green) topics immediately begins the conversation, while 'Interest' (Orange) presents a pop-up ② with the child's pre-uploaded interests for further selection. ② The parent's turn screen, which provides ③ conversation guides and ④ example phrases for the parent. ③ The parent speaks to the child and then ④ presses the turn-pass button to end their turn. ⑤ The child's turn screen, which offers vocabulary cards for the child. ⑥ The child presses the turn-pass button to end their turn. ⑦ If a negative conversational pattern is detected in the parent's previous turn, AACessTALK shows ⑧ feedback during the next parent turn ⑨. After several iterations of turn-taking like ②-⑥, either the parent or the child ends the conversation ⑩ via menu ⑪.



**Figure 4: Generative pipeline for parental guidelines. The pipeline analyzes the current dialogue (A) and generates parental guidelines with example messages (H).**

or pointing out that the child is wrong), and (3) *complex* (the dialogue contains more than one goal or intent). If the message is tagged with any one of these categories, the inspector generates the feedback message. The **guide generator** (C in Figure 4) analyzes the entire dialogue and generates guide statements for the next parent response. To simplify the information to be shown to the parent, we limited the number of guides to two when there is inspector feedback or three when there is none (See D in Figure 4). To avoid generating duplicate guides, we provided 12 predefined guide directions—*Ask for Elaboration, Show Encouragement, Suggest Choices, Encourage Self-Disclosure, Ask for Intentions, Extend Topic, Open Up, Show Empathy, Pique Interest, Provide Clues, Suggest Coping Strategies, and Wrap Up* (See Table 2 for descriptions)—and prompted the model to choose the most appropriate direction for each guide. The feedback categories and guide directions were derived from both formative interviews with experts and widely recognized intervention programs [40, 128], and then reviewed by a child psychotherapist.

The guide statements are then passed onto the **example generator** (E in Figure 4), which generates example messages that the parent can try. For instance, an example message “Emma, how do you feel when running on the soccer field?” can be generated from the guide “Ask Emma how she feel when playing soccer.”

As we planned to deploy AACESTALK to parent-MVA child dyads in South Korea, we also incorporated translation steps in the end (F and G in Figure 4). We used the DeepL translation API [35] to translate the guide statements due to their formal nature. DeepL has been shown to outperform other AI-based machine translation systems, including ChatGPT-3.5, in English-to-Korean translation quality evaluations [75]. For the translation of example messages, we used GPT-4o to apply an informal style of voice, which is typical in parent-to-child communication in Korean. To ensure that the model generates translation in consistent quality and style, we employed few-shot prompting [140], where the model input includes three translation samples most similar to the input English text, retrieved through a similarity search. For the sample database, we crafted 18 English-Korean translation references inspired by the cases observed during internal testing.

**4.3.2 Generating Card Decks for Children.** The current dialogue, card deck, and selected cards (A in Figure 5) are considered when generating the next card deck. The **card generator** (B in Figure 5)

generates four card labels in *topic* and *action* categories respectively. For the *emotion* category, the LLM curates four *emotion* cards by selecting from a predefined list of 12 emotions (C in Figure 5)—*joyful, glad, happy, excited, sad, angry, upset, scared, afraid, surprised, amazed, and bored*. We derived this set of emotions by referring to Plutchik’s wheel of emotions [98] and based on previous research on an LLM-driven chatbot for children [105]. A child psychotherapist reviewed the list, excluding emotions that children with autism may rarely understand. For the *core* category, a fixed set of four cards (*Yes, No, I don’t know, and How about you, mom/dad?*) was consistently used.

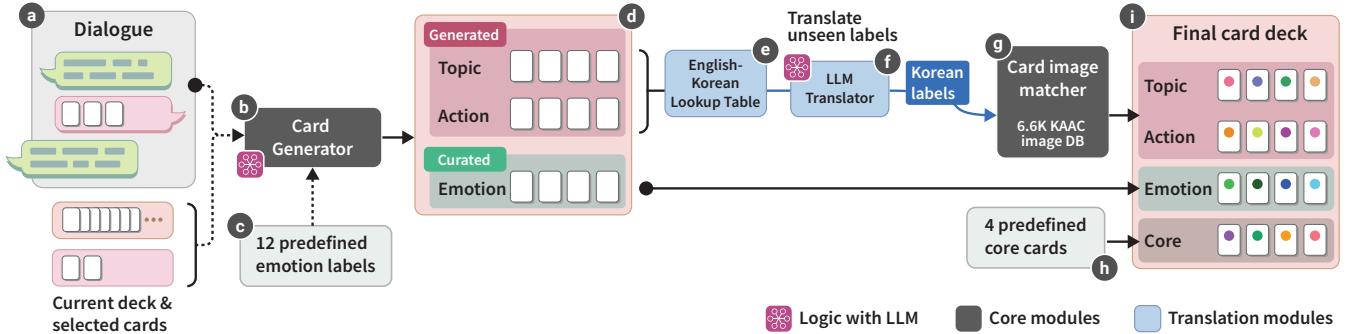
The generated topic and action cards (A in Figure 5) go through a translation process combining a cached lookup table (E in Figure 5) and an LLM translator (F in Figure 5). The lookup table, indexed by pairs of categories and English labels, contains 305 translation references based on cases collected from multiple rounds of internal testing. The LLM translator translates only labels not found in the lookup table, but it also retrieves the five most similar references from the table for each label to use in few-shot prompting.

The translated Korean card labels are then matched with appropriate symbol images by **card image matcher** (G in Figure 5). We used 6,658 AAC symbol and label pairs in the KAAC Symbols Search<sup>3</sup> database [94]. The card image matcher performs a similarity search with the card labels across the captions describing the symbol illustrations, generated by GPT-4 [92] and Gemini [39] in advance, to find the best match. For all cards, if the user has registered their own card image for the same label, the system prioritizes the custom images.

#### 4.4 Implementation

We implemented the core system of AACESTALK in Python using a FastAPI [42] server that serves REST APIs. The generative pipelines incorporate OpenAI [93]’s ChatCompletion APIs to run the underlying LLM inferences. We used gpt-4-0613 model for generative tasks (e.g., B, C, and E in Figure 4 and B in Figure 5) as the model showed promising performance in complex instruction follow-ups and language generation tasks in previous research (e.g., [65, 105, 106]). To minimize peaking latency in the

<sup>3</sup><http://symbol.ksaac.or.kr/>



**Figure 5: Generative pipeline for curating card decks for children. The pipeline analyzes the current dialogue and card information ① and generates a deck of cards in four categories ② along with symbol illustration retrieved from the KAAC database ③.**

user interface caused by the English-to-Korean translation overhead, we used faster gpt-3.5-turbo and gpt-4o models for translation tasks (e.g., ④ in Figure 4 and ⑥ in Figure 5). The interaction and conversation logs were stored in the SQLite database.

The client tablet app was implemented in TypeScript [82] on React Native [81] as a cross-platform running on Android and iPad. The client communicates with the server via REST API. On parent turns, the utterance is audio-recorded and sent to the server. The recording is then transcribed using CLOVA Speech Recognition API<sup>4</sup>, which is widely applied to Korean automatic speech recognition tools. On child turns, we also used CLOVA Voice API<sup>5</sup> to generate voice-over audios for card labels.

## 5 Deployment Study

We conducted a two-week field deployment study with 11 dyads of MVA children and their parents. We aimed to examine how MVA children and parents interact with AACeSSTALK to engage in reciprocal conversations and how the use of AACeSSTALK influences the everyday conversation and interaction dynamics of these dyads. The study protocol was approved by the Institutional Review Board.

### 5.1 Participants

We recruited MVA child-parent dyads by ensuring that both the child and the family met the following specific criteria: For the child, (1) a diagnosis of Autism Spectrum Disorder classified as Level 2 autism per CDC guidelines, (2) an ability to understand vocabulary to some extent but with challenges in verbal expression, (3) no difficulties with hand coordination, ensuring they could interact with a touchscreen tablet without assistance. We did not impose an age restriction on the children in the study, as the cognitive and communicative abilities of autistic children are not strictly dependent on age [90]. For the family: (1) one parent who can consistently use the AACeSSTALK to communicate with the child over the two-week period, and (2) a stable home Wi-Fi connection. The flyers were distributed to potential parent participants who met our criteria through a local child development center in South

Korea, where one of the authors is affiliated, along with snowball sampling. A total of 25 dyads expressed interest in participation.

We involved two additional screening steps to ensure the system would not cause discomfort or difficulties to the children. First, we asked parents to provide a written description of their child's verbal and cognitive characteristics, as well as their usual interaction patterns with the parent, before the study. An autism expert then assessed whether the system would be suitable for each dyad and whether there were any potential negative outcomes associated with its use. Second, we provided parents with a demo video explaining how to use AACeSSTALK and asked for their feedback on whether it could be used with their child. We specifically requested that parents focus on whether their child could understand and engage with the system's flow rather than on their ability to use it fluently in conversation. After this process, three parents decided not to participate in the study.

Finally, a total of 11 parent-child dyads (P1–11, C1–11; a parent and a child with the same number denote the same dyad) gave their informed written consent and participated in the study, with no dropouts. While we designed the recruiting and screening questionnaires to target potential parent participants according to IRB guidelines, these questionnaires also asked parents to confirm their children's willingness to participate. Table 1 summarizes the demographics of the participants, including the child's verbal and cognitive characteristics as reported by the parents. The MVA child participants aged from 5 to 15 ( $avg. = 8.8, SD = 3.63$ ). Among the 11 children, ten were boys and two were girls. This gender distribution aligns with previous studies, which report a male-to-female ratio of 4–7.38:1 [11, 129]. Three children primarily used echolalia, and the remaining eight were reported to verbalize 1–3 words mainly for requests, with little to no spontaneous speech in daily communication with their parents. The average age of parent participants was 42 years (ranged 43–51,  $SD = 5.58$ ); 10 self-identified as the primary caregiving mother, and 1 as the secondary caregiving father. All parents were aware of AAC, with 3 dyads reporting its frequent use, 1 dyad reporting occasional use, and 7 dyads reporting no prior experience with AAC. Additionally, all dyads with previous AAC experience had used low-tech AAC, such as physical cards made by parents, rather than high-tech AAC on tablets or digital tools.

<sup>4</sup><https://api.ncloud-docs.com/docs/en/ai-naer-clovaspeechrecognition>

<sup>5</sup><https://api.ncloud-docs.com/docs/en/ai-naer-clovavoice>

For compensation, we rewarded participants up to 200,000 KRW (approx. 150 USD) per their participation. We gave 20,000 KRW (approx. 15 USD) for attending the introductory session, 160,000 KRW (approx. 120 USD) for completing the deployment period, and an additional 20,000 KRW for a debriefing interview. To meet the minimum requirement for completing the deployment period, participants were advised to use the AACeSSTALK for at least nine out of the 14 days. This allowed participants to miss up to four days,

providing some room for dyads to take time in getting used to the system. Additionally, we did not make it a mandatory condition to meet a certain number of conversations to encourage and observe naturally occurring conversations.

**Table 1: Demographics of our study participants. It includes the age and parental role of the parent participants, as well as the age and gender of the MVA children. Additionally, it features a parent-reported description of the children's speech and cognition status, their use of AAC, the presence of siblings, and personal interests.**

Parents			MVA Children					AAC use	Siblings	Interests
Alias	Age	Type	Alias	Age	Gender	Description of speech/cognition				
P1	35	Mother (primary)	C1	6	Boy	• Produces speech with 1-2 words for requests. • Understands familiar expressions but struggles with verbal responses.		-	-	Clay, Train, Animals, Whale, Shark, KATURI (animation), Baby Shark (animation)
P2	38	Mother (primary)	C2	6	Boy	• Produces echolalia with around 10 words. • Uses PECS cards to request. • Understands basic instructions (e.g., sit, stand, no).	Very freq.	Non-autistic twin brother		Train, Vehicles, Numbers, Alphabet, Colors, English
P3	47	Mother (primary)	C3	8	Boy	• Produces speech with simple 3-word phrases for requests. • Verbalizes interest-related words. • Pronunciation is unclear due to articulation issues. • Communicates through writing.	Very freq.	-		Elevator, Automatic restroom door, Water slide
P4	43	Mother (primary)	C4	5	Boy	• Produces speech using nouns. • Verbalizes favorite characters. • Understands simple instructions.	-	Two non-autistic brothers and one autistic twin brother		Firefighter, Pororo (animation), Dinosaur
P5	51	Father (secondary)	C5	13	Girl	• Produces speech in sentences for requests about areas of interest. • Can read and write.	Very freq.	-		Catch! Teenieping (animation), Coloring, Ramen, Pizza
P6	47	Mother (primary)	C6	15	Boy	• Produces speech with 2-3 word sentences for requests. • Expressive language is limited compared to receptive language. • Pronunciation is unclear. • Understands symbolic images and written language well.	Very freq.	Non-autistic sister		Soccer, Running, Magformers (toy), Puzzle, iPad, Songs, Todo Hanguk (education material)
P7	42	Mother (primary)	C7	6	Boy	• Produces speech with 2-word phrases to convey requests. • Understands symbolic images well.	Sometimes	-		Bus, Bread Barber Shop (animation), Duda & Dada (animation), Swimming
P8	42	Mother (primary)	C8	10	Boy	• Produces speech with 2-word phrases to convey requests. • Pronunciation is unclear. • Understands and learns symbolic images well.	Very freq.	Two non-autistic brothers		Car, Train, Spaceship
P9	37	Mother (primary)	C9	8	Girl	• Frequent echolalia and non-meaningful vocalizations. • Understands parents' speech to some extent. • Recently shows signs of reading words without images.	-	-		Pororo (animation), Puzzle, Scribbling
P10	47	Mother (primary)	C10	14	Boy	• Produces speech with 2-word phrases for requests.	Sometimes	-		YouTube, Toy cars
P11	34	Mother (primary)	C11	6	Boy	• Produces echolalia, but no spontaneous speech. • Pronunciation is unclear. • Expresses requests through pointing. • Understands parents' instructions to some extent.	-	-		Pinkfong (animation), MyChew (candy), Bread



**Figure 6: Parents and MVA child participants are engaging in conversation using the AACeSS TALK during the introductory session.**

## 5.2 Study Instrument

We deployed a Samsung Galaxy Tab S9 tablet and a hardware button from Taotao Technology at each dyad's home. The tablet has an 11-inch AMOLED display with a  $1600 \times 2560$  resolution (274 PPI). The button is round and has a diameter of 90mm with a height of 40mm. It is connectable to the tablet using a USB cable. To minimize the time for the initial setup, we configured the tablet and installed the AACeSS TALK app in advance.

## 5.3 Procedure

Our two-week deployment study consisted of four phases: (1) pre-study preparation, (2) an introductory session, (3) the deployment, and (4) debriefing interviews.

**Pre-study Preparation.** We first sent parents a video outlining our study goal, the overall procedure of the study, and the usage flow of AACeSS TALK. Then, through a remote survey link, we asked parents to share their child's interests to be included in the system's Interests section. We also requested photos of people, places, and objects familiar to the child to be used as custom AAC symbols.

**Introductory Session.** A few days after the remote survey, one researcher visited participants' homes to connect the tablet device to the home Wi-Fi and set up the device (see Figure 6). To ensure participants fully understood how to use the system, the parent and MVA child participated in a pilot session, freely engaging in conversation using AACeSS TALK. During this session, the researcher ensured parent participants that AACeSS TALK is not a teaching aid but a communication aid, emphasizing not to pressure the child to use precise words, complete sentences, or to force the child to use it by physically placing the child's hand to make AAC card selection. We also obtained parents' informed consent for speech recording and transcription, with transcriptions accessed by researchers only to verify recording accuracy. The introductory session lasted about 30 minutes.

**Deployment.** From the day of the introductory session, participants began using AACeSS TALK for the two-week period. We designed the deployment environment to establish a conversational routine at home, making it a natural and accessible part of daily life. Therefore, we informed participants that they could use AACeSS TALK at any time of the day and have multiple conversations in a single day.

They were also free to choose conversation topics and were not required to use each topic equally. Importantly, to prevent parents from becoming overly dominant when initiating conversations, we instructed them to have conversations only when both were prepared and comfortable. During conversations using AACeSS TALK, recognizing that AAC can facilitate a gradual transition from touch-based communication to verbal expression [102], we encouraged parents not to prevent their child's spontaneous speech or echolalia but to address it naturally, as they would in their usual interactions. We collected all data related to participants' interactions with AACeSS TALK, including parents' voice input and the LLMs' output for parental guides and AAC cards.

Each morning, we sent a text reminder to remind them of their participation. If AACeSS TALK was used in the day, we sent the conversation logs in the evenings in plain text and asked parents to review the interactions through a survey. The survey included 5-point Likert scale questions on overall satisfaction with the conversation, the smoothness of back-and-forth exchanges, and the child's level of engagement, as well as open-ended questions for parents' self-reflection.

To see if AACeSS TALK may play a role in parents' sense of efficacy in parenting and their perceived burden in communicating with their child, we asked participants to complete an online survey three times: the day before the experiment, after Week 1, and after the deployment. The survey utilized the Parenting Sense of Competence Scale (PSOC) [50] and the Family Empowerment Scale (FES) [109], each consisting of eight items on a 5-point Likert scale.

**Debriefing.** The day after the 2-week deployment period, we visited each household to conduct a debriefing session that included completing surveys and a semi-structured interview with parent participants. The survey consisted of a total of 8 items on a 7-point Likert scale, including five items based on the Technology Acceptance Model (TAM) [123] and three items assessing the appropriateness of the AI outcomes (AAC words, symbols, and parental guidance). To gather the voices of MVA children regarding their experience with AACeSS TALK, we provided a simplified version of the TAM survey on a 3-point scale (Yes, Maybe, and No) [69]. However, since we did not receive valid responses from all children participants, we do not include these results in the analysis.

Following this, parents participated in an hour-long interview with one researcher. The interview questions covered topics including the overall usability of AACcessTALK and its impact on conversation patterns, the influence of the system's parental guidance and AAC recommendations, challenges encountered while using the system, and any changes in attitudes or perceptions of both parents and children in conversations. All interviews were audio-recorded and anonymized for analysis.

## 5.4 Data Analysis

Before analysis, we pre-processed the parent messages transcribed by the system by correcting typos and removing erroneous texts. We referred to the audio recordings of the parent turns to confirm the transcript. We conducted a descriptive statistical analysis from the collected dialogue dataset to investigate the usage patterns of participants with AACcessTALK. This includes the total number of conversation sessions and exchanges—defined as turn-taking counts of parent and child at a time—per session, the duration of each turn for parents and children, and the distribution of topics discussed. Following this, we assessed the types and frequencies of parental guides and feedback recommended by the system. To measure the adoption rate of these guides by the parents, one researcher confirmed whether each parent's utterance during their turn reflected the system's guides or example phrases. Another researcher reviewed these analyses for consistency, and discrepancies were discussed and resolved collaboratively. Additionally, we analyzed the usage patterns of AI-recommended vocabulary cards by the child participants, examining the frequency of selection by categories and the number of unique vocabularies recommended to each child. We also conducted an overlap coefficient analysis on the top 20 vocabulary words recommended to each child to examine the degree of personalization in the recommendations.

To assess the shift in the quality of conversations over time, we employed a mixed-effect model [97] using the `lmer` package [12] in R to analyze three key indicators from daily surveys: overall satisfaction, the smoothness of back-and-forth exchanges, and the child's level of engagement. Additionally, we examined changes in parental self-efficacy using the Friedman test on survey data collected at pre-deployment, one-week, and post-deployment.

We further analyzed debriefing interviews and parents' reflections on conversations recorded in daily surveys using open coding and Thematic Analysis [22]. All qualitative data were digitized using ATLAS.ti [8], and the first author generated initial code themes. Another researcher then read the classified initial themes and quotes and responded with feedback. Based on this, the entire research team discussed any disagreements and iteratively revised the themes. Additionally, we applied open coding to dialogue of parent-child conversations to identify recurring patterns and interactions. These themes were used to support the analysis of the debriefing interviews. Through our comprehensive qualitative analysis, we found the impacts of AACcessTALK on MVA child-parent conversation patterns and changes in parents' perceptions of conversation with their MVA children.

## 6 Findings

We present our findings on: (1) the overall use of AACcessTALK; (2) conversational experiences with AACcessTALK; and (3) changes in parents' perceptions of conversations with their MVA children over AACcessTALK use.

### 6.1 Overall System Usage

Over the two-week period, participants actively used AACcessTALK for daily conversations. Five dyads out of 11 used the system every single day, and no dyad skipped more than three consecutive days. According to the 7-point scale TAM survey that measured acceptance of AACcessTALK, parent participants gave positive evaluations, with scores of 5.64 ( $SD = 1.57$ ) for ease of use, 5.91 ( $SD = 1.38$ ) for enjoyment of use, and 5.73 ( $SD = 1.42$ ) for the system's usefulness in facilitating conversations (see Figure 7a, 1–3). Notably, parent participants rated the system favorably on whether the system vitalized their conversations and whether they are willing to continue using it, both giving a score of 6.09 ( $SD = 1.30$  and  $SD = 1.45$ , respectively; see Figure 7a, 4 and 5). In this section, we describe how participants interacted with the AACcessTALK based on system usage logs.

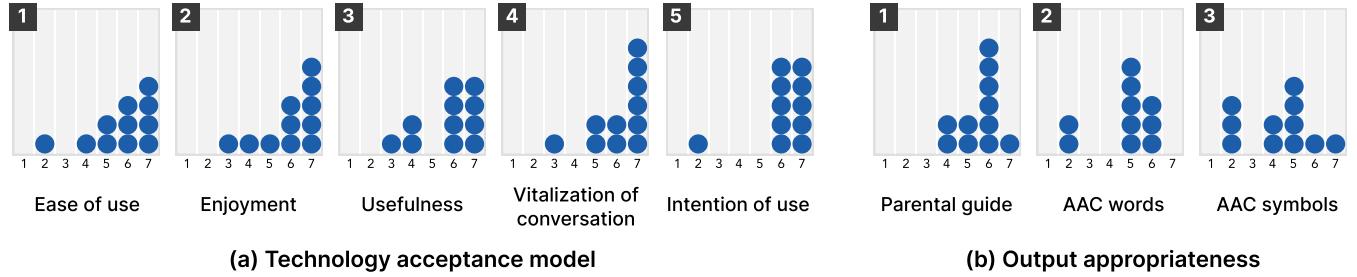
**6.1.1 Dialogue.** Figure 8 shows participants' daily engagement with the AACcessTALK over the two-week period. The colored squares represent the conversation sessions attempted by each dyad, and the color of the square indicates the topic of the conversation. Participants engaged in a total of 232 conversation sessions, with an average of 21.09 sessions per participant ( $min = 13$  [D1 and D9],  $max = 41$  [D6]). On average, participants engaged in 1.55 conversations per day ( $SD = 0.70$ ), with a maximum of 6 sessions in a single day [D6]. The conversation topics were fairly evenly distributed, with 63 sessions focused on "Plan", 99 on "Recall", and 70 on "Interest". The average duration of each session was 248 seconds (around 4 minutes) ( $SD = 91.87$  seconds). Participants averaged 2.66 exchanges per session, with notable variance across dyads ( $SD = 1.16$ ,  $min = 1.27$  [D8],  $max = 4.21$  [D6]). The highest number of exchanges in a single session was 8.5, recorded by D6. Given the few conversational exchanges participants had before the deployment, it appears that AACcessTALK positively influenced both the duration of conversation and the number of exchanges.

During the deployment period, parent participants took a total of 690 turns with speech and child participants took 608 turns using AAC cards. The average duration of a parent's turn was 31 seconds ( $SD = 14.68$ ), whereas the child's turn averaged 63 seconds ( $SD = 32.89$ ), indicating children spent more than twice as much time per turn as their parents. The average syllable count for parents' turns was 67.46 ( $SD = 49.25$ ). The analysis of children's AAC-based communication will be discussed in Section 6.1.3.

**6.1.2 Parental Guides.** Parent participants received a total of 1,979 speech guides over two weeks ( $M = 179.82$ ,  $SD = 130.02$  per participant). Table 2 summarizes the guide types with example snippets and the acceptance ratio. On average, parents adopted 78% of the LLM generated parental guides during their turns ( $SD = 14$ ;  $min = 47\%$  [P1],  $max = 95\%$  [P7]). "Ask for elaboration" was the most commonly provided guide type (835 out of 1,979; 42%), followed by "Show encouragement" (236 out of 1,979; 12%) and "Suggest choices"

**Table 2: Guide types and descriptions for parental guidance, including examples of recommended guides and sample phrases from the deployment period, along with the total number of recommendations and the parents' acceptance rate.**

Guide type	Definition	Example	Total	Accepted
Ask for Elaboration	Ask about "what" to specify the event.	P6: The Olympics have a lot of sports. Right now, archery is on TV. Let's watch the archery first, then we can check out table tennis later. Sound good? Can you cheer for Korea? <b>C6:</b> Archery Cheer up	835 (11Ps)	310 (37.1%)
Show Encouragement	Encourage the child's actions or emotions.	<b>Ask your child what Olympic sport they like to watch.</b> "What sport do you like watching in the Olympics?"  P9: [child], at kindergarten, you made amazing things. Do you want to make more? <b>C9:</b> Go Eat Go Draw	236 (11Ps)	59 (25.0%)
Suggest Choices	Provide choices for children to select their answers.	<b>Show excitement about what the child plans to create.</b> "I can't wait to see what you're gonna make!"  P2: [child], wanna see ABCD? <b>C2:</b> Alphabet	214 (11Ps)	57 (26.6%)
Encourage Self-Disclosure	Ask about the child's feelings and emotions.	<b>P11:</b> Now that you brushed your teeth and took a bath, should we go to bed? <b>C11:</b> How about you, Mom? How about you, Mom?  <b>Ask the child how they feel after the bath.</b> "How do you feel after the bath, [child]?"	194 (11Ps)	74 (38.1%)
Ask for Intentions	Check the intention behind the child's response and ask back.	<b>P11:</b> Today, you're gonna meet your teacher with me, and then go study, okay? <b>C11:</b> Mom No  <b>Check if the child doesn't feel like studying today.</b> "Don't feel like studying today?"	124 (11Ps)	29 (23.4%)
Extend Topic	Induce an expansion or change of the conversation topic.	P3: [child], why did you think of Dubai? Was it because it was your first time seeing it? <b>C3:</b> Travel Song Airplane  <b>Talk with the child about other places childs might want to travel to.</b> "Is there anywhere else you'd like to go? Maybe Paris or London?"	110 (11Ps)	11 (10%)
Open Up	Share the parent's emotions and thoughts in simple language.	P3: How does the automatic bathroom door sound? <b>C3:</b> Sensor  <b>Talk about your experience with automatic bathroom doors.</b> "I get surprised by the automatic bathroom doors too!"	90 (11Ps)	19 (21.1%)
Show Empathy	Empathize with the child's feelings.	P5: [child], where did you go with mom after lunchtime? Went to the hospital, right? <b>C5:</b> Hospital Doctor Nurse Scary Bed Afraid  <b>Let the child know it's okay to be scared of the hospital.</b> "The hospital can be scary, right? You were so brave."	90 (10Ps)	16 (17.8%)
Pique Interest	To stimulate the child's interest, present information that contradicts what is known.	P4: Wanna talk about Pororo? <b>C4:</b> Pororo Play Poby Crong Pororo Yes  <b>Tell the child that Poby is taller than Pororo and ask if they noticed.</b> "Did you see that Poby is taller than Pororo?"	48 (9Ps)	9 (18.8%)
Provide Clues	Give clues that can be answered based on previously known information.	P7: Wanna talk about buses? <b>C7:</b> Bus Ticket Tayo Bus Stop Open No Yes  <b>Mention the last time you took the bus together.</b> "Remember when we took the bus to the park last week?"	29 (7Ps)	11 (37.9%)
Suggest Coping Strategies	Suggest coping strategies for specific situations to the child.	P10: [child], are you gonna watch the iPad tonight for study? <b>C10:</b> Study Read Sad  <b>Suggest strategies to make studying more enjoyable.</b> "How about we read a book together instead?"	9 (5Ps)	4 (44.4%)
Wrap Up	Inquire about the desire to end the conversation.		0	0



**Figure 7: Distribution of parent participants' post-study ratings for the technology acceptance model (a) and output appropriateness surveys (b). Each circle represents the rating score of an individual parent participant. For all scales, the higher number indicates a more positive rating.**

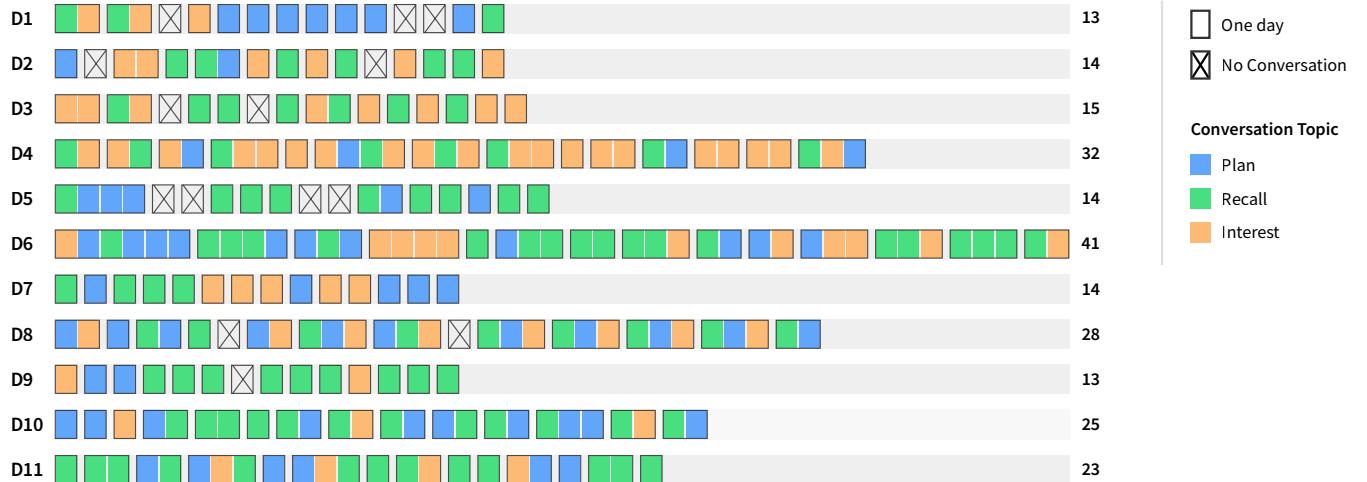
(214 out of 1,979; 11%). During the deployment, the “Wrap up” guide did not appear, potentially because that guide type was triggered only after three or more exchanges were made, but only 74 out of 232 conversations met this criterion. In debriefing, parent participants also mentioned that they often concluded the conversation upon the child’s behavioral signals.

As for the dialogue inspection feedback, parent participants received a total of 92 feedback alerts ( $M = 8.36$ ,  $SD = 8.62$  per participant;  $min = 0$  [P2],  $max = 16$  [P6]). Table 3 summarized the feedback types, example snippets, and the number of occurrences. The feedback was most frequently related to complex language (47%), followed by blame (30%) and correction (29%). Additionally, parent participants rated the guides and examples as useful for conversations, with an average score of 5.55 ( $SD = 0.93$ ) on a 7-point scale survey (see Figure 7b-1).

**6.1.3 Children’s Use of Cards.** Child participants selected a total of 2,244 vocabulary cards recommended by AACeSSTALK to engage in conversations. On average, they picked 9.74 cards per session,

with significant individual differences ( $SD = 4.73$ ,  $min = 2.21$ ,  $max = 17.23$ ). Children used Topic cards for more than half of their conversations (51.92%). The remaining categories—Emotion (18.63%), Core (14.80%), and Action (14.66%)—were fairly evenly distributed, though usage patterns varied significantly between participants, as shown in Table 4. Among the Core words, **Yes** and **No** accounted for about half (55.42%) of the usage, followed by **I don’t know** (25%) and **How about you, Mom/Dad?** (19.58%).

Excluding the Emotion and Core categories with fixed word pools, the AACeSSTALK recommended a total of 4,324 unique vocabulary cards to the children, with 2,673 unique Topic cards and 1,700 unique Action cards. On average, each conversation session featured 11.9 unique Topic cards ( $SD = 2.22$ ) and 7.7 unique Action cards ( $SD = 1.31$ ), exposing children to an average of 19.3 unique cards ( $SD = 3.13$ ) per session. The results of the overlap coefficient analysis of the top 20 cards recommended to each child revealed an average overlap of 33% on the first turn. This indicates that while the recommendations started relatively generally, they still showed



**Figure 8: Overview of participant engagement with AACeSSTALK.** The colored squares represent daily conversation sessions attempted by each dyad. Days with conversations are enclosed in squares with black borders, while days without conversations are marked with an ‘X’ inside the bordered squares. The color of each square indicates the topic of the conversation. On the right side of the chart, the total number of conversation sessions for each dyad is numerically displayed.

**Table 3: Feedback types and descriptions for parental guidance, including examples from the deployment period and the total number of feedback provided.**

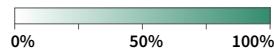
Feedback type	Description	Example	Total
<b>Complex</b>	When a parent's dialogue contains more than one goal or intent.	<b>P9:</b> It's Saturday! We're going to draw, visit the zoo, and have ice cream. Do you know what we should talk about today? Should we start with the zoo?  <b>Feedback</b> <i>Focus on one topic at a time and guide the child clearly so they can easily understand and respond.</i>	62
<b>Blaming</b>	When the parent criticizes or negatively evaluates the child's response, like reprimanding or scolding.	<b>P6:</b> Hmm, no... take a closer look. This isn't light blue. Look carefully and answer.  <b>Feedback</b> <i>Create an environment where the child feels understood and supported.</i>	39
<b>Overcorrection</b>	When the parent is compulsively correcting the child's response or pointing out that the child is wrong.	<b>P5:</b> Let's do that again. We had chicken for dinner. Next time, pick chicken.  <b>Feedback</b> <i>It seems like you're trying to correct the child's response. Please support the child in expressing themselves in their own way.</i>	29

a significant degree of personalization, likely influenced by parents' initial input. As the turns progressed, the overlap decreased to 25% on the second turn, 14% on the third turn, and 10% on the fourth turn. This declining trend suggests that the system could tailor its recommendations as the conversation unfolded, resulting in more contextualized selections and less overlap among participants.

Nevertheless, parent participants rated the appropriateness of the recommended words at an average of 4.73 ( $SD = 1.42$ ; see Figure 7b-**2**) and the appropriateness of the symbols at an average of 4.27 ( $SD = 1.68$ ; see Figure 7b-**3**), which are relatively lower scores compared to the overall satisfaction with the system. In the debriefing interviews, parents attributed these lower ratings to inaccuracies in speech recognition, which led to incorrect word recommendations, and suggestions that didn't align with the Korean cultural context. They also highlighted the need for more individualized AAC recommendations that reflect the child's cognitive and developmental levels, as well as their daily events.

**Table 4: The number of vocabulary cards used by each MVA child participant for each word category. The intensity of the cell color indicates the ratio of each word category used by the participants.**

Categories	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	Total
<b>Topic</b>	45	21	42	165	128	280	63	252	33	76	40	1,165
<b>Action</b>	9	0	11	21	40	25	30	22	52	85	34	329
<b>Emotion</b>	5	2	17	39	39	50	44	48	131	25	18	418
<b>Core</b>	13	8	4	61	1	29	35	41	8	7	125	332
<b>Total</b>	72	31	74	286	228	384	172	363	224	193	217	2,244

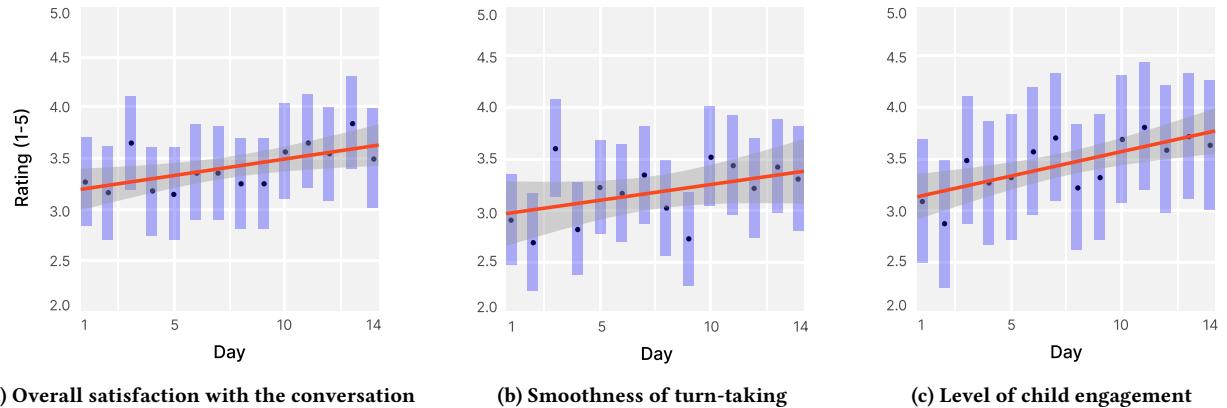


## 6.2 Conversational Experiences with AACESSTALK

The daily conversation survey results from parent participants showed that the MVA child-parent conversation improved not only in frequency but also in the quality of their interactions. Over the two-week period, overall satisfaction with conversations ( $p = 0.006^{**}$ ), the smoothness of turn-taking ( $p = 0.028^*$ ), and especially the level of child's engagement ( $p < 0.0001^{***}$ ) all showed statistically significant increases (see Figure 9). Based on the conversation logs and interview analysis, we illustrate how AACESSTALK facilitated parent-child conversations.

**6.2.1 Enriched Conversational Patterns.** AACESSTALK's guides provided parents with ideas for responding in varied ways, even in repetitive situations. All parent participants mentioned that their previous daily conversations with their child had become routine and fixed. P5 described, "My child's routine is pretty much the same every day, so I always end up asking, 'What did you do at school today?' or 'What did you eat for lunch?' And my child always answers, 'It was fun' or 'Pasta.' But sometimes that meal wasn't even served. They're just saying what they've memorized." The parental guides led parents to move beyond the habitual "what" questions, encouraging them to explore the various response strategies. In doing so, parents gradually developed a way to communicate for their children to easily understand and enjoy engaging with. P8 remarked, "I'd read about praising and empathizing in books, but this was my first time trying it. I thought the conversation would just end if I said something like that. But when I said, 'Wow, that's awesome,' my child's face lit up, and they got more engaged. So I kept reacting, the conversation kept going, and it felt like we were really talking."

The increased self-expression of the child through AI-driven AAC was another factor that made the conversations more vibrant. Unlike previous AAC experiences with the limited words provided by parents, AACESSTALK continuously introduced new words to the children. While children didn't understand every word, they often used words in context that their parents had assumed they wouldn't know. This naturally led to a wider variety of conversation topics



**Figure 9: Daily trends in the estimated marginal means of parent's self-evaluations of (a) overall satisfaction, (b) the smoothness of turn-taking, and (c) the level of child engagement over a 14-day period, after controlling the random effect of individuals using mixed-effect models. The blue bars indicate the 95% confidence interval.**

and more dynamic responses from parents. P6 mentioned, “*I kept saying, ‘You know that word?’ When he went on a field trip, he saw a drone and pressed [scared]. I didn’t think he knew the word ‘scared.’ But then, remembering that my child is usually afraid of heights, they pressed the [scared] button with an uncomfortable expression. He knew what it meant! When I realized he knew more than I thought, I suddenly had so much more to talk about.*” (see Dialogue 1) Several parents (P3, P4, P6, P9, and P10) even reported that by the later stages of using AACeSSTALK, their children began repeating the AI-generated voice after selecting a card, significantly increasing their imitative speech.

[...]

**P6** The drone flew up into the sky. How did you feel while flying it?

**C6** Balloon Sky Button Sky Scared

**P6** Scared? Were you scared flying the drone, [child]?

**Dialogue 1.** Dialogue snippet from P6 and C6.

**6.2.2 Serendipitous Parent-child Interaction.** Some parents (P1, P2, P7, P8, and P11) occasionally questioned if their children’s expression through AACeSSTALK included communicative intention. They mentioned that the child seems to treat the system as an engaging activity or game, with words and symbols continually appearing, and chooses AAC cards to listen to and mimic the sounds. Early on, parents perceived their children were not fully engaging in conversation. However, they began to see the AACeSSTALK sessions as opportunities to initiate interaction. For example, some parents searched for and explained the words their child selected (P3, P4, and P9) or incorporated the device into playtime, like discussing fruits with AACeSSTALK while playing with fruit-shaped clay (P1; see Dialogue 2).

Moreover, the unexpected AAC use by children provided parents with a sense of enjoyment in their conversation. During our introductory session, every parent mentioned that their child

[child], let’s play with the fruits today. What’s the red fruit? And **P1** the yellow fruit like lemons, mangoes, and pears. Yellow corn, purple grapes, purple sweet potato, purple eggplant, and purple onion.

**C1** Fruit Grapes Red fruit Fruit game Purple fruit  
Orange fruit Broccoli Yellow fruit Purple fruit

**P1** It’s so juicy! [child], let’s sort them by color.

**C1** Yes

Wow, you sorted the fruits and veggies so well. Look at that! These **P1** are the fruit friends, and those are the veggie friends. Is this a fruit or a veggie? Cabbage? Is cabbage a veggie? [child], which fruit do you like the most?

**C1** Fruit Fruit shop Fruit friends

**Dialogue 2.** Dialogue snippet from P1 and C1.

likely would not use the **How about you, Mom/Dad?** card, as they had never asked such a question before. However, all children except C5 used this card in their conversations, a total of 65 times ( $M = 5.9, SD = 9.67$ ). Although parents were uncertain about children’s intent in using the card, they were all pleasantly surprised by the experience of being asked a question by their child and happily shared their own feelings and thoughts (see Dialogue 3): “*Usually, I’m the one asking all the questions, and it gets pretty lonely. But when [child] used the **How about you, Mom?** card, it was so sweet and touching. It really felt like [child] cared. I got all excited and, for the first time, shared my own story with my child. It felt like we were in conversation ‘together,’ like we were connected.* [P11]”

**6.2.3 Reflection in Conversation.** Parent participants valued the AI-generated feedback on their speech as it allowed them to reflect on their conversational patterns and consciously adjust them in the next turn. Most parent participants (all except P5) did not have experience receiving feedback on their dialogue with their child from experts or others. P4 remarked, “*Speech therapists usually talk a lot about the child but not so much about ME. Most of the*

P11	[child], you just take a bath with mommy. How do you feel?
C11	How about you, mom? How about you, mom?
P11	How about me? I feel so happy because I took a bath with you.
C11	Feelings No
	You're doing great. You're even talking with mommy, [child].
P11	Mommy is so happy to take a bath with you like this. Give me a kiss. Love you so much.
C11	How about you, mom? Happy How about you, mom?
	Happy

**Dialogue 3.** Dialogue snippet from P11 and C11.

*parents are already doing their best, so criticizing them might just overwhelm them. It can feel like a stab to the heart and could even lead to emotional issues.* Parents also appreciated that the feedback was provided by AI rather than a person, as it enabled them to digest feedback with less emotional burden and make their own decision on whether to accept it.

Some parents (P4, P6, and P10) even reflected on their speech patterns through the AAC cards that the AI recommended to their child: “*After a few days, I realized that to make [child] express himself better, I need to ask specific questions. If I ask something broad like, ‘What do you remember most about today?’ his cards show sorts of unrelated stuff. Seeing the cards, I realized my questions made it tough for him to think of responses. So I made it more specific, like, ‘What did you play with at the pool?’*” The AI’s recommendation of AAC cards mirrored the parents’ speech patterns and served as implicit feedback, leading parents to self-assess and adjust their speech.

**6.2.4 Shared Control Between Parent and MVA Child.** AACeSSTALK served as a channel for MVA children to take the lead and express their intentions within the conversation flow. Half of the children (C3, C4, C6, C8, C9, and C11) initiated communication by handing the tablet with their preferred conversation topic open to their parents. Some gently expressed their desire to end the conversation by finding and pressing the hidden “End Conversation” button (C4, C5, C10) or by closing the tablet case and saying “End” (C6). Notably, the visually distinct screens for the parent’s and child’s turns

make the children better understand the concept of turn-taking by showing them when to wait and when to express themselves.

We found that the parents also developed a better sense of turn-taking through AACeSSTALK. By observing their children carefully read and select AAC cards, parents could recognize that the child’s turn was not yet over. P3 noted, “*Normally, if my child didn’t answer right away, I’d just jump in with the answer. But using AACeSSTALK, I noticed [child] was actually thinking what to say. And when he didn’t pick cards right away, I went to press the button, but he stopped me. That’s when I realized, ‘Oh, he’s talking. I just need to wait.’ It made me see I need to respect my kid’s turn.*”

### 6.3 Parent Perceptions of Conversations with AACeSSTALK

Based on the analysis of parents’ debrief interviews, we observed that the consistent use of AACeSSTALK over two weeks positively influenced parents’ perceptions and attitudes toward conversations with their MVA children.

**6.3.1 It’s Okay to Have Imperfect Conversations.** The results of the parenting efficacy surveys conducted before the deployment, on day 7, and on day 14 showed a general trend of positive change (see Table 5). Notably, there was a statistically significant increase in parents’ confidence in supporting their child’s development ( $p = 0.026^*$ ) and a statistically significant decrease in feelings of frustration when the child did not follow their guidance as expected ( $p = 0.003^{**}$ ). While it is difficult to directly attribute these changes to the short two-week system usage, we also found evidence of shifts in parenting efficacy and parents’ perspectives on conversations through the debrief interviews.

Using AACeSSTALK, parents experienced a release from the pressure and burden they once had in conversations with their children. Most parents felt responsible for guiding their children to perfectly match subjects and predicates and use contextually appropriate language in conversations. Parents’ emphasis on refining their child’s expressions was noticeable in the early stages of using AACeSSTALK. P1 pointed out, “*The screen has topics, actions, and emotions on it. I felt like my child needed to pick them in order. So I guided his hand to press the cards, but he didn’t like it and stopped using it (AACeSSTALK). I backed off and let him press what he wanted. Then, [child] mostly*

**Table 5: Parental efficacy survey questions with average ratings from parents at Pre-study, After Week 1, and Post-study periods. Results of the Friedman test are reported as p-values. Q1-Q4 indicate that a higher number represents a positive rating, whereas for Q5-Q7, a lower number signifies a positive rating.**

# Questionnaire	Pre-study	After Week 1	Post-study	p-value	sig.
Q1 I feel confident in supporting my child’s growth and development.	3.09	3.9	4.00	<b>0.0259</b>	*
Q2 I can effectively resolve issues related to my child.	3.18	3.82	3.91	0.0545	-
Q3 I make efforts to learn new approaches to support my child’s growth and development.	4.45	4.55	4.73	0.1738	-
Q4 I understand my child’s challenges better than anyone else.	3.91	4.09	4.00	1.0000	-
Q5 I feel frustrated because my child does not follow my guidance and instruction.	4.27	3.36	2.82	<b>0.0027</b>	**
Q6 I worry that I might not be a good parent.	3.00	2.36	2.27	0.0545	-
Q7 Talking to my child makes me feel anxious and tense.	2.64	2.09	2.18	0.4578	-

*picked words from the topic section, but I could still understand what he meant. [...] If we both get it and have fun, that's the conversation. It's just important to keep going.*" Parents realized there is no right or wrong in conversation and tried to make it a natural, enjoyable part of daily routine.

**6.3.2 Moving Beyond Autism Labels.** As parents reviewed the daily conversation logs each evening, many of them reflected on the stereotypical thoughts they had previously held that conversations with autistic children need to be short and simple. P11 remarked, "*Funny how I realized the things I've been saying here [AACeSSTALK] are just like what I used to tell my child every day before the autism diagnosis. He was just a baby then, but I talked to him so much. But after the diagnosis, I stopped and only gave simple commands, thinking that conversations like this wouldn't be possible. But when we tried, it turned out we could do it. I was the one who was trapped in this mindset while my child was growing in their own way all along.*" Parents who also have non-autistic siblings (P4 and P6) or twins (P2 and P8) were surprised to notice that they had never spoken to their autistic child in the same way they did with their non-autistic children. This reflection led parents to resolve to provide their MVA children with a wider range of topics and stimuli, breaking from self-imposed limits on daily conversations.

## 7 Discussions

In this section, we reflect on how parents and MVA children adopted AACeSSTALK as a mediating tool for conversation through a collaborative meaning-making process. We also discuss how the system usage log can be utilized to better understand MVA children. We then propose broader design implications for supporting long-term interaction. We also share the challenges and strategies of running a deployment study with MVA children. Lastly, we discuss the study limitations that could impact the generalization of the findings.

### 7.1 Collaborative Meaning-making about Conversation Tool

AACeSSTALK provided a scaffolded conversation structure through visual and behavioral cues that helped both MVA children and their parents naturally develop key communication skills such as initiating conversations, expressing themselves, taking turns, waiting for others to speak, and signaling when they want to stop. MVA children, in particular, used various components of the system to actively express their communicative intent. For example, they would bring the tablet or choose a favorite topic to initiate conversation, use the **I don't know** card to indicate confusion, and press the "End Conversation" button to conclude the conversation. Beyond these explicit expressions of intent, parents also noticed implicit cues—such as the child carefully examining vocabulary cards or their facial expressions while selecting one—which encouraged them to respect the child's agency in the conversation.

More importantly, each dyad developed unique routines for using the system and assigned personalized meanings to its elements to express communicative intent. In the early stages of deployment, parental involvement played a significant role in initiating conversations using AACeSSTALK, as is common in parent-child studies [108]. However, the flexible conversation settings, locations,

and features of AACeSSTALK allowed each dyad to collaboratively shape the system's role over time and identify environments that matched their mutual conversational needs. For example, some used it for bedtime reflection, while one dyad incorporated it during playtime, and others used it to study new words that the child showed interest in. Also, some dyads employed the turn pass button for end their turn, while others had the child prevent the parent from pressing the button as a way to express refusal.

In the adoption of technology by autistic children, Spiel et al. pointed out that neurotypical adults often define the meaning and purpose of the technology in a one-sided manner, limiting children's ability to articulate their thoughts within narrow boundaries set by the adults [113]. They argue that autistic children should have agency in deciding which forms of interaction are meaningful to them [4]. Similarly, in our study, we observed some parents initially guiding the child's system use by directing their hands to select specific cards or pressing the turn-taking button on their behalf. While this parent-directed approach often led to the child refusing to engage, it prompted parents to reflect and begin respecting the child's intent. However, the risk of parents unconsciously imposing the use of the communication tool remains. Thus, we emphasize the need for a space where children can freely explore the tool and identify interactions that suit them in a self-directed manner, especially during the early stages of its introduction. In doing so, parents should not act as instructors but as equal communication partners, collaboratively defining which forms of use foster meaningful and mutually satisfying conversations.

### 7.2 Toward Better Understanding of MVA Children through Data

We found that AACeSSTALK allows parents to better understand their MVA children's language use characteristics and capabilities. By leveraging the generative power of an LLM, AACeSSTALK continuously provides children with diverse language input across various categories of topics, actions, and emotions. This stimulates children to use vocabulary they may know but have had little opportunity to express. Parents are often surprised by their child's unexpected language use like, "*Do you know this word (or emotion)?*" This, in turn, encourages parents to introduce richer topics and vocabulary, setting new goals for language development.

Parents often struggle with a lack of objective data to assess the communicative and language capacities of MVA children [85]. The assessment of these abilities varies greatly, depending on the perspectives and methods used by individual professionals [111]. Moreover, clinical feedback typically emphasizes a child's weaknesses, as the primary goal is to improve communication [21]. In this context, AACeSSTALK has helped parents gain a clearer understanding of the words and symbols their child comprehends and uses, as well as the types of words and combinations they are skilled at expressing through the card selection process. Our analysis of children's vocabulary card usage showed significant variation in the categories of words used for communication. While some children had over 50% of their expression on topic-related words, others used all four categories more evenly, and some expressed emotions in over 50% of their interactions.

Building on these findings, we envision that a future version of AACessTALK can empower parents to better understand MVA children through data. By providing parents with insight into the words their child is exposed to and patterns in their word usage, AACessTALK could offer a more objective view of the child's communicative abilities. This would allow parents to identify their child's strengths and characteristics, enabling them to set more informed interaction and educational goals in collaboration with experts. Furthermore, gaining deeper insight into the child's unique traits can increase the sense of parental efficacy by empowering parents to better support their child's growth and development.

However, as our findings revealed, not all words were fully comprehended or deliberately used by the MVA children. As a result, parents often inferred their child's communicative intent through their facial expressions or familiar interests. By reviewing conversation logs through the daily survey, parents reflected on their child's expressions within the broader context. They also evaluated the effectiveness of their own communication strategies and parenting approaches, identifying ways to better understand and support their child's expression. Building on this, we suggest introducing systemic nudges that encourage parents to reflect on both their children's word usage and their own communication styles, fostering more meaningful interactions.

### 7.3 Design Considerations for Long-term Interaction

Our findings showed that AACessTALK increased the frequency of conversations and turn-taking between parents and MVA children, enabling more meaningful interactions. Furthermore, by addressing the unique needs of both parties, the system reduced the parents' burden while encouraging children's self-expression, fostering mutual engagement. Notably, changes in daily conversation practice and parents' attitudes resulted in 10 out of 11 parents expressing their desire to continue using the system. However, our findings also revealed potential challenges that need to be addressed to support long-term conversations as MVA children grow.

First, the cognitive and language stages of MVA children, as well as their pace of development, vary significantly between individuals [90]. While we customize LLM prompts based on the characteristics of MVA children to set appropriate vocabulary levels, many parents articulate a need for more personalized vocabulary recommendations tailored to their child's language capabilities. A discrepancy between MVA children's developmental stage and the recommended vocabulary can reduce motivation and engagement, potentially hindering genuine self-expression. To address this, the system could continuously update the vocabulary recommendations by regularly assessing each child's communicative capabilities using clinical measures, such as "MacArthur-Bates Communicative Development Inventories [43]" or the "Expressive Vocabulary Test [131]." In addition to these clinical measures, the system could analyze previous conversation sessions to extract specific data, such as topics, content, and the frequency of specific words used, on communication characteristics of MVA children. This information could be stored in the LLM's long-term memory [9, 126] and used in future sessions to offer tailored recommendations to each child's language use. To implement such approaches while considering

user privacy issues, measures such as providing options for users to exclude sensitive topics or contexts from being recorded or analyzed can be included. Additionally, while our study involved transcription to allow researchers to verify recording accuracy afterward, future systems could adopt technologies such as speaker separation for more accurate real-time speech recognition [114], ensuring that no sensitive information is unnecessarily stored.

Secondly, previous research has highlighted that AAC systems designed for autistic users often rely on the communicative norms and practices of neurotypical frameworks [77, 122]. In our study, the LLM used to generate parental guidance and vocabulary cards primarily reflected neurotypical perspectives, which constitute the majority in our society [48]. This raises concerns that the LLM's recommendations may potentially enforce neurotypical standards and normative behaviors on MVA children, limiting their communicative agency [29]. Therefore, further studies are needed to consider the unique characteristics of neurodiverse populations throughout the entire LLM-mediated communication process. For example, this could involve fine-tuning or integrating recommendation logic trained on neurodiverse communication datasets. Additionally, the system could broaden communication modalities to include sensory, physical, and tangible elements, integrating more natural signals from MVA children into conversations.

### 7.4 Conducting a Deployment Study with MVA Children

Since our study involved MVA children—who are often unfamiliar with both technology and conversational interactions—we had to address several challenges in conducting a home-based deployment study with minimal researcher guidance. Here, we share the challenges we encountered and expert-guided strategies we implemented to address them.

First, during the recruitment phase, we found that many parents of MVA children viewed our AAC-integrated system as a language education tool, as suggested by our formative study. To align parents' expectations of AACessTALK with our goal of fostering natural conversations, we conducted two phone calls with applicants to clarify the study's purpose in detail and ensure their understanding and agreement.

Second, providing a detailed system walkthrough during the introductory session was impractical due to the involvement of MVA children in a home setting. To keep the session concise, we provided pre-recorded instructional videos to parents in advance. Additionally, we installed TeamViewer<sup>6</sup> remote control app on the tablets, enabling researchers to remotely troubleshoot technical issues during deployment (e.g., installing an updated version of the app with bug fixes).

Lastly, in our formative study, both parents and experts pointed out the lack of motivation among MVA children to engage with AACessTALK, which may create a burden for both parents and children as they attempt to use the system. To motivate children, we incorporated reward-based features that could incentivize autistic children to participate in conversations [104]. Specifically, dyads could earn stars based on the number of completed conversational

<sup>6</sup><https://www.teamviewer.com/en/>

turns (see Figure 3-⑨). During the introductory session, we instructed parents to implement their own motivational strategies upon the star system at their discretion, tailoring their approach to their child's individual characteristics.

By navigating these challenges, we contribute to a broader understanding of how technology can be effectively deployed to support communication in MVA children. We hope this study provides valuable guidance for researchers conducting deployment studies with similar populations.

## 7.5 Limitations and Future Work

In this section, we discuss the limitations of our study that could impact the generalization of the findings. First, we used an LLM trained on datasets dominated by Western languages and cultures to support parent-child conversations in a Korean context. Although the LLM-driven recommendations did not pose significant issues in exchanging intentions between parents and MVA children, some participants reported that the recommendations did not adequately reflect Korean cultural sensitivities (*c.f.*, [84]). Running a study with LLMs aligned with the primary language and cultural context (*e.g.*, using HyperCLOVA X [31] for Korean) may improve the quality of dialogue understanding and thus further impact the engagement.

Second, we sourced participants for our deployment study through a single expert. As an early step in designing an LLM-driven communication mediation tool for parents and MVA children, we selectively sampled dyads that could employ AACeSSTALK without discomfort or difficulties in a home setting. Although we sought diversity in parent roles, genders, and children's speech and cognitive statuses, our participants are not representative samples of these populations. Therefore, further investigation is needed across populations with diverse backgrounds and characteristics.

Lastly, we faced challenges ensuring that the MVA child's *voice* was authentically represented through the system, without being influenced by parental guidance or lacking conversational intent. To understand the child's behaviors and intentions, we relied on parents' recalls and secondary interpretations. In addition, we could not obtain evaluations directly from the MVA children regarding their satisfaction with the system. As highlighted in previous discussions [113, 133, 134], there is a need for a participatory approach in designing, developing, and evaluating systems for MVA children that incorporates their perspectives.

## 8 Conclusion

In this paper, we designed AACeSSTALK to enrich conversations between MVA children and their parents through reciprocal engagement. Drawing on formative interviews with professionals and parents of MVA children, AACeSSTALK leverages AI to provide parents with actionable speech guides that encourage participation of MVA children in conversation, while offering the children context-relevant vocabulary cards to expand their expressive range. Our deployment study with 11 parent-MVA child dyads over two weeks demonstrated that AACeSSTALK supported mutual participation, significantly increasing the frequency of conversations and turn-taking. Parents felt relieved from the pressure to lead flawless conversations, and increased self-expression by MVA children led parents to respect their child's agency. They also discovered that

conversations could become enjoyable interactions that deepen mutual understanding and empathy. We hope this research contributes to the development of inclusive communication technologies that bridge the communicative gap between the neurodiverse and neurotypical populations.

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