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Exploring communication ability in individuals with Angelman syndrome: Qualitative Interviews with Caregivers
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**Exploring communication ability in individuals with Angelman syndrome: Findings from
Qualitative Interviews with Caregivers**

ABSTRACT

Communication deficits have a substantial impact on quality of life for individuals with
Angelman syndrome (AS) and their families, but limited qualitative work exists to support the
necessary content of measures aiming to assess communication for these individuals. Following
best practices for concept elicitation studies, we conducted individual qualitative interviews with
caregivers and clinicians to elicit meaningful aspects of communication for individuals with AS.
Caregivers were able to discuss their child's specific communication behaviors within a large
number of expressive, receptive, and pragmatic functions via numerous symbolic and non-
symbolic modalities. These results aligned well with published literature on communication in
AS and will be used to inform the design of a novel caregiver-reported measure. Future studies
on communication in individuals with AS should focus on gathering quantitative data from a
large samples of diverse caregivers, which would allow for estimations of the frequency of
specific behaviors across the population.

Angelman syndrome (AS) is a rare, neurogenetic disorder caused by loss-of-function of the maternally inherited allele of the *UBE3A* gene (Sadikovic et al., 2014), resulting in deficits across multiple domains including communication, cognition, sleep, and mobility (Bonello, Camilleri, & Calleja-Agius, 2017; Buiting, Williams, & Horsthemke, 2016; Margolis, Sell, Zbinden, & Bird, 2015). Individuals with AS experience high unmet clinical needs (Wheeler, Sacco, & Cabo, 2017), although recent and ongoing preclinical studies are demonstrating exciting breakthroughs (Daily et al., 2011; Meng et al., 2015; Wolter et al., 2020). Understandably, deficits in expressive and receptive communication have a substantial impact on quality of life for these families (Wheeler et al., 2017; Zylka, 2020), and caregivers have identified communication ability as the most important area to target when evaluating efficacy for novel therapeutics (Willgoss et al., 2020). Unfortunately, there is a lack of communication measures designed specifically for these individuals, and existing measures may not include appropriate content for this population based on the "striking and unusual communication profile" (Grieco, Bahr, Schoenberg, et al., 2018; Pearson, Wilde, Heald, Royston, et al, 2019).

Most individuals with AS do not use words as a primary mode of communication (Calculator, 2013; Pearson et al., 2019; Alvares & Downing, 1998; Andersen, Rasmussen, & Strømme, 2001; Calculator, 2013; Clayton-Smith, 1993; Micheletti et al., 2016). Instead, people with AS often use alternative modalities like gestures, non-speech vocalizations, physical manipulations, sign language, and augmentative and alternative communication (AAC) devices (Alvares & Downing, 1998; Calculator, 2013; Didden et al., 2009; Grieco et al., 2018; Keute et al., 2020; Penner, Johnston, Faircloth, et al., 1993). Individuals with AS also may have more advanced receptive and pragmatic language skills that are seemingly unlinked to expressive language

deficits or cognition (Jolleff & Ryan, 1993; Penner et al., 1993; Micheletti et al., 2016)). Taken together, the communication profile in individuals with AS is distinct from that of typically developing children, supporting the need for highly targeted and specific measurement tools.

A truly AS-specific measure would include all the communication functions identified by parents as being important to their lives, align well with models of communication development, and account for the different modalities used by individuals within this population. Thus, this study's main goal was to conduct formative concept elicitation interviews with caregivers to obtain detailed information on key concepts that are relevant for understanding parental perception of communication ability in individuals with AS. To inform patient-centered practices broadly in this work, our study team included parents and relatives of individuals with AS, who are listed authors (A.S., P.E., & J.P.).

METHODS

Participants

Caregivers. Caregivers or parents of individuals with AS were eligible for the study if they were ≥ 18 years, had the ability to read, speak, and understand English, could provide informed consent, and had access to a telephone for interviews. Their child had to be at least two years of age, and caregivers had to report that their child's diagnosis of AS was molecularly confirmed (e.g. DNA methylation test, FISH, CGH, or sequencing). The caregiver also had to live with the individual with AS and reside in the United States.

Recruitment of caregivers was done in close partnership with an established patient advocacy organization, the Foundation for Angelman Syndrome Therapeutics (FAST). A recruitment invitation was posted to an existing Facebook page and circulated to other similar forums for parents of children with AS. Using snowball-sampling methods, FAST members could also distribute the recruitment flyer via email. Interested participants directly contacted the study team and were screened for eligibility.

Enrollment of caregivers was stratified by their child's age using four groups to ensure representation of communication across children, adolescents, and adults. Ages of the individuals with AS were grouped as follows: 2-7, 8-12, 13-17, and ≥18 years old. In addition to stratification by age group, we targeted recruitment to achieve a representative mix of the genetic mechanism of AS (chromosomal deletion, UBE3A mutation, paternal uniparental disomy [UPD], or imprinting center defect [ICD]). The identified genotype has important implications for both severity and symptom presentation of AS (Keute et al., 2020; Mertz et al., 2014). We also monitored caregiver race and ethnicity to support sample diversity.

The final sample included 22 caregivers of individuals with AS (n=6 each for ages 2-7 and 8-12 years; n=5 each for ages 13-17 and 18+ years), with one caregiver screened as eligible but lost to follow-up prior to their interview. Caregivers were on average 45.7 years old (SD = 8.2) and were predominantly mothers/step-mothers (86%; Table 1) with 73% (16/22) of caregivers identifying as non-Hispanic white, two caregivers as Black, 2 as Hispanic/Latino, one as Asian, and one as American Indian/Alaskan Native, meaning around 1/3 of caregivers in our sample

were non-white or Hispanic. All caregivers reporting having at least some college/university education, with 11 completing their undergraduate degree and 6 reporting post-graduate degrees.

Clinicians. To be eligible, clinicians were required to have an advanced degree in a communication-relevant field (e.g. speech-language pathology or augmentative and alternative communication (AAC) devices) and at least 2 years of experience working directly with individuals with AS. Eligible experts were identified by FAST study team members through their AS-specific networks and received a recruitment email from a member of the study staff. If an individual was interested in the study, they then contacted the study staff using the contact information in the recruitment email to obtain more information. Study staff conducted a screening visit, where eligibility of the clinicians were confirmed and additional demographics collected. After enrollment into the study, the qualitative interviews were scheduled and conducted.

In the final sample of 6 clinicians, 5 were women, average age 42.8 years, four had Master's degrees and two had doctoral degrees. Of the individuals with Master's degrees, four indicated their title was 'speech-language pathologist' (SLP) with one clinician reporting an additional title as 'complex communication needs specialist'. The two clinicians with doctoral degrees were faculty members at academic institutions. On average, clinicians had about 10.5 years of experience working with individuals with AS (median = 7 years; range = 4-30 years). All indicated they had experience with augmentative and alternative communication (AAC) devices. When asked about average caseloads, 3 clinicians reported seeing ~5 individuals with AS per year, and the other 3 reported upwards of 15 individuals per year.

Interview Script Creation

After a review of the literature, semi-structured interview scripts were created for both caregivers

and clinicians. The caregiver interview script (Appendix) started with asking caregivers to

describe the types of communication they see in their child on a typical day. Interviewers then

queried around <u>why</u> and <u>how</u> individuals with AS communicate within expressive, receptive, and

pragmatic communication functions. Caregivers were also asked about what would constitute

"meaningful" changes in communication for their child. The resulting structure of the interview

guide aligned with published models of communication development (Crais & Roberts, 1991;

Paul, 2001) and existing communication measures (Didden et al., 2009; Quinn & Rowland,

2017). The wording of the questions reflected a strength-based approach ("how does your

child…") in contrast to a deficit based approach ("does your child…"). This choice was

deliberate and based on discussions with relatives of individual with AS, to allow caregivers to

respond in an open-ended format.

The interview script for clinicians was developed in a similar fashion (Appendix). Clinicians

were asked to describe how individuals with AS typically communicate and what these

individuals usually communicate about. Like the caregivers, clinicians were also asked about

what constitutes meaningful changes in communication.

Data Collection

The relevant Institutional Review Board approved all study procedures prior to initiation, and

their review conformed to recognized standards including the Declaration of Helsinki and the US

Federal Policy for the Protection of Human Subjects. Participants provided verbal consent prior to the interviews. Due to the rare nature of this condition and to ensure geographical representation, all interviews were conducted over the phone. Interviewers (M.M., N.L., & C.Z.) were trained in qualitative methods and on the specific interview guide, and were not formally a part of any AS-specific organization. With permission from study participants, interviews were audio recorded and transcribed. The interviews lasted 60-90 minutes, and interviewers took detailed field notes that were expanded immediately following completion of the interview using a semi-structured debriefing form.

We planned to conduct approximately 20 interviews with caregivers (5 caregivers in each of the 4 age groups), and 5 interviews with clinicians, understanding that more interviews might be needed to recruit caregivers of individuals with more rare genotypes. Based on initial review of our sample, we recruited one additional caregiver to ensure representation from UPD and ICD genotypes in each of the youngest age groups (2-7 and 8-12 years old). We chose to enroll caregivers and clinicians to provide complementary information; caregivers could talk in detail about their own child's communication in multiple settings (e.g., home, community) and over time, while clinicians could speak more generally across individuals they had worked with and their knowledge of AS, communication development, and communication disorders.

Analysis

The goals of analysis were to (1) confirm the major communicative functions relevant to caregivers within expressive, receptive, and pragmatic communication and (2) describe a wide breadth of communication behaviors within each function. Secondary goals were to examine the

use of different modalities (e.g., verbal speech, gestures) and meaningful change in communication from the perspectives of caregivers and clinicians. It is important to note, that the goal of this analysis was not to speak to the frequency of specific communication behaviors in the larger population of individuals with AS or to identify developmental trends.

Thematic analysis was performed on all transcripts using the framework proposed by Nowell (Nowell, Norris, White, & Moules, 2017). Thematic analysis is a method that is used for identifying, organizing, describing, and reporting themes (Braun & Clarke, 2006). Nowell's framework supports trustworthiness of thematic analysis specifically through well-structured procedures that support summarization of findings (Nowell et al., 2017). As fully described in Table 2, three analysts participated in the five phases of research including familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing reports (Nowel et al., 2017). The final codebook included 19 codes describing specific modalities ('words', 'gestures', and 'AAC Devices') as well as larger areas of communication ('expressive', 'receptive', 'pragmatic'). The broader communication codes also had related subcodes, representing more targeted communication functions (e.g., 'expressive' => 'refuse'; see Appendix). The goals of our analysis were primarily descriptive (and not interpretive), to report examples using the caregivers' own words.

Please note, we report frequency counts for specific aspects of the interview that every participant was queried about in the same way (i.e., meaningful change and number of words). For observable behaviors within a communication function, as is traditional for thematic analysis, we selectively and intentionally use semi-quantitative terms (e.g. 'a few', 'many',

'some'), when we want to reflect patterns seen in the data. Caregiver interviews were the primary data for analysis, clinician interviews were utilized to expand on and confirm concepts identified by caregivers. Thus, when we report data that was obtained from clinician interviews, this is specifically stated.

RESULTS

Overview

Caregivers confirmed a number of communication functions relevant to individuals with AS and were able to describe a number of observable communication behaviors associated with each function. For ease of review, the results are organized by expressive, receptive, and pragmatic communication (Figure 1), with tables including additional quotations (Tables 3-5).

Expressive communication.

Expressive communication was defined as specific communication interactions where the individual with AS was communicating something to their communication partner (most often, their caregiver).

Requesting. Caregivers reported that individuals with AS requested a variety of objects and activities, including food, attention, entertainment (i.e. music, TV shows), places (outside, pool, store, etc.), baths, and social games. Individuals with AS could be skilled at requesting a small number of things that they specifically enjoyed or that were motivating for them (e.g. their

favorite food, a TV show or a game they like to play). A few children could request specific things that were not in the same room or that they could not see.

For non-specific communication attempts like crying, caregivers reported using context clues to help decipher what it is the child truly wanted. For example, caregivers mentioned they used context like the time of day or physical location (e.g., kitchen) to know that their child wanted food. "*So, if it's 11:00 a.m. or 12:00 p.m. and she's fussing, then I know that she wants lunch.*" Caregivers also looked for confirmatory behaviors to help determine if their child's request was met (i.e., smiling, nodding yes, or squealing in excitement).

Seeking Attention. Individuals with AS sought attention from their caregiver using sounds, their body, or their AAC device. For example, one caregiver of an individual who was ambulatory stated, "*He will usually approach us and tap us, or pull on our pant legs if we're standing.*" Caregivers reported that their child would seek their attention before communicating a request.

Requesting More of Something. Caregivers reported children requested 'more' of something using different behaviors including reaching, pointing, vocalizations, specific signs/gestures, or by using their AAC device. One caregiver said, "*I would usually ask him, 'Do you want more?' and he'll either – he might do that little head nod thing with his body – 'Yes' – or he might push his plate towards you. He might just reach for whatever it is.*" Another caregiver reported use of symbolic language to request 'more', "*He makes the 'more' sign language. You sort of hit your two fists together in the front, and occasionally he will use the more button on his device or if he can see the item.*"

Toileting. There was variation in the sample around observed communication behaviors about toileting. Some examples of communication around toiling included using an AAC device or tapping on their front or backside to share they needed to use the bathroom or needed a diaper change. There also was heterogeneity in the relevance of the concept to different families, which varied based on the priority caregivers placed on expressing needs around toileting (high/low), how intensely caregivers were reinforcing these skills with their child, and different levels of independence the individual had around toileting (being fully potty-trained vs on a timed schedule vs not being potty-trained). When clinicians were asked about this concept, they reported that when non-symbolic communication modalities were being used by the child, it is often not clear if the child was intentionally communicating or if the caregiver was identifying the individual's feelings of discomfort.

Directing Attention. Caregivers reported individuals with AS using physical means to direct their attention. Examples of this included grabbing the caregiver's hand and bringing them to something, turning the caregiver's face, and handing something of interest to the caregiver. One caregiver said, "*She may point if she's wanting to show me on her iPad, she's watching kids at a water park, and she'll use her voice to get my attention and then point to that. If I still don't look because I'm doing something else or talking to someone, she may tap me and/or turn my head by pulling my chin to what it is she wants me to look at.*" Other observed behaviors for directing attention included pointing to the object/action of interest and vocalizing/squealing ("ah ah!" or "eh eh!"). Some caregivers believed that their child could not direct attention or could not think of examples of directing attention.

Refusal. Individuals with AS refused objects or activities for a variety of reasons and used a variety of different methods. The most common refusal behavior reported by caregivers was pushing an object away. Similarly, individuals with AS also might refuse something by walking/moving away from the object or person, whining, or fussing. Another example caregivers provided was use of a symbolic 'no'. One caregiver stated, "*She does a sign for, 'No I don't want it.' She'll shake her head, 'No.'*" We also heard caregivers discuss use of an AAC device to indicate refusal or use of a word/word approximation like "*No*" or "*Nah*". Caregivers could identify and discuss these non-symbolic and symbolic forms of refusal and some reported they were working specifically to build and reinforce these skills.

Commenting. Commenting was defined as remarks expressing opinions or reactions. Typically, comments that caregivers of individuals with AS identified were simple things like a laugh, smile, or vocalization to express happiness or excitement. Happy vocalizations came in the forms of shrieks or high-pitched babbles. Conversely, caregivers reported individuals with AS also made low-pitched vocalizations (i.e. whines, cries, or growls) or use facial expressions (scowling/frowning) to comment that they were unhappy or "displeased" with someone or something. In both cases, these reactions were used by the caregiver to identify their own understanding of the child's communication (e.g., to determine if they responded appropriately to a request). Some, not all individuals, were able to tell simple stories about something that happened in the past (using a device or gestures). For caregivers that could describe this type of communication, there often was significant interpretation that occurred on behalf of the communication partner using contextual cues. For example, on caregiver said, "*The cat coughed*

up a hairball in the middle of the floor and it was dark in the room, [the child] stepped in it and I heard her fuss and then she walked out, found me, held her foot up and pointed to it. And then she proceeded to show me exactly where the cat threw this hairball up at."

The importance of communication modality.

Caregivers confirmed that individuals with AS used one or more of the following communication modalities: sounds/vocalizations, words or word approximations, signs or gestures (including modified gestures), and AAC devices. Caregivers reported that individuals with AS use these modalities across communication areas (e.g. expressive, receptive, and pragmatic) in varying degrees, and this was confirmed by clinicians. Some caregivers reported the use of multiple modalities within a specific function (e.g. using vocalizations, gestures, and body movements to seek attention). Individuals who could utilize symbolic forms of communication, like words/word approximations and AAC devices, were able to communication more sophisticated messages, like answering open-ended questions, making requests for something out of view, or telling stories.

Finger point. Caregivers and clinicians reported the importance of the use of finger points in advancing communication skills across a number of functions. For example, individuals might reach toward a general area to let their caregiver know they wanted something or utilize a finger point: "*She's getting better with her pointing, we've been working on her with that because a lot of times it's just the hands opening and closing at a specific item to lets us know that she wants that item. Now, she's advanced to where she can finger point to that specific item.*"

Words/Word approximations. About half of caregivers reported that their child used words or word approximations; however, only four caregivers said their child had more than three words that they used consistently. Of note, only one child in the 2-7 age group used any words or word approximations. The most consistently used word/word approximation across all age groups was "mama." Caregivers also talked about words/word approximations that were "lost" over time. One caregiver stated, "*She used to say 'dad' when she was younger but then about three years ago, she started saying mom, and she doesn't say dad anymore.*"

AAC devices. Use of an AAC device was common in our sample in at least some capacity, whether high tech (e.g. iPad with an app) or low tech (e.g. picture book). Although we did not explicitly examine cohort effects, there were differences in device use between older and younger individuals with AS in this sample. For example, a caregiver of a child in the 2-7 years age group said, "*He went through this huge spike of being able to communicate so much more with the introduction of the device…*" However, caregivers of adults with AS typically reported introduction later in life and less positive experiences: "*Everybody was trying really hard to get him to use it …. It just didn't really click with him*". When caregivers spoke about their child's level of mastery with the device, they mentioned various factors; how much modeling the support system was doing with the child, the child's motivation to use the device, the years using the device, the robustness of the device, and the child's fine motor abilities.

Receptive communication.

Receptive communication is the process of understanding a message expressed by a communication partner. By definition, it is less directly observable than expressive

communication. Thus, in describing examples of receptive communication, we focused on observable behaviors that indicated understanding after a specific prompt.

Responding to Name. Almost all caregivers reported their child would respond to their name in some fashion. Examples of other observed responses included physically coming to the caregiver, making a sound, looking up, or making eye contact with the communication partner. One caregiver said, "*If you call him or say his name, he'll look up and look at whoever just said his name or called him. He will respond to that. He may make eye contact with you to see – 'What?'*"

Answering Questions. When asked to respond to a yes or no question (e.g., do you want to go to the park? Do you want a banana?), caregivers in our sample were able to report if their child could make a choice using at least one modality (e.g. a head nod, an informal gesture, or sound like clapping or squealing), but this behavior was less common than other functions. Other examples of responding to questions can be found in Table 4.

Making Choices. Some caregivers in our sample said their child was able to consistently make personal choices, and caregivers reported using different methods to assist their child in making these choices. For example, one caregiver said, "*We actually put two or three food items or snacks in front of her and ask her to choose one…we just set them there and then let her just pick it up. We tell her to pick it up, whichever one she wants, and that's what she does.*" Other caregivers reported that their child would utilize their device to make a choice. *"I'll say, what do*

you want to play, tell me what you want to play, and he'll go to the play button in his iPad where a bunch of choices exist and he'll pick the thing that he wants to do."

Responding to Directions. Caregivers reported children understanding the word 'no' (a very simple direction), with less frequent reports of understanding more complex directions. One caregiver shared examples of simple directions that their child follows, "*If I say the word 'bath', he's off to the bathroom. He understands that.*"

Motivation played a role in caregivers being able to observe receptive communication behaviors, and could influence whether an individual with AS would respond appropriately to a communication partner and indicate understanding. One caregiver said, "*…like if she wants my cell phone and it's on the floor, I can say, "Hey, my cell phone's on the floor," and…she would go over and pick it up because she wanted it. But if I was like, "pick up your toy,"…she wouldn't do it.*"

Understanding Isolated Words or Mood. Caregivers reported that individuals with AS were able to indicate their understanding of familiar words when overhearing their caregiver speak about something that mattered to them. For example, one caregiver was speaking about their child's love of their favorite food and how she could not say the word aloud because the child would demand it immediately. Caregivers also reported that their child indicated name recognition by responding with excitement when someone mentioned the name of a person they like.

Taking Turns in Conversation. Caregivers reported examples of their child taking turns in conversations and expressed enjoyment around these interactions with their child. For example, "*When [name] babbles, I talk back to her. I try to figure out what she's babbling what she goes, 'Buh-buh-bub,' or 'Guh-buh-buh' and then point to something. I go, 'Oh. So, you like this movie?' And she'll do the nod or not a nod and it's really cool.*" Another caregiver provided an example of their child responding back to her with a question or comment: "*If I say 'Dad,' ..., she might say, 'When? When will I see Dad?' Or [name] – if I say '[name],' she might say, 'When?', or she might say 'movie.' She likes to watch a movie with [name].*"

Pragmatic Communication

Social communication was described by both caregivers and clinicians as a strength of individuals with AS (Table 5). Caregivers reported their child greeted others and played familiar games (e.g., peekaboo). For older individuals, caregivers discussed their child's requests for familiar activities they may enjoy with others, like swimming. Other social communication functions that were described by caregivers included the use of specific names for people like siblings, cousins, or aids, using specific signs, symbols on their devices, or vocalizations. Some caregivers also reported that their child would comfort others if they noticed they were upset; although, this was only described by a small number of caregivers.

Meaningful Change

Caregivers and clinicians all provided multiple answers for what would represent meaningful change; responses were aggregated into nine overlapping themes. The most frequently mentioned themes focused on complex communication, initiation of communication,

communicating with people, verbal speech, and being able to communicate when hurt or sick. Examples of all themes can be found in Table 6.

Generally, caregivers and some experts mentioned that a meaningful change for an individual with AS would be gaining more complex communication skills. Some participants defined these skills in terms of more complex linguistic skills, like increased words per sentence or vocabulary. Other caregivers mentioned that this change could be independent of modality. The development of speech was also frequently mentioned by caregivers; interestingly, however, most caregivers tempered these comments and suggested this goal was likely out of reach. For example, one caregiver expressed that a full vocabulary would be "*amazing*", but it was more important that their child used some words that "*everyone could understand*."

Initiating communication was also a popular theme, which was often discussed in terms of initiating communication on an AAC device. Caregivers wished that their child would initiate use of the device in multiple settings and for multiple reasons. Relatedly, one expert discussed meaningful change as a child understanding the value in communication. In their view, "increased association of using the device and receiving desired stimulus" would reflect this understanding.

Both caregivers and experts mentioned that the ability to communicate with other people (outside primary caregivers/family members/teachers) would be meaningful. Examples included more communication at school, with peers, with less familiar family members, or in other environments. Caregivers and experts also mentioned that social 'back-and-forth' conversation

skills (i.e. "turn-taking") are really important to social well-being, even if this is entirely non-verbal.

DISCUSSION

To our knowledge, this is one of the first systematic, qualitative explorations of communication ability in individuals with AS from the perspective of caregivers with an explicit focus on future measurement development. Caregivers could clearly articulate how their child communicated in the areas of expressive, receptive, and pragmatic communication, supporting multiple relevant concepts that could be included in future measures (Figure 1). Caregivers in the sample also reported a spectrum of communication behaviors within the identified functions, indicating variability within this population.

Our results support the unique communication profile of individuals with AS identified by previous research (Alvares & Downing, 1998; Calculator, 2013; Didden et al., 2009; Pearson et al., 2019; Quinn & Rowland, 2017). Data from both caregivers and clinicians confirmed the importance of considering alternative modalities used by individuals with AS when communicating. Words and word approximations were not common, and even when individuals used words (e.g. 'mama'), they often did not rely on them for many communication functions. Any future measurement tool for this population must consider the implications of these alternative modalities and their ability to increase communication ability in the absence of verbal speech.

In the eyes of caregivers, meaningful changes in communication consisted primarily of improvements in language complexity with a focus placed on verbal speech. Caregivers also prioritized allowing their child to be more universally understood by others and to have more freedom of expression. Clinicians also discussed these themes. Almost all caregivers in our sample reported multiple changes that could be 'meaningful', including behaviors that were very specific to the family situation. Thus, any future explorations of meaningful change in communication ability within clinical trials should allow for multiple areas of improvement.

It is important to note that recruitment occurred through collaboration with one patient advocacy organization. Strong partnerships with patient advocacy organizations are an invaluable asset to research done in rare disease populations but also have limitations (Pinto, Martin, & Chenhall, 2016; Vat, Ryan, & Etchegary, 2017). In our study, we utilized a purposeful sampling approach, stratifying our enrollment by age group, and including specific recruitment targets for genotype and race/ethnicity with the goal of diversity across these variables. Although we met our pre-specified targets for enrollment, our sample does not fully represent all subgroups of caregivers and individuals with AS. Importantly, our sample consists of caregivers with overall high levels of education and only 2 fathers and 1 female legal guardian. Future work should continue to carefully gather validity evidence with diverse samples.

Conclusion

In this work, we describe caregiver identified communication behaviors within expressive, receptive, and pragmatic functions (Figure 1) and through numerous symbolic and non-symbolic modalities for individuals with AS, supporting the utility of caregiver report. These qualitative

findings can be used to inform the development an AS-specific measure capturing communication from the caregiver's perspective for use in clinical trials. Future work should include also exploration of the frequency of communication behaviors in the larger population of individuals with AS, estimate developmental trajectories for communication, and confirm results in a larger sample of diverse caregivers.

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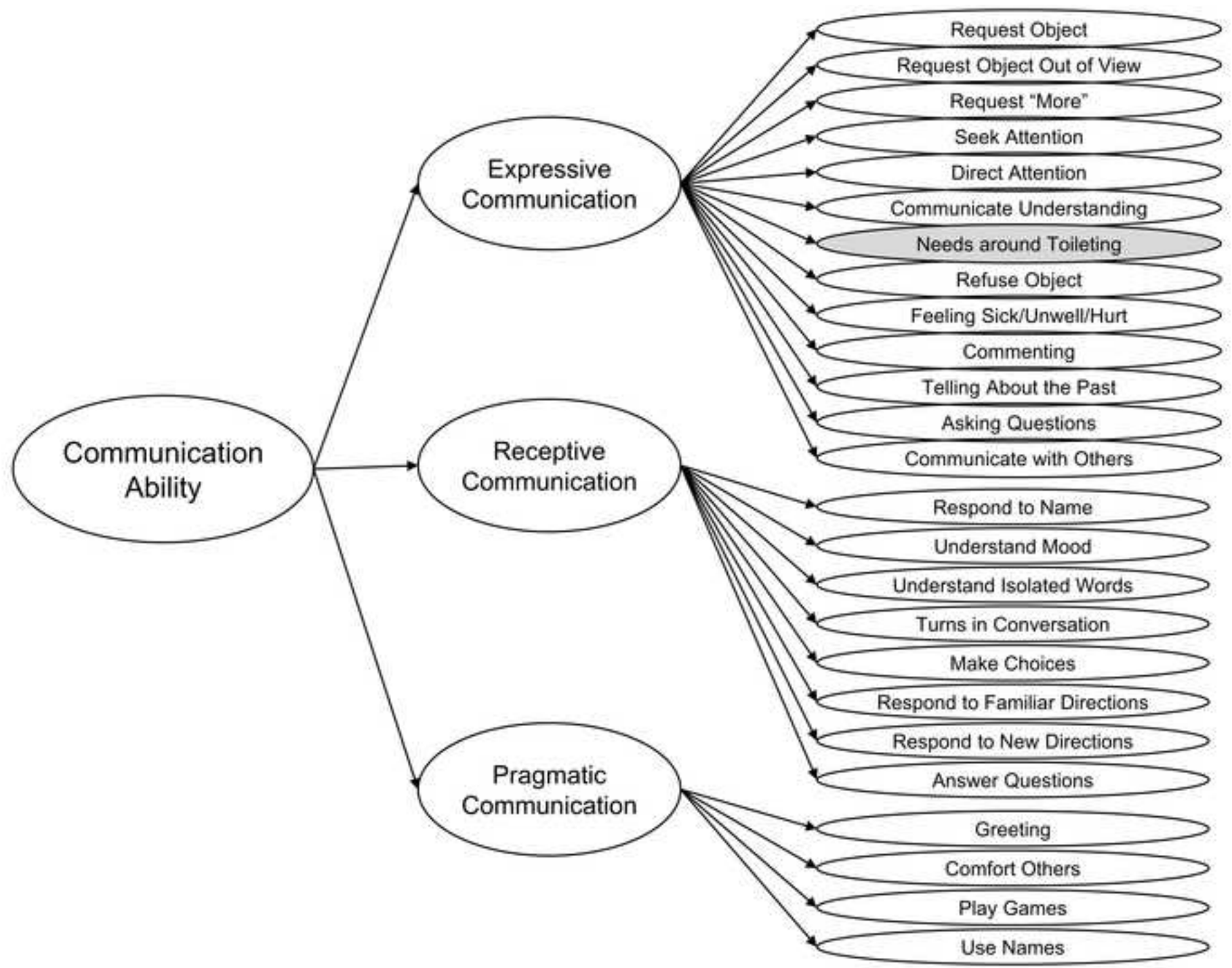
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Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Page no(s).

Title and abstract

Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	1

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	1-3
Purpose or research question - Purpose of the study and specific objectives or questions	4

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	9
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	8
Context - Setting/site and salient contextual factors; rationale**	8
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	5-6
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	8
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	7-8

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	7
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	5 and 6
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	8
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	8-9
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	10

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	11-21
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Tables 2-5

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	22-23
Limitations - Trustworthiness and limitations of findings	23

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	Title page
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Title page

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:
O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014 DOI: 10.1097/ACM.0000000000000388

Table 1

Table 1. Demographics for 22 caregivers and their children with Angelman syndrome who participated in the concept elicitation interviews.

Caregivers	*n (%)*
Ethnicity	
Hispanic or Latino	2 (9)
Race	
White	18 (82)
African-American or Black	2 (9)
Asian	1 (5)
American Indian/Alaskan Native	1 (5)
Caregiver relationship to child	
Mothers/Step-Mothers	19 (86)
Father/Step-father	2 (9)
Legal Guardian (female)	1 (5)
Individual with Angelman syndrome	
Genotype	
Deletion Positive	13 (59)
Mutation/UBE3A	5 (23)
Imprinting (ICD)	2 (9)
Uniparental Disomy (UPD)	2 (9)
Gender	
Female	12 (55)
Ethnicity	
Hispanic-Latino	2 (9)[1]
Race	
White	17 (77)
African-American or Black	2 (9)
Asian	1 (5)
Mixed Race	2 (9)[2]
Age, years (*Mean / SD*)	12.4 / 7.7

[1]One caregiver did not report their child's ethnicity. [2]One caregiver reported their child race as American Indian/Alaskan Native and white; one caregiver reported their child's race as Asian and Native Hawaiian/Other Pacific Islander.

Table 2

Table 2. Thematic analysis approach of qualitative data to support trustworthiness of findings.

Phases of Thematic Analysis[1]	Methods utilized by study team to ensure trustworthiness
Phase 1: Familiarization with the data	-Data for this study included audio files, transcripts, and interviewer notes. These data were stored on a private, password protected server that was accessible by the analysts. -Interviewers/analysts (subsequently referred to as analysts) took detailed notes during interviews to capture details such as duration of the interview, perceived attitudes about the questions asked, and any difficulty understanding concepts discussed. -Following the interview, analysts completed semi-structured debriefing forms using audio files and interviewer notes in order to summarize findings at the individual participant level. -Analysts memoed (Given, 2008) on all interview transcripts (including interviews they did not conduct) to underscore themes and patterns that emerge from the data.
Phase 2: Generating initial codes	-Analysts created the initial codebook, which was structured with deductive codes from the interview guide. - NVivo12 was utilized to code the transcripts. -An audit trail was begun to record subsequent code generation. -Team meetings to discuss code generation were documented. -Peer debriefing occurred regularly at bi-weekly study meetings to review patterns in the data, themes and general impressions with parents & relatives of individuals with AS.
Phase 3: Searching for themes	-As deductive codes were applied, inductive codes were identified through study team discussion and review of the data. -Triangulation of new codes generated from different analysts were explored at regular meetings, and subsequently inductive codes were applied to all transcripts. -Analysts pulled code reports from NVivo12 and then analysts memoed on all code reports to understand patterns and organize themes.
Phase 4: Reviewing themes	-Themes and subthemes were vetted by team members. -Referential adequacy was checked by continuously returning to the data.
Phase 5: Defining and naming themes	-Discrepancies in coding were resolved through discussion within the analysts group and the larger study team, resulting in a refined codebook (documentation of these meetings occurred). -Consensus was reached on defining and names of themes. -Inter-rater reliability was examined and any conflicts in coding on individual transcripts were discussed (kappa range: 0.54-0.97). -Peer debriefing and member checking occurred regularly at bi-weekly study meetings to review themes with parents & relatives of individuals with AS.
Phase 6: Producing the report	- Analysts reviewed the code reports and wrote final analytical reports, including direct quotes from the transcripts assigned to each code. -Thick descriptions of context were included within the reports, focusing on linkages across themes. For example, caregivers and clinicians reported that 'motivation' played a role in their child's communication, and we specifically discuss motivation in terms of expressive, receptive, and pragmatic communication.

| | -Process of coding and analysis was described in detail & descriptions of the audit trail provided. |

1. Based on the framework proposed by Nowell et al., 2017.

Table 3

Table 3: Conceptual areas representing the expressive communication ability of individuals with Angelman syndrome described by caregivers and clinicians.

Expressive	Examples from Caregiver Interviews
Requesting an Object	Well, she will kind of just start fussing and you kind of know what time of the day it is. So, if it's 11:00 a.m. or 12:00 p.m. and she's fussing, then I know that she wants lunch. Other times, if she sees you eating and she's hungry, then she kind of whimpers. Let's say I have a piece of string cheese and she will literally track it with her eyes and watch you pull it and put it into your mouth. And that's kind of her tracking it very intently. It's her way of saying that she would like some. So, she will do the banana sign with ASL [American Sign Language]…and then she uses sign language sign for chocolate. He touches his finger on his mouth if iPad is not next to him. Otherwise, he's gonna say, "I'm thirsty," "food." You know, "I want crackers." He gonna click that button a lot. So, that way we know if he's hungry.
Seeking Attention	One of her things that she does to get attention is she'll come upstairs and she'll go for the thing that she knows she's not supposed to touch or do, and she'll just head for it, and then she'll just grab it, and then like have this wicked smile and then look at me. She'll get your attention really quick and she'll, like I said, she does this babble thing and then will do her hands...And other times, if she comes in the room, she'll get right in your face and look you in the eye and then she'll do the gesture or sign what she wants. Or another thing is when you're sitting there…she'll take your face with her hand and move it so you look at her, or she'll tap you. How does she ask for attention? Well, she says "Look at me" [on her device]. That's extremely effective, but we worked hard to get to that – we worked hard to teach her that that's the most effective way. But, like I said, she has used that button 12,000 times, so that's a lot. And then, the other way would just be to grunt. "Eh."
Requesting "More" of something	I would usually ask him, "Do you want more?" and he'll either – he might do that little head nod thing with his body – "Yes" – or he might push his plate towards you. He might just reach for whatever it is. So she has a particular sound that she uses for I think more. She used to actually have a "more," like she used to say "muh" for "more." But then that's again, that's one that she's lost that we may hear again sometime or not. So she used to say more, like at least part of it. And now she's just kind of like, "Aaa. Aaa." But it's a particular "Aaa" that we know exactly what it means.

	He makes the 'more' sign language. You sort of hit your two fists together in the front, and occasionally he will use the more button on his device or if he can see the item
Expressing needs around toileting*	She actually pats the lower of her belly when she has to use the toilet.
	She has a button that says "Ladies' room, please."… She also will simply just get up and go because she has the ability to do that. She can just walk to the bathroom herself and go. She doesn't need anyone to take her, typically, if we're at home.
Directing Attention	If we're sitting at the kitchen table and he wants to direct my attention to the door because somebody's there, he can't do that. But if he wants me to activate or turn something on, he'll scoot over to it and tap on it.
	He'll come and get you if you're not sitting right there. His other thing – probably in the last year and a half – he's constantly – he takes my face, he pushes my face with his hands. He'll grab my face – lip or nose – turn my face towards whatever it is he wants to show you.
	If I'm not looking at her and she's sitting next to me, she'll make a sound. She may point if she's wanting to show me on her iPad, she's watching kids at a water park, and she'll use her voice to get my attention and then point to that. If I still don't look because I'm doing something else or talking to someone, she may tap me and/or turn my head by pulling my chin to what it is she wants me to look at
Refusing an Object	He'll either just push it away or walk away from you. He does not shake his head. We have not been able to get him to understand either to nod "yes" or to nod "no" on a consistent basis. So, if he doesn't want something, he'll just turn away from it or push it away.
	She will push it away with her hands or turn her head and not look back at you, or just crawl away.
	She does a sign for, "No I don't want it." She'll shake her head, "No."
	She'll put her hand up in the air to say stop. Sometimes she'll use one hand. I don't know what the term is why she may use two hands, but sometimes she'll put two hands up to let you know to stop or I don't want that. Like I said, she'll use a waving motion, for instance, if I don't understand what she wants to drink and say I pull out juice she'll wave her hands, or she'll take her straw out of the cup to indicate that she doesn't want what's in that cup. And then along with that, she'll do a no or a sound in disagreement. So, she'll do a host of things to let you know that I don't want that.
Commenting/Communicating understanding	Besides smiling, laughing, crying, he does have a confused face. If he's not sure about something, he kind of scrunches up his eyebrows and gives that "What's going on?" kind of look.
	He'll pull out the Tupperware container with a cookie in it, and I'll say, "You really want a cookie," and he will immediately – he'll hold that cookie in his mouth or in his hand and he'll just like "Huh," make a

	happy face, give me a sly smirk, and usually throws his arms up like, "Haha. I did it." So, that's right on the mark. His gesture and his movement was "I want this." That's totally easy to interpret.
	She'll say really funny things. She says, "That's my jam." If she likes a song, she says, "That's my jam." She says, "I think that's awesome," "I think that's silly." Sometimes, when she hasn't been really good, we'll say, "How was school today?", and she'll say, "Naughty." She's like, "Yeah, I'm not gonna lie. I'm naughty." I don't know. She comments – she has hundreds and hundreds of symbols on her talker to get her point across. I'm sure there are ways I can't think of.
Feeling Sick or Hurt	And if she's sick, if I'm not sure, sometimes that is the hardest thing for us to point out where she's sick at. If she's sick, I will ask her to show me so she will actually take her hand and point to the area where it's bothering her.

*Expressing needs around toileting seemed less related to communication ability and more related to other abilities like motor skills (ability to walk to bathroom) and being independently potty-trained. Please see text for more discussion.

Table 4

Table 4. Conceptual areas representing the receptive communication ability of individuals with Angelman syndrome described by caregivers and clinicians.

Receptive	Examples from Caregiver Interviews
Responding to Name	When he was little, it was kind of like, "Yes, that's my name. That's my name." But now, I think it's more an anticipation. "Okay, you said my name. You're either gonna talk to me or tell me something that I wanna know." He's more curious as to what's gonna follow his name.
Answering Questions	Familiar objects, you know, if I say "Where's your backpack" or "Where's your lunch bag" or "Where's your water cup," she'll go and get it for me or point and show me it's in the kitchen or something. So she mostly uses inflection in her voice. Sounds, questioning sounds. Most of the sounds that she uses, like "ah? ah?" She has, when she's very excited about something that I might ask her, like "Do you want to go to Legoland today?" She has said "Uh-huh" when shaking her head I can ask him questions, do you want to play Play-Doh, and he'll nod, or would you like a cookie, of course we always get a nod with that one, or sometimes, do you want to go see daddy, and he shakes his head no, he wants to stay with mommy.
Making Choices	We actually put two or three food items or snacks in front of her and ask her to choose one, and we don't – we just set them there and then let her just pick it up. We tell her to pick it up, whichever one she wants, and that's what she does. He tells me on his device. If I'm giving him a choice, do you want grapes or strawberries, he will answer. I'll give her three choices for breakfast and she'll point to it or she'll just take it. And, like, this morning, she picked oatmeal. So, I had oatmeal, I had cold cereal and then I had a breakfast sandwich. As she picked oatmeal. I ask him, what does he want to play, and sometimes I say we can do Play-Doh, we can play with stamps, we can do tattoos, we can finger paint, Lite-Brite, so it's not necessarily just two choices, but I'll say, what do you want to play, tell me what you want to play, and he'll go to the play button in his iPad where a bunch of choices exist and he'll pick the thing that he wants to do.
Responding to Directions	Like if I tell her no, she will normally stop doing what she is doing and back away from it. But other than that, there's no direction. If I say the word bath, he's off to the bathroom. He understands that. If I say, "It's time to put on your shirt." A lot of times he'll dunk his head down for me to put a shirt over his head, and then he'll put his arms through. Or if I say, "It's time for your shoes." Sometimes he'll, not consistently, but sometimes he'll give me a foot.

Understanding Isolated Words	I'll saying, something like, "I have to go to the store." And she'll go and get her shoes. We have no way of really understanding how much more he's understanding because he can't verbalize it or communicate it to us, but there's times where all of a sudden, we might be talking about something, and he…he will show that he knows what we're talking about, and it's just like, "Oh, okay…"
Understanding Mood	He had a hard time expressing or understanding feelings when he was younger. If you had a frown face on, and you were saying whatever he did was bad, he would just look at you and smile. He didn't recognize that you're making a frown face because you're upset about something. It's like pretend I'm crying kind of thing, he say like, "No, stop." He knows Mommy's mad. So, he gonna run away and show things like Mommy's mad or something. He realize like tone of the voice.
Taking turns in Conversation	Under a year old also, she would cough. It was one of the only sounds I think that she could make herself, so she and I would cough back and forth because it was, you know, like some kids start babbling and then the mom says "mamama," and then the baby does it. When [name] babbles, I talk back to her. I try to figure out what she's babbling what she goes, "Buh-buh-bub," or "Guh-buh-buh," and then point to something. I go, "Oh. So, you like this movie?" And she'll do the nod or not a nod and it's really cool.

Table 5

Table 5. Conceptual areas representing the pragmatic communication ability of individuals with Angelman syndrome described by caregivers and clinicians.

Pragmatic/Social	Examples from Caregiver Interviews
Greeting	He usually jabbers at them, waves. He's big on waving and just making sounds to get their attention. If he is – a lot of times, when we're out in the community, he's in his chair, so the waving and the chatting – if he can get close to somebody, he will grab people and hang onto them while he's chatting away. If he's not in his chair, he will go up and just hug people, grab them and hug them, get in their face. If I get her up from her nap, she's very excited to see me when I walk in the room. But, she'll bounce her body and she'll make happy noises.
Playing Games	When he wants you to play peek-a-boo with him, he'll just take your hand and put your hand over your face. And, if you act like you don't know what you're saying, he might take your shirt and put it over his face – or a towel or something that's close by to let you know he wants to play peek-a-boo. I'll put a blanket on her head. And she'll take it off. And I'll put it on again, and she'll take it off, and put it on again. And then, we've always done, for a long time, since gosh, she was five or six years old, we would do a vocal game where we do back and forth, where I mimic her. And sometimes she'll mimic, we'll go back and forth. And she'll say the sound again and I'll do it exactly like she does it. And we'll just go uh, uh, uh, uh. And that cracks her up.
Using Names	If he want his sister, he gonna touch like "[name], [name], hi." So, he wants some attention from his sister or dad, he gonna point out their name, you know. For like Dad, he'll do, "Dah." For Mom, well, he does "Mama" for Mom. For Sister, he'll do like "Sissa," like he'll tell like kind of like an S together. He calls, his grandmother's name is [name]" He calls her [name] like plain as could be.
Comforting Others	She also is, if she sees other people upset, it can make her upset. That's both in real life and on TV. If she sees like kids crying out in public, she often is like, "Aaa. Aaa." And then she'll look at me, and then I have to tell her like, "They're gonna be okay." You know?

Table 6

Table 6. Themes identified when 22 caregivers and 6 clinicians were asked about meaningful changes in communication for individuals with Angelman syndrome.

Theme	Caregivers[1]	Clinicians[1]	Caregiver Quotations[2]
More complex communication (higher vocabulary, stringing words/symbols together, more back-and-forth dialogue)	13	2	It could be having some words like no and yes, or it could be something even more like – you know, the most meaningful change would be to have like a vocabulary of 1,000 or 2,000 words with verbs and, you know, the whole thing. If she could actually do more signs or better signs to use her fine motor skills better, if she added any vowel-consonant sounds for a word approximation, if she started describing even more on her talker, you know, great, she wants to go to the store. If she said she wants to go to the grocery store, or she wants to go to the store for bananas, just adding on top of any of the building blocks she already had would be immensely helpful.
More initiation of communication	6	2	I think meaningful change would be him taking more of the initiative to use pictures or an [device] rather than us initiating it and reminding him to use those things. What I would love to see is her be able to not so much always be responding to questions in terms of what she wants, but to be able to initiate communication.
Communication with other people	4	4	Connecting socially with others, I mean, other than us, just being able to have a conversation with someone else, connecting in that regard…
Verbal speech	6	0	I guess if she could speak, that would – She could actually use words. That would be the most profound. Obviously, I mean, the most meaningful change in communication

			would be speech, right...Because that is ultimately – and it could just be having a hello and a goodbye, you know? That would be a wonderful meaningful change.
Communication around safety or feeling sick			I mean there's always the fear that your child will be abused, so there's like the sense that you want them to be able to tell if someone's hurting them.
	4	2	A meaningful change in communication, would just – sorry, this question gets me every time. Every time I think about communication. Just knowing what hurts. If something hurts, knowing what he needs.
Better motor skills to facilitate communication	4	0	I think it's not a cognitive impairment that keeps her from talking, it seems to me that it's a motor impairment. When she wants to talk, she knows what she wants to say, but she's not able to do it.
Communication Success	3	2	I would really want him to be able to clearly state what his needs are and what his dislikes are, so I would like it if I could just say concretely if he could use his [device] and he could tell people "I want that" or "I don't like that" in a very consistent way or even build sentences like, "I want to go to the zoo,"
Less aggressive communication	2	2	I think that's where a lot of his frustration comes from, the behaviors, is because it's kinda like stuck in his head but he can't get it out.
Expressing feelings	2	1	Like real communication, we do every day…feelings like missing, love. That kind of communication he can have besides just making requests or something, you know?

[1]Frequency counts in columns 2 & 3 were calculated during rapid data analysis using data extracted via structured debriefing forms. These numbers are meant to support salience of each theme to caregivers and clinicians who participated in the interviews, but are not meant to represent overall prevalence in the population. [2]Example quotations were pulled from caregiver interview transcripts to illustrate themes.

In-depth Interviews with Parents/Caregivers of Children with Angelman Syndrome: Communication Abilities
Interview Guide Version: 1/28/19
Pro00101207

Date of interview: _____

Participant ID number: _____

Interviewer's name: _____

Interview Start Time (24-hour clock): _____:_____

Thank you for taking the time to participate in this study. For this interview, we want to discuss your child's communication abilities. Your answers to our questions will help us develop a questionnaire that will assess how your child both communicates and understands communication. This questionnaire is planned for use in future clinical trials to find treatments for individuals with Angelman Syndrome.

The interview will take about an hour. We are first going to discuss what typical communication looks like for your child and the ways in which they communicate with you. I'm also going to ask about different situations and people they might communicate with, and how they show you that they understand you and others. Finally, we are going to talk about how their communication has changed as they've grown older.

Please note that individuals with Angelman Syndrome have a range of communication abilities. During this interview, I am going to ask about different types of abilities, but it is not expected that your child will be able to do everything I describe. If I ask about something that your child is not able to do or has not done before, you can simply tell me that your child is not able to do that and we will move to the next question.

Please remember that there are no right or wrong answers. You are the expert on your child, and we are interested in your perspective and experiences. Your participation is completely voluntary, and you can choose to take a break at any time or stop the interview entirely.

I would like to audio record the interview because I want to make sure I don't miss any of your comments. If you don't want the interview audio recorded, I will take detailed notes during the interview instead. The recording will be stored securely and eventually destroyed after we publish the study's findings.

Do I have your permission to record this interview?

☐**Yes**　　　　　　　　　　　　　☐**No**

Do you have any questions for me so far about the interview?

[Begin recorder]: This is participant ID [*Insert Participant ID number here*] on [*Date*].

[*Goals for Questions #1-2: Build rapport with caregiver and start to learn about typical and atypical communication for the child.*]

1) Who does your child communicate with on a typical day?

   Probes:
   • What kinds of things does your child communicate about?

2) What are your child's communication strengths?

   Probes:
   • What do they do well?

[*Goal for Question #3-4: Learn about typical gestures and their context of use. Expressive.*]

3) How does your child use facial expressions to communicate with you?

   Probes:
   • Please describe the different facial expressions your child uses to communicate.
   • How do they use eye contact to communicate?
   • Do facial expressions change when communicating with different people? Siblings? Strangers?

4) What types of gestures does your child use to communicate with you?

Note to interviewer: Gestures can include Sign Language or less formal gestures, like pointing, informal signs, etc. Please probe on each gesture the caregiver mentions.

Probes:
- Please describe the different gestures your child uses.
- At what age did your child start using gestures to communicate?
- Can you describe to me what each gesture means? The intended goal of each gesture?
- How often do they use gestures?
- How many gestures/signs do they have?
- When do they use the gestures (i.e., do they use them to direct or request action)?
- Does the meaning of the gesture stay the same (consistent)?
- Does one gesture have multiple meanings?

[*Goals for Question #5-6: Learn about typical vocalizations and their context of use. Expressive.*]

5) What types of sounds does your child use to communicate with you?

Note to interviewer: Sounds can include things like grunts, babbling, etc.

Probes:
- How often do they make these sounds?
- At what age did your child start using sounds to communicate?
- When do they use sounds?
- Can you describe what each sound means? The intended goal of each sound?
- Can you give me examples of the types of sounds they use?
- Do the meanings of the sounds stay the same?
- Do certain sounds have multiple meanings?

6) What types of words does your child use to communicate with you?

   Note to interviewer: Please let the caregiver answer without a prompt. If they need a prompt: "Words don't need to be full words. Words can include syllables, word approximations, or any vocalization that has a consistent meaning."

   Probes:
   - How often do they use words?
   - At what age did your child start using words?
   - Have they ever used words?
   - About how many words do they have? Please will you list all the words they have?
   - When do they use words?
   - Can you describe what each word means? The intended goal of each word?
   - Do the meanings of the words stay the same?
   - Do certain words have multiple meanings?
   - Do they ever string sounds and words together? Tell me more about that.

[*Goal for Questions #7-8: Learn about assistive devices, their context for use, and how helpful parents believe them to be. Expressive.*]

Next, I would like to ask you some questions about the types of aided communication devices your child uses, such as a tablet.

   Note to interviewer: Respondent may have already answered many of these questions so adjust questions and probes as needed.

7) What types of devices does your child use to help them communicate?

   Note to interviewer: Devices could be "high tech" like iPads, ACC devices, or speech generating devices. Or "low tech" like pictures, binder, etc.

   Probes:
   - How long has your child been using the device(s)?
   - At what age did they start using assistive devices?
   - How often do they use the device?
   - Is the device your child's primary mode of communication?
   - In what setting does your child use the device?
   - Does your child initiate the use of the device? How so?
   - In what ways does the device help your child communicate?

8) How has your child's usage of the device changed over time?

Goal for Questions #9-13: Identify typical communication skills. Expressive.]

For the next set of questions, I am interested in specific ways your child communicates with you. As discussed earlier, children have a range of communication abilities and it is okay to tell me that your child cannot do something.

9) Please describe how your child <u>refuses</u> something they don't want.

    Probes:
- How would they refuse a book or toy?
- How would they refuse an action, such as not wanting to stay seated?
- Does this behavior change depending on what they are rejecting?
- What circumstances affect how or when your child refuses/rejects?
- How do they communicate "no"? How do they communicate "yes"?

10) How does your child <u>ask for</u> attention?

    Note to interviewer: Attention/interest/level of engagement can include physically approaching something, gestures, pulling, etc.

    Probes:
- When does your child ask for attention?
- How does your child show interest in other people?
- How does your child show interest in an object?
- Is this action specific to gaining attention?

11) We are very interested in the specific ways your child expresses himself or herself. These next set of questions are about specific scenarios:

(a) How does your child let you know they need to go to the bathroom?

(b) How does your child let you know that they are hungry or thirsty?

(c) How does your child request an object, like a book or toy?
- How does your child request something they don't have any of, so they need to tell you exactly what it is they want? Such as a favorite toy?
- How does your child request something they have some of, but want more? Such as markers or food?

12) How does your child <u>direct your</u> attention, like if they want you to look at something?

Probes:
- How does your child show you something?
- How do they draw your attention to an action? To an object?

13) How does your child use challenging behaviors to communicate?

Note to interviewer: These behaviors can include things like biting or hitting. These behaviors could be exhibited when the child is refusing, requesting, or something else.

[*Goal for Question #14-16: Identify social communication skills. Pragmatic.*]

14) How does your child comment?

Note to interviewer: Comments can be non-verbal and include facial expressions (like raised eyebrows), eye contact, etc.

Probes:
- How does your child tell you about something you didn't see?
- Does your child let you know they are thinking about something?
- How does your child tell you about an event?
- How does your child show you that they like something? Don't like something?

15) How does your child greet people?

Probes:
- How do they greet you?
- How do they greet other family members?
- How do they greet strangers?

16) How does your child make choices?

Probes:
- How do they indicate preferences?

[Goal for Questions #17-19: Identify typical communication skills. Receptive.]

Now we will discuss how you communicate with your child.

17) How do you get your child's attention?

Probes:
- How do they respond to your voice?
- How do they respond to their name?
  - Does their facial expression change?
- How has their response to your voice changed as they've gotten older?
- How does their response change in certain situations?

18) How do they respond to someone they aren't familiar with trying to get their attention?

19) What other things affect your child's ability to respond to you?

    Probes:
- How do they respond to directions or requests?
- How do they respond to the name of familiar objects? Do they look at the person or thing?
- How do they respond to simple routine commands? Like a bath, do they start to undress?
- Are their routine games that your child knows? Like peek-a-boo?
- Describe circumstances when their response is better or worse.
- Can your child identify objects when given choices? For example, blue versus green? A horse versus a cow?
- When is your child least successful in their communication? More successful?

Finally, we will discuss global communication questions.

[Goal for Question #20: To identify the stability/variability of communication in this population]

20) How has communication between you and your child changed over time?

    Probes:
- As your child has gotten older, how have their communication abilities changed?
- When did their communications change?
- Were the changes fast or slow?
- When you do see changes, over what time period do changes typically occur?
- How have people helped you measure this change?
- Once a new communication skill is learned, does it stick around? Did you need to keep working on it?
- What happened to other skills during this time?
- As a parent, what has changed in how you support your child's communication?

[*Goal for Question #21: Define what meaningful improvement in communication looks like.*]

21) What would a meaningful change in communication look like for your child?

    Probes:
- What improvements in communication skills would you like to see for your child?
- Why?

22) We know many different things can affect communication skills and abilities. How easy or hard is it for you to access the therapy your child needs?

    Note to interviewer: This is an optional question, time-permitting.

    Probes:
- What things affect this access?

23) Can you think of anything else that you would like to share with me that you think is important for us to know about your child's communication abilities?

Thank you so much for talking with me today. Your thoughtful responses will help us to develop a better questionnaire.

After we've finished all of the interviews, we will analyze everyone's responses and create a summary report. Would you like to receive the summary report via email?

☐**Yes**   ☐**No**

[Stop recorder]

Interview Stop Time (24-hour clock): _____:_____

In-depth Interviews with Communication Experts discussing children with Angelman Syndrome
Interview Guide Version: 12/5/18
Pro00101207

Date of interview: _____

Subject ID number: _____

Interviewer's name: _____

Interview Start Time (24-hour clock): _____:_____

Thank you for taking the time to participate in this study. The overall goal for our research study is to design and to evaluate a questionnaire to assess communication ability in children and adults with Angelman Syndrome. The questionnaires will be completed by parents or caregivers and used in future clinical trials to evaluate treatment efficacy. We seek your expert input to help us understand the type and extent of communication ability in children, as young as 2 years, adolescents, and adults.

During this interview, I am going to ask you questions about how children with Angelman Syndrome communicate and understand communication. I also want your thoughts on what types of communication skills and abilities caregivers are able to observe. Also, we are interested in how these children's communication abilities and skills may change over time. We will finish with seeking your input on the questionnaire design itself. The interview will take about an hour.

There are no right or wrong answers. We are interested in your thoughts and experiences. Please remember that your participation is completely voluntary, and you can choose to take a break at any time or stop the interview entirely.

I would like to audio record the interview because I want to make sure I don't miss any of your comments. If you don't want the interview audio recorded, I will take detailed notes during the interview instead. The recording will be stored securely and eventually destroyed after we publish the study's findings.

Do I have your permission to record this interview?

☐**Yes**   ☐**No**

Do you have any questions for me before we start the interview?

[Begin recorder]: This is participant ID [*Insert Participant ID number here*] on [*Date*].

1) Please define what "communication ability" means to you.

2) What are the different components that make up communication ability?

3) How does your definition change when considering communication ability in the context of individuals with Angelman Syndrome?

4) How do you assess communication ability in individuals with Angelman Syndrome?

    Probe:
    - Please tell me more about that approach.

5) What are the different levels of communication ability <u>you see</u> in individuals with Angelman Syndrome?

    Probe:
    - What are the range of communication modalities you see used by the individuals with AS that you work with?

6) What role does assistive technology play in improving communication with this population?

   Note to interviewer: assistive technology can include low tech (e.g., pictures, cards) or high tech (e.g. tablets).

Now, let's talk about how parents or caregivers may assess their child's communication ability.

7) What are examples of communication that caregivers are good at noticing?

   Probe:
   - What is information you typically ask parents to give you?

8) What are examples of communication that caregivers are bad at noticing?

   Probe:
   - What are things caregivers may misinterpret? Such as problematic behaviors?

9) When caregivers share their observations of their child's communication abilities, what terms do they use to describe it to you?

   Probes:
   - Are they describing how frequently something is happening?
   - How do they describe mastery of a communication ability?
   - What terms are most helpful in understanding the child's abilities?

Now let's switch gears and talk about changes over time in communication abilities.

10) For individuals with Angelman Syndrome, how do communication abilities change as children get older?

    Probes:
    - What factors may affect change?
    - During what ages or time periods does communication typically change?

So we've talked about changes over time, now let's talk about meaningful changes in communication abilities.

11) For children with AS, what does meaningful change in communication look like to you?

   Probes:
   - What factors are important when assessing meaningful changes in communication abilities in this population?
   - What are some examples of meaningful change that you've seen in this population?
     o Do you have an example of meaningful change in expressive communication?
     o Receptive communication?
     o Pragmatic communication?
     o [*Other types brought up by expert*]?

   - Are the meaningful changes you've seen consistent with the families' expectations?
     o Where is there agreement about meaningful change?
     o Where is there disagreement about meaningful change?
     o How have you had to manage caregiver expectations regarding improvements in communication abilities?

   - Have you seen change that looked at first to be meaningful but ended up not being meaningful?
     o For example, a child with AS may say a new word they've never said before, but they never say that word again. What would that represent in terms of a change in the child's communication abilities?
     o What sporadic improvements in communication are seen in this population?

12) For a child enrolled in therapy, what types of improvements would you expect to see?

   Probes:
   - What does early skill acquisition look like in these children?
   - What does skill mastery look like in these children?
   - What happens to other skills when new skills are being acquired?
   - Is there an amount of time when you would expect to see a change in communication abilities for children receiving therapy?
   - How would this be different for a child not enrolled in therapy?

13) How are other communication abilities impacted when learning new communication skills?

Finally, I'm going to ask you some specific questions that will help us to design the new questionnaire.

14) Questionnaires use different reference periods to ask parents to recall their child's communications. For example, we might ask about the "past 4 weeks", "past 7 days" or the "past 24 hours". What time period would you would recommend we use?

Probe:
- Why?

15) You had talked about different types of communication ability [*interviewer should mention types discussed like expressive, receptive, pragmatic*]. How do the different types of communication ability overlap with each other?

Probes:
- How does change within one type of communication associate with changes in other types of communication?
- How helpful is having one score from the questionnaire to represent overall communication ability to assess change?
- How helpful is it to have a score for each type of communication ability to assess change?

16) Those are all of the questions I have. Is there anything else you would like to share with me about communication abilities or the development of our caregiver-reported questionnaire?

Thank you so much for taking with me today. Your answers will help us design a better questionnaire.

[Stop recorder]

Interview Stop Time (24 hour clock): _____:_____

Codes	Subcodes	Code ID	Description	Code Type
Typical Day		TD.0	Apply to descriptions of a typical day, including what the child communicates about and who the child communicates with. Include descriptions of when the child is most successful in their communication and communication strengths. Include discussion of access to therapy.	Topical
Gestures		G.0	Apply to descriptions of how the child uses gestures to communicate. Include facial expressions and eye contact.	Topical
Words		W.0	Apply to descriptions of how the child uses words and word approximations to communicate.	Topical
AAC Device		AA.0	Apply to text describing the child's AAC device usage	Topical
Expressive	Refuse	E.0	Apply to descriptions of how the child refuses an object or action	Topical
Expressive	Request	E.1	Apply to descriptions of how the child makes requests. Requests can include physically approaching something, gestures, pulling, etc. Include discussions of how the child ask for attention.	Topical
Expressive	Direct attention	E.2	Apply to descriptions of how the child will draw attention to an object or action.	Topical
Expressive	Comment	E.3	Apply to descriptions of how the child comments. Include descriptions of how the child let's the caregiver know they need to go to the bathroom.	Topical
Choices		C.0	Apply to text describing how the child makes choices	Topical
Challenging behavior		B.0	These behaviors can include things like biting or hitting. These behaviors could be exhibited when the child is refusing, requesting, or something else.	Topical
Pragmatic-Social		P.0	Apply to descriptions of how the child greets people. Include descriptions descriptions of social communication including turn-taking, apologizing, saying "excuse me", etc.	Topical
Receptive		R.0	Apply to text describing examples of the child's receptive communication. Descriptions may be throughout the interview during discussion of expressive and pragmatic communication. Include descriptions of how the child uses facial expressions and eye contact to indicate understanding.	Topical
Changes over time		CT.0	Apply to descriptions of how the child's communication abilities have changed over time. Include descriptions of how device usages has changed. Apply this code to text describing at what age a child started doing a communication behavior. Also, apply this code to discussions of what has changed in how the caregiver supports their child's communication.	Topical
Meaningful changes		MC.0	Apply to text where the caregiver discusses meaningful change. Include descriptions of meaningful change, even if the caregiver does not label it as such. Include discussions of aspirational changes.	Topical

Motivation		M.0	Apply to descriptions of what the child find motivating. Included discussions of what is unmotivating as well, including ignoring something or someone.	Topical/Interpretive
Sounds-Vocalizations		SV.0	Apply to descriptions of how the child uses sounds to communicate	Topical
Mixed Modes		MM.0	Apply to description of the child using 2 or more modes of communication at once. Examples could be using gestures and sounds, sounds and device, or gestures and device. Note to coder: Code both individual modes and Mixed Modes.	Topical/Interpretive
Feelings and Emotions		F.0	Description of feelings and emotions and how it affects communication. How emotions affect preferences. Include descriptions about how illness/sickness affects communication.	Topical/Interpretive

Lizbeth H. Finestack, Ph.D., CCC-SLP
Associate Editor
American Journal on Intellectual and Developmental Disabilities

cc: Frank Symons, Editor

Ref.: Ms. No. AJIDD-D-21-00022R1
Exploring communication ability in individuals with Angelman syndrome: Qualitative Interviews with
Caregivers American Journal on Intellectual and Developmental Disabilities

May 6, 2022

Dear Dr Finestack,

We deeply appreciate this second round of detailed comments and suggestions on our manuscript, titled
"Exploring communication ability in individuals with Angelman syndrome: Qualitative Interviews with
Caregivers " to be considered for publication by the American Journal of Intellectual and Developmental
Disabilities.

We have replied, point by point, to both your comments and those of the reviewers. Please note our
responses to comments are indicated in **bold**, below. Additionally, we have made the relevant edits to the
attached manuscript text, with changed areas highlighted in grey to assist in your review.

Please note, to respond to all reviewer comments while subsequently coming in under the journal's word
count requirement of 5,000 words, we have edited the manuscript accordingly.

Please see our specific responses below.

Comments and Responses:

Editor Comments
1. The lack of representation of minority populations remains a concern. Efforts were made to have
representation of different age groups and genotypes, but not racial or economic groups. This greatly
limits generalization of study results. Having one or two representatives from non-white groups is
insufficient.
**We agree that representation of all caregivers is absolutely critical to the applicability of this
measure to all families. This is an important limitation of this initial qualitative study. We have
strengthened the discussion of this important limitation in the discussion section. We also want to
acknowledge to reviewers, that this work is currently a focus for our study team and is on-going.**

Minor point, the racial composition of parents should be detailed in the Method section, instead of the
Discussion section.
This was moved to the methods section.

2. I agree with Reviewer 1 that the recruitment and eligibility of the clinician participants need to be
better described. I remain confused about the expertise of the clinicians. It is noted that four were MA-
level SLPs and two had PhDs. What was the area of expertise of the individuals with PhDs?

More specific detail has been added to this section to better describe clinicians who were eligible to participate in this study.

3. I agree with Reviewer 2's concern about the inter-rater reliability, one being low and only based on two transcripts. A reliability estimate should be reported for the remaining samples.
We believe the concerns that the reviewers have with the trustworthiness of our approach has been due to the vagueness in which we described how we performed our thematic analysis. We have provided additional details around thematic analysis that we hope will alleviate these concerns. Please note that the methods we utilized for this approach does not make the inter-rater reliability estimates as relevant to our results as other, more quantitative approaches, although we kept in these estimates for the reader's information.

4. I agree with Reviewer 1's concerns regarding the use of the somewhat subjective terms. I remain confused by the lack of numbers provided to describe responses. Given that all responses are coded, is it possible to report the number of caregiver/clinician responses in a particular area (like in Table 5)? I appreciate the examples provided, but It leads me to wonder if they were the only examples available or if they were selected from many.
In addition to the additional details around the thematic analysis approach we used, we have added in the methods section more clear delineation of what our results are showing (descriptions of communication behaviors) and what our results do not show (salience or frequency in the larger population of individuals with AS).

5. Both reviewers and I note that the Results section is difficult to interpret. Results should be reporting on the data, instead of making broad generalizations (e.g., "Individuals with AS request a variety of objects and activities").
We hope that this concern has been alleviated with the additional details of our specific analysis process. As noted in the methods, we utilized thematic analysis, as per Nowell et all, 2017. We designed our qualitative protocols to support 'trustworthiness' of our results, but our approach is different from other more quantitative approaches to qualitative research. After reviewing this additional detail, we are happy to answer additional questions about the pros/cons of this approach.

Reviewers' comments:

Reviewer #1: Thank you for the opportunity to review this revised manuscript. The authors have substantially revised the manuscript based on reviewer feedback which has improved the manuscript. In particular, I appreciate the authors' reorganisation of the results section in response to my suggestion and inclusion of the codebook in the appendix.
Thank you for this comment.

I would like to note that I think it is a shame the authors have had to reduce the meaningful change section and discussion as this was a really interesting and novel section. But I appreciate the constraints of the length of the manuscript and substantial revisions will have impacted the focus and this was not a primary aim of the manuscript.
We appreciate this comment and have added back in some details around meaningful change, as we also feel this was interesting information for readers.

I still have some concerns regarding the level of detail and clarity of the manuscript alongside some general considerations. These are outlined below.

*   The inclusion of further information about the clinical experts is helpful. However, as written, the points regarding eligibility are confusing and the specific eligibility criteria are not clear. The authors note

that "All clinicians had advanced degrees and at least 2 years of experience working with individuals with AS", were these resulting characteristics of the sample or were these requirements to be eligible? Additionally at the end of the same paragraph the authors mention that others with relevant experience were eligible. What was considered relevant experience?

We have added additional information about clinicians, including to better specify the areas of expertise that made clinicians eligible for participation in this study.

*   Furthermore, the authors state that eligible experts were identified by FAST and then recruited by the study team to be screened based on eligibility criteria. Were there further eligibility criteria used by the general study team after initial identification?

More detail has been added about the screening process for clinicians.

*   Can the authors provide more information about how the semi-quantitative terms were intentionally selected when reporting data (i.e. when was 'some' chosen over 'few'?). It is unclear if this was done based on the number times a certain concept was reported, particularly when they state that frequency counts were only calculated for specific aspects of the interview. I am slightly concerned about the potential for misinterpretation or over- or underestimation of the data especially when there is a lack of objective data provided and the sample of people with AS is not characterised (e.g. cognitive/developmental level), meaning we can't conclude how representative the sample beyond age and genetic aetiology. In particular, the comment regarding "some, but not all" parents reporting people with AS commenting about the past. This was an area that was infrequently reported by parents when directly asked in the companion article and was considered for removal from the ORCA.

This is not to say that these skills should not be reported as I think it clearly demonstrates the heterogeneity and variability in communicative ability across people with AS. However, I think careful consideration or justification is required around the broad language used when describing concepts in the absence of objective data.

We believe the major concerns that the reviewers have with the trustworthiness of our approach has been due to the vagueness in which we described how we performed our thematic analysis. We have updated and provided additional details around thematic analysis that we hope will alleviate these concerns.

*   I miss the step about how the conceptual areas reported in tables 2-4 and figure 1 were formulated and/or derived from codes in the methods section.

We have provided more information (table 2) about our methods and how codes were derived.

*   Would be useful to refer to figure 1 in the beginning of the results section.

We have now referred to this figure earlier.

*   Additional data is now presented in the discussion section, potentially due to the extensive revision of the results section. This is predominantly discussion around clinicians, where focus has now been reduced in the results (I.e. discussion of concrete goals). Can these either be added back into the results section or removed from the discussion.

We have confirmed that there are no additional results reported in the discussion section.

Reviewer #2: Thank you for the opportunity to provide a review for the revision of "Exploring communication ability in individuals with Angelman syndrome: Qualitative interviews with caregivers." I want to commend the authors for being very responsive to the initial reviews; this manuscript is much more objective and clear than the original, and I now feel more equipped to comment on the data itself, knowing how it was collected and coded. The use of SRQR is great.

Thank you.

Here are a some comments based on the revision:

The inclusion of 5/22 minority participants is notable. I remain concerned about underrepresentation of diverse voices in the sample, however. Given the methods used for transcribing and analyzing - including quick code methods and minimal quantitative integration - I continue to think that adding more voices to the sample would be helpful and potentially not very burdensome to the authors. Communication (and standards of communication) vary across cultures in important ways, and lower SES/less educated families may use different language and perspectives when describing communication. If the goal here is to develop a measure, it seems important that all potential users are considered. More folks were added to enhance diversity of genotype - why not do the same for demographics?
This is an important limitation. We have highlighted this more clearly in the discussion section as well as the abstract to allow readers to identify this more easily. Please also note that although not described in this formative work, our study team continues to explore the validity of this measure in diverse populations.

The adjusted descriptions of caregivers/parents/clinicians is very helpful and appreciated.
Thank you.

Thank you for adding information about inter-rater reliability. Now I do have some concerns that one of the two transcripts had pretty low reliability (.54) and the interviewers progressed to code the rest without any final checks. I'm not sure what can be done now, but I see this as a moderate weakness.
We appreciate this comment. As discussed above, the methods we utilized for our thematic analysis does not make the inter-rater reliability estimates as relevant to our results as other, more quantitative approaches, although we kept in these estimates for the reader's information. Please also note that all discrepancies were discussed within the study team, and we only moved forward when we were confident that all analysts were fully aware of the definitions of the themes and could apply them appropriately. We also continued to check our agreement using the methods described in Table 2, so that one analysts was not responsible for a majority of the results without discussion, triangulation, and peer checking with the larger study team.

The description and justification for when/how frequencies were reported is really helpful.
Thank you.

I'd suggest adding more frequency data around words and AAC usage given these are Y/N categories that are highly discussed around AS. It would also be helpful to have more information about word regression - what # currently have words, once had words but don't anymore, and never had words?
We appreciate how important this knowledge is to the field. However, this specific phase of the study was not designed to draw conclusions about the frequencies of specific communication behaviors in the larger population of individuals with AS. We believe that this work can be done with a content-valid communication measure in the future, once validation support has been provided for the measure. However, we do have some information around frequency of modality, which is now included in the 'expressive language' section.

I continue to think that adding more developmental information would be very, very helpful. Much of the discussion of the transcripts focuses on the "upper bounds" of skills rather than the lower bounds of skills. I would suggest adding more language around the lower bounds of skills - e.g. "Several caregivers reported little to no ____, with no caregivers endorsing skills in the youngest age group." This clarification and focus on lower bounds is important both for measure development and for potentially normalizing the lower bounds of the AS communication profile. One strategy could be to add a brief subsection at the end of each age section summarizing developmental trends, even if just to note that skills were endorsed with relative consistency across age bands.

We appreciate how important this knowledge is to the field. However, this specific phase of the study was not designed to draw conclusions about the frequencies of specific communication behaviors in the larger population of individuals with AS, nor was it developed to fully describe developmental trends. We do describe age related effects around modality, where we were able to report trends where we had more confidence in the data (for example, only one child in the 2-7 age group used any words or word approximations.) We also note that we focused on a strength-based approach to interviewing caregivers (e.g. '*how* does your child do this' instead of the typical '*does* your child do this') – and more justification for this particular stylistic choice was added to the methods section.

It would be particularly helpful to know when skills are "saturated" within a domain. Do people with AS "peak" in a domain early and maintain consistent skills across age bands, or is there a progression across bands? Is there a broad spectrum of upper bounds reported across individuals, or are people pretty consistent? If the goal is to develop a measure of individual differences, the "shape" and development of skill trajectories is particularly important to describe.
We appreciate how important this knowledge is to the field. However, this specific phase of the study was not designed to draw conclusions about the frequencies of specific communication behaviors in the larger population of individuals with AS nor was it set up to understand skill trajectories outside the individual caregiver experiences.

Relatedly, age of first ____ data were collected but not reported. I understand these data may be complicated due to some younger kids not yet being able to demonstrate a skill they may achieve later in development.. but these data could help contextualize the sample.
We appreciate how important this knowledge is to the field. However, this specific phase of the study was not designed to draw conclusions about the frequencies of specific communication behaviors in the larger population of individuals with AS.

Information on genotype was collected but not mentioned. Similar to age effects, were there differences in genotype, including in terms of lower bounds of skills?
We have some general impressions about genotype, with deletion children generally having less communication behaviors than other genotypes (which is supported by the literature). However, we were not set up in this study to report cross-genotype variations in skills and thus, do not report those here.

When expressive language is described, it would be helpful to clarify whether people with AS expressed themselves via AACs.
We have made some edits to more clearly discuss modality and include that context within the expressive language section. In particular, we have moved the modality section to be subsumed under the expressive language section, and we hope this adds additional clarity.

Some of the tenses are a bit awkward and are reminiscent of the original draft where the authors were not as clear about what exactly was observed/reported in session. For example, "individuals with AS may also express displeasure by using facial expressions.." is a summary rather than a caregiver-reported statement.
We have done a more thorough edit of the document, and appreciate your attention to detail here.

The separation of clinicians and caregivers is helpful. However, I now wonder whether clinicians converged or not with caregivers. Would it be possible to add a brief subsection at the end of each main section discussing convergence? This seems particularly important for the data on meaningful outcomes, where there are some pretty substantial discrepancies in the frequency of clinician versus caregiver input.
Thank you for this recommendation, we saw significant overlap between clinicians and caregivers, while allowing for slightly different perspectives (e.g. caregivers speaking to their child and

experience, with clinicians speaking more broadly). We did not have space to fully articulate this within the manuscript, but for meaningful change, we saw clinicians recommend specific behaviors that they would target with an intervention (e.g., finger point, a symbolic 'no') versus caregivers answering more broadly.