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This study examined the changes in the communication skills of preschool students with autism spectrum disorder (ASD) that resulted from an intervention that featured three evidence-based, transactional approaches to augmentative and alternative communication (AAC) intervention: (a) attributing communicative meaning to student behaviours; (b) providing aided language input; and (c) focusing on graphic symbols representing core vocabulary. Using a mixed-methods design with multiple sources of data (i.e., observation field notes, IEPs, and direct communication assessment), the study was conducted in three classrooms with 6 educators and 13 preschool students with ASD. The purpose was to explore interaction patterns between educators and students while also analyzing improvements in student communication as measured by the Communication Matrix. The results point to a transactional relationship between educators' and students' communication across the three classrooms. This group of preschool students with ASD learned to use abstract graphic symbols representing core vocabulary to request as a result of educators' focus on this requesting. A number of students demonstrated growth in use of non-symbolic communication for social interaction and information sharing as a result of educators' increased use of aided language input.

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Abstract

This study examined the changes in the communication skills of preschool students with autism spectrum disorder (ASD) that resulted from an intervention that featured three evidence-based, transactional approaches to augmentative and alternative communication (AAC) intervention: (a) attributing communicative meaning to student behaviours; (b) providing aided language input; and (c) focusing on graphic symbols representing core vocabulary. Using a mixed-methods design with multiple sources of data (i.e., observation field notes, IEPs, and direct communication assessment), the study was conducted in three classrooms with 6 educators and 13 preschool students with ASD. The purpose was to explore interaction patterns between educators and students while also analyzing improvements in student communication as measured by the Communication Matrix. The results point to a transactional relationship between educators' and students' communication across the three classrooms. This group of preschool students with ASD learned to use abstract graphic symbols representing core vocabulary to request as a result of educators' focus on this requesting. A number of students demonstrated growth in use of non-symbolic communication for social interaction and information sharing as a result of educators' increased use of aided language input.

Many students with autism spectrum disorder (ASD) have complex communication needs (CCN; Wetherby & Prizant, 2000), which lead to difficulty using speech, graphic symbols, or sign language to communicate across purposes (Beukelman & Mirenda,

2013). Yet, these non-symbolic communicators have many means of communication. Whether or not they are used intentionally, these students communicate using a variety of movements, expressions, gestures, and vocalizations (Rowland, 2013). Helping non-symbolic communication improve over time requires educators and other adults to recognize and respond to the intent of all of the forms of communication (Ronski, Sevcik, Robinson, & Bakeman, 1994).

Non-symbolic Communication and Students with ASD

Students with ASD may not use conventional means to communicate non-symbolically. For example, children with ASD make limited use of gestures (e.g., pointing to an item to show or request; Colgan et al., 2007; Watson, Crais, Baranek, Dykstra, & Wilson, 2013). Instead they rely on unconventional forms of communication such as leading an adult by the hand, grabbing an object, or producing a sound associated with an object or action (Prizant & Wetherby, 1987). Importantly, their use of negative affect expressions (Nugai, Hinobayahsi, & Kanazawa, 2017), and other unconventional forms of communication, are often viewed as maladaptive, disruptive, and as lacking in communicative intent (Fox, Dunlap, & Buschbager, 2000). This negative view often leads educators to focus on eliminating the behaviours rather than on attributing meaning to and building on them (Fox et al., 2000).

Students with ASD and CCN often struggle when communication partners fail to attribute meaning to their communicative behaviours (Colgan et al., 2007) and do not help them apply their behaviours in meaningful ways across contexts (Beukelman & Mirenda, 2013). These students may be more successful if communication partners honoured and attributed meaning to all potentially communicative behaviours while helping students learn to use AAC for a range of purposes (American Speech-Language-Hearing Association [ASHA], 2016). In order to learn to communicate for a variety of purposes and to develop autonomy and friendships, students with ASD and CCN need others to help them learn the symbolic equivalents to their non-symbolic behaviours across contexts (Beukelman & Mirenda, 2013).

Aided Language Input

Aided language input is one method of teaching symbolic equivalents to various forms of non-symbolic communication. When providing aided language input, adults point to or otherwise pair graphic symbols with spoken words. Adults can provide aided language input by pointing to graphic symbols that reflect at least some of the words they use in their own speech or by attributing meaning to a student's non-symbolic communication, then demonstrating the use of a graphic symbol to code the interpreted meaning (Ronski et al., 1994). Research supports the use of aided language input as a method to teach symbolic communication to students with ASD and CCN (O'Neil, Light, & Pope, 2018). However, for aided language input to be successful, adults must have access to graphic symbols representing words that reflect at least some of the meaning they are communicating or attributing to students' non-symbolic communication. These symbols can be single symbols that adults point to and pair with single spoken words or more complex sets of symbols that allow them to demonstrate multi-word utterances

(Ronski et al., 1994). The benefit of more complex sets is that they also allow students to develop a deeper understanding of vocabulary, syntax, and social communicative functions (O'Neil et al., 2018; Ronski et al., 1994).

Core Vocabulary

Core vocabulary is one way to provide a fixed set of symbols that adults can use across contexts to provide aided language input (Geist, Hatch, & Erickson, 2014). Core vocabulary describes the words that are used most frequently in face-to-face communication by typical and atypical populations (e.g., Marvin, Beukelman, & Bilyeu, 1994; van Tilborg & Deckers, 2016). Core words are primarily function words that can be used flexibly across contexts and can facilitate both receptive and expressive language (Dukhovny & Zhou, 2016; O'Neil et al., 2018). Unfortunately, there is little evidence pointing specifically to the impact of aided language input with core vocabulary or the practice of attributing communicative meaning to students' prelinguistic communication (O'Neil et al., 2018; Warren, Yoder, Gazdag, Kim, & Jones, 1993).

Theoretical Framework

The current study is framed in a transactional theory of communication development (McLean & Snyder-McLean, 1999; Wetherby & Prizant, 2000). As first described by Barnlund (1970), this theory holds that communication develops as a result of continuous, dynamic interaction between sender and receiver that is influenced by personal, behavioural, and environmental factors that reciprocally impact each other throughout interactions. The transactional theory also considers the interaction between the individual and the individual's own behaviour, which is influenced by personal thoughts and actions. Furthermore, it considers the interactions between the individual and the environment, which is affected by beliefs and cognitive competencies and is modified by social influences. Environment and behaviour also have bidirectional influences, as the individual's actions influences the environment, which in turn, affects behaviour.

The transactional theory framed the current investigation of students with ASD and their communicative behaviours in preschool classrooms as they interacted with the environment, their peers, and the educators who worked with them. The purpose was to examine the implementation and impact of an intervention that featured attribution of communicative meaning and aided language input with graphic symbols representing core vocabulary. The research questions were: (a) How did adults attribute meaning and use aided language input? (b) How did adults' use of attributing communicative meaning and aided language input with graphic symbols representing core vocabulary influence child communication?

Methodology

A convergent mixed-methods design (Fetters, Curry, & Creswell, 2013) combined rich descriptions of the communicative interaction via participant observations with direct quantifiable measures of students' communication form and function. This design

provided specific data regarding changes in child communication in the context of the complex, transactional exchanges among the adult and child participants.

Setting

The study took place in three preschool classrooms situated in a suburban, public, separate and segregated special education school in the southeastern United States. The school serves more than 120 students with significant disabilities aged 3 to 21 years. The three classrooms in the current study, and all but one classroom in the school, participated in a larger project focused on building and evaluating an implementation model that helps teachers learn to address the symbolic communication needs of their students with significant disabilities.

Approval, Recruitment, and Participants

The current investigation was approved by the Office of Human Research Ethics at The University of North Carolina at Chapel Hill and then approved by the school system and the school principal. Next, classroom teachers were recruited, followed by other adults serving students in the classroom (e.g., teaching assistants, speech-language pathologists). Finally, parents or guardians provided consent for the child's participation. For the current study, consents were secured from three classroom teachers, three teacher assistants, two speech-language pathologists, one art teacher, and the parents or guardians of 13 students.

Adult participants. Each of the three teacher participants were licensed by the state to teach children from birth through kindergarten (age 5); they had 12–24 years of teaching experience. Each teacher reported completion of Level 1 training in the Picture Exchange Communication System (PECS; Bondy & Frost, 1994). One teacher also completed Level 2 PECS training. The speech-language pathologists (SLPs) held state licensure and nationally recognized certificates of clinical competence. The SLPs provided training and ongoing support in the use of PECS and aided language input in addition to providing direct services to the students. The art teacher held a license in teaching art and divided her time between two special education schools. Throughout this report, the collective term *educators* will be used to describe the adult participants.

Student participants. Thirteen children (nine male), between the ages of 3 and 6 years ($M = 4$ years 5 months, $SD = 6.3$ months) participated in the study. Each was eligible to receive special education services under the category of autism as determined by the school system. The reported race or ethnicity of the children was White ($n = 7$), Black or African American ($n = 2$), Asian ($n = 2$), multiracial ($n = 1$), and unknown ($n = 1$). All of the children received full-day special education services in the separate classrooms where the study was conducted. Each classroom had a ratio of no more than eight children for each teacher and teaching assistant. All students had an Individual Education Program (IEP), which provided documentation of present level of academic and functional performance, educational goals, and levels of support and services as determined by the IEP team. Assistive technology was indicated on ten of the IEPs, with multiple modes of assistive technology specified for five students including: picture symbols ($n = 8$), aided language board ($n = 4$), and use of PECS ($n = 2$).

Procedures

Starting in the first month and extending throughout the school year, four members of the research team (two SLPs and two special educators, all holding PhDs) provided interactive face-to-face professional development (PD) to all school staff during after-school sessions. Participant observations and teacher interviews were initiated during the first month of school. At the same time, members of the research team completed the Communication Matrix (Rowland, 2013) for each student. Each of these is described in detail below.

Professional development sessions. A range of 20 to 30 educators participated in each of the seven face-to-face PD sessions conducted by the four researchers from August to March during the 2015–2016 school year. Early PD sessions (see Table 1) focused on orienting participants to the larger project, target practices, and the researchers' philosophy that: (a) all individuals have the right to instruction to develop versatile communication, (b) core vocabulary has the potential to support early communication, and (c) teachers can learn the skills to teach symbolic communication. Later sessions focused specifically on supporting educators in attributing meaning and providing aided language input.

Table 1
Topics Addressed During Professional Development Sessions

Session	Topic(s) Covered
1	<ul style="list-style-type: none"> • Overview of the larger project • Teaching principles: augmented language input, core vocabulary, naturalistic teaching
2	<ul style="list-style-type: none"> • Early forms of communication • The Communication Matrix • Importance of personal access to AAC systems with core vocabulary • Augmented language input • Example lesson integrating AAC systems with core vocabulary into shared reading
3	<ul style="list-style-type: none"> • Review of personal access to AAC systems with core vocabulary and supports to select formats to meet individual student needs • Example lessons integrating AAC systems with core vocabulary into common activities, including: art, mealtime and shared reading
4	<ul style="list-style-type: none"> • Integrating AAC systems with core vocabulary into literacy instruction <ul style="list-style-type: none"> ◦ Shared reading ◦ Predictable chart writing
5	<ul style="list-style-type: none"> • Review of project goals • Exchange of examples of specific ways teachers integrate AAC systems with core in their everyday instruction
6	<ul style="list-style-type: none"> • Use of AAC systems with core vocabulary during daily routines
7	<ul style="list-style-type: none"> • Attributing meaning • Encouraging versus requiring communication • Modeling communication versus managing behaviours • Ways to support communication of <i>yes</i> and <i>no</i>

AAC supports and systems. Historically, the participating preschool classrooms implemented PECS until students mastered Phase IV—Sentence Structure, as defined by the PECS protocol (Bondy & Frost, 1994). Only then were students provided with an “aided language board” (Figure 1) created by one of the site’s SLPs. The board has 65 symbols including 54 core vocabulary and symbols representing colors. In the current study, teachers were encouraged to introduce the school’s aided language board from the beginning regardless of the students’ level of success with PECS. The classrooms continued to implement PECS as usual, predominantly during mealtimes (i.e., snack and lunch) and structured play interactions with adults. The aided language board was also used during mealtimes by two classrooms. Unlike PECS instruction, use of the aided language board was encouraged via aided language input throughout the school day.

**Figure 1. The Research Site’s Aided Language Board
Using Picture Communication Sources of Data**

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The convergent mixed-methods study involved both qualitative and quantitative data. Qualitative data included field notes from classroom observations, pre-and post-interviews with teachers, IEPs, and photographs. Observations were conducted by four PhD researchers (2 SLPs, 2 special educators) and one research assistant (SLP). At least two different researchers documented observations in each of the three classrooms. The observers had different background experiences, biases, and expectations that influenced their observations (Freeman, deMarrais, Preissle, Roulston, & St. Pierre, 2007), which served to increase the trustworthiness and credibility of the research by balancing individual biases (Krefting, 1991). Twenty-nine sets of field notes were collected using live, open-ended observations of instructional routines ranging in length from approximately 15–45 minutes (see Table 2). The field notes were recorded by researchers using laptops with the purpose of capturing communication interactions among students

and educators with specific attention to attributing meaning and using aided language input with core vocabulary.

Table 2
Number and Length of Field Notes of Classroom Observations

Classroom	Number of Classroom Observations	Duration Average (Range)	Total Pages*
Classroom A	10	30 min (17–50 min)	26
Classroom B	9	25 min (10–40 min)	25
Classroom C	8	26 min (20–29 min)	22

* Pages are US letter with 12-point font, single spacing.

Typically, observations occurred during the morning meal and during small-group and large-group instruction. Small-group instruction involved teacher-directed, structured activities at multiple tables involving games and sensory play. Large-group activities included circle time, art lessons delivered by the art teacher, and a science lesson that included all three of the classes together.

Communication Matrix. The Communication Matrix (“the Matrix”; Rowland, 2013) was used to assess student communication skills pre- and post-intervention. The Matrix is an assessment tool for individuals of any age who communicate at the pre-symbolic and early symbolic levels and can be used to assess all types of communication including speech, alternative forms of symbolic communication (graphic symbols, speech generating devices, sign language) and pre-symbolic communication (facial expressions, body movements, eye gaze, and sounds). The Matrix covers seven levels of communication from pre-symbolic (i.e., pre-intentional behaviours, intentional behaviours, unconventional and conventional communication) to symbolic communication (i.e., concrete symbols, abstract symbols, and symbol combination or language) across four communication purposes (i.e., refusing, obtaining, social, and information). The Matrix was completed by members of the research team during a series of pre- and post-observations scheduled specifically for this purpose.

Teacher interviews. All three teachers were interviewed a month after the first PD session and again after the last PD session. As part of the analysis, the information teachers shared about their training, experience, knowledge, and skills in the area of communication were considered in relation to the communication instruction that was reported in the field notes.

Analysis

A mix of qualitative and quantitative approaches were employed to analyze the various sources of data beginning with field notes.

Field notes. Inductive open coding was used to analyze the field notes for instances of transactional language learning and use, without testing hypotheses or applying codes identified a priori. Constant comparative analysis was then used to seek commonalities in themes and concepts (Glaser, 1965; Strauss & Corbin, 1990). Axial coding (Kelle, 2017)

was then used to highlight segments of text that could define, then confirm the prevalence of student and teacher communication patterns. Analytical memos (Bex Lempert, 2011) supported reflection on themes, concepts, and theoretical insights drawn from field notes.

The open-coding process was complemented by coding that helped to characterize each instance of student and adult communication. For students, the coding focused on differentiating between behaviours that were communicative, intentional, and/or symbolic while identifying the purpose or intent of each communication act. For educators, the coding helped identify when they attributed meaning or provided aided language input and the communicative intents they demonstrated. As described in Table 3, this coding involved a series of seven passes through the field notes for the students and four additional passes for the educators.

Table 3
Coding Child and Educator Communication Acts

Pass	Student Communication	Educator Communication Instruction
1	Each reported student behaviour is coded as: non-intentional communication OR intentional communication act	Each educator communication act that involves aided language input is identified
2	Each student's intentional communication act is coded as: symbolic OR non-symbolic	Each educator use of aided language input is coded as: aided language input without prompting techniques
3	Each student's symbolic communication act is coded as: conventional communication OR unconventional communication	Each educator–student interaction that includes attributing communicative intent to students' non-symbolic communication is identified.
4	Each student's non-symbolic communication act is coded as: conventional non-verbal communication OR intentionally communicative	The communicative intent* of the symbols demonstrated by educators during aided language input is coded.
5	The communicative intent* of each student's intentional non-symbolic communication act is coded.	
6	Each student's non-intentional, non-symbolic communication act is coded as atypical vocalization or repetitive behaviour.	
7	The communicative intent* of each student's non-intentional, non-symbolic communication act is coded.	

* The communicative intent was coded as: refuse, obtain, engage social, inform, and unclear.

After the first author completed the coding detailed in Table 3, a second coder worked with her to code a randomly selected subsample of 20% ($n = 6$) of the field notes. The percentage agreement ranged from 90% to 100% for the communicative meaning of students' non-symbolic and symbolic communication, and the percentage agreement for the communicative meaning of educators' use of aided language input was 86.6% as coded through passes 1–4 using consensus coding.

Communication Matrix. The pre- and post-test communication levels for each student were compared using a one-tailed Wilcoxon Rank Sum Test. This test was selected because the Matrix yields ordinal data that was compared for a single sample across two measurements.

Results

The results are reported here with reference to the research questions. In each case, relevant qualitative and quantitative data are reported separately. Throughout the results, words that were communicated by pointing to a symbol appear in all capital letters with symbols selected in sequence marked by the “+” symbol.

The Use of Attributing Meaning and Aided Language Input

Attributing meaning. Throughout the PD sessions, educators were encouraged to attribute meaning to all student communication acts; however, the behaviour was observed in fewer than one third of all observations. Each time it was observed, educators demonstrated symbols to request or to provide information after attributing meaning to the students’ non-symbolic behaviour. For example, teachers were observed pointing to symbols while saying, “I +WANT” and asking questions such as, “Do you WANT?” after observing a student reaching or grabbing during mealtime. Sometimes, teachers were observed attributing meaning and working to confirm their interpretation of the student’s intended meaning. For example, the following excerpt from field notes describes one teacher’s efforts to attribute meaning to what was described by the researcher as a “happy noise.”

The teacher asked the student, “Are you finished?” The teacher then turned her palms up and asked, “All done?” The student looked at the teacher and smiled, and the teacher responded by saying, “No, you want more cereal?” Then the teacher demonstrated the symbols, “YOU+WANT+MORE” while speaking the words.

When the SLPs were present during observations, field notes included more evidence of attributing meaning to students’ communication behaviours. For example, in response to a student reaching, the SLP said, “You WANT that.” On another occasion, a student pointed to the word DIFFERENT on the aided language board, and the SLP repeated the selection and added GO, attributing the meaning that the student wanted to go and do something different.

Students were observed using non-intentional and intentional communication acts to engage socially (e.g., look, touch others) and protest (e.g., cry, drop to the floor, push away), but educators did not attribute meaning to these acts or use aided language input to demonstrate symbolic equivalents. There were also no reported observations of educators attempting to demonstrate or otherwise teach gestures or other conventional means of engaging socially or refusing, even though these were addressed in PD sessions. Instead, educators responded to these communication behaviours in ways that suggested they viewed the behaviours as maladaptive. For example, in response to one child’s screams, the teacher said, “We can’t do this” rather than attributing meaning and demonstrating a symbolic equivalent using aided language input.

While educators attributed communicative meaning to students' behaviours infrequently, they frequently provided aided language input. In fact, use of aided language input appeared in nearly three quarters of the field notes. Educators were regularly observed pointing to symbols as they were speaking or demonstrating symbols they wanted the students to use, but they rarely demonstrated symbolic equivalents to students' non-symbolic communication attempts.

Aided language input. During PD sessions, educators were taught to use aided language input by pointing to symbols while speaking without the expectation that students would imitate the use of the symbol at that time. They were also specifically taught to avoid using prompting, including verbal, visual, and physical prompts like hand-over-hand support, to teach students specific symbolic communication acts. While pointing is often a prompt, educators were taught that they were pointing to symbols to demonstrate their use rather than pointing to prompt a specific response from a student.

In Classroom "A," aided language input with core vocabulary was noted at least twice in one observation within the first month of school and was noted in nearly all of the observations (more than 90%) throughout the school year. In Classrooms "B" and "C," aided language input was not observed until the fourth month. However, once educators started, it was noted at least twice during most of the subsequent observations. Educators used aided language input to demonstrate symbols to request ($n = 147$), provide information ($n = 86$), and engage socially ($n = 8$). The symbols the educators used most frequently during aided language input were WANT, ON, FINISHED and LIKE. Each was used to request and provide information.

In spite of specifically being discouraged from using prompting during aided language input, the educators continued providing hand-over-hand support to physically move the students through the motion of touching symbols that educators first demonstrated via aided language input, especially during mealtime when the focus was on the use of PECS. Using a structured approach, with this physical prompting, students were taught to build and exchange a sentence strip by selecting a single symbol that represented the two words, I WANT. Then the student added a symbol representing a desired food item.

Over time, educators began to encourage but not require symbol use throughout the day. One example was seen as students played at a sensory table, a teacher asked, "YOU + WANT a TURN?" The student responded by standing up. The teacher assistant, who had previously directed and controlled which symbols students selected, stepped in to support the student and said, "Tell her, I WANT a TURN." This time, however, she did not require the student to select the same symbols in response. Instead, she added, "You want MORE? Do you like the way it FEELS? You love the way it FEELS." The teaching assistant attributed meaning to the students' communication act of standing up but not moving. Equally important, as the teaching assistant pointed to FEELS and built on her initial comment, she demonstrated an understanding that aided language input is a means of demonstrating the use of graphic symbols that does not require immediate imitation or use by the student.

Overall, educators were more likely to provide aided language input to match their own speech than they were to demonstrate a symbolic equivalent for the meaning they

attributed to a student's non-symbolic communication. However, this began to shift as educators participated in the ongoing PD sessions and incorporated aided language input into their daily routines.

The Impact of Attributing Meaning and Aided Language Input

Prior to the introduction of the aided language boards, most of the students only had individual access to symbolic communication when they were told to get their PECS books during mealtime and structured, 1:1 play. The increased access to graphic symbols that accompanied the introduction of the aided language boards helped students begin to connect the symbols to communication and led students to look, hold, rub, touch, and use an isolated finger to point to symbols to explore the effects of such an action or to intentionally communicate. The students also began to seek out the aided language boards outside of mealtime.

The biggest increase in student use of the aided language board was noted in Classrooms "A" and "C," where teachers provided the most frequent individual access to the board and were observed providing aided language input most frequently. This is in contrast to Classroom "B," where students were rarely provided individual access to the aided language board and adults rarely provided aided language input during observations.

When students had access to aided language boards and educators who attributed meaning and provided aided language input, students began to use the aided language board to communicate. It began with requesting, using single symbols representing EAT, DRINK, and STOP, but included the use of symbols to inform with FINISH.

Symbolic communication. The meaning of the students' symbolic communication overwhelmingly served the function of requesting. Requesting occurred most frequently during meals, when students had access to core vocabulary and their PECS books (97 symbols selected). The number of symbols used decreased dramatically during small group (35 symbols selected) and large group (6 symbols selected) instruction, when PECS books were never available and aided language boards were rarely available. The students were occasionally observed using symbols to provide information (19 symbols selected) but rarely used symbols to engage socially (2 symbols selected) or to refuse (1 symbol selected).

On rare occasions, students did combine symbols using the aided language board, PECS sentence strips, and a combination of core plus nouns in *flip-core* books that one of the SLPs introduced when she began to see children combining their use of the aided language board with the nouns in the PECS book. The flip-core books had the aided language board as the base and a set of nine category-based pages (e.g., places, body parts, drinks, food) of a single row of nine symbols from the PECS books attached flip-style along the top. Unfortunately, this flip-core board, the aided language board, and the PECS books were not consistently available to students, which decreased opportunity to develop these skills over time and across activities and settings.

Non-symbolic communication. Students engaged in a variety of non-symbolic yet intentional communication acts reflecting the purposes of sharing information,

requesting, engaging socially, and protesting. Not surprisingly, use of non-symbolic communication was most prevalent when students did not have access to the aided language boards, their PECS books, or the flip-core book. For example, when none of these communication supports were available during group instruction, students often communicated that they were “all done” by standing up. They communicated a desire to obtain something by reaching or grabbing. They sought help by handing an item to an adult, and they engaged in social acts that appeared to be efforts to attract attention by smiling, clapping, or touching another student or educator. Other social communication acts included students watching their peers eat, cry, play, and use the aided language board. Students were also observed joining another student in a centre and walking around the classroom together. Finally, students refused or protested using vocalizations such as whining, screaming, crying, demonstrating visible signs of distress and sadness with tears, banging the table, and other gestures. The preponderance of the students’ non-symbolic communication served the purpose of protesting or refusing, which could both be demonstrated using symbols on the flip-core board or aided language boards, but educators consistently missed these teaching opportunities.

Changes in students’ level of communication complexity. The Matrix was examined to determine the highest level of communication used by students regardless of communication purpose at pre- and post-intervention. Secondly, the highest level of communication was determined for each of the four individual purposes assessed by the Matrix (refuse, obtain, social, and information). The average highest level of communication for the 13 students at pre-test was 5.31 ($SD = 1.11$) with an increase to 5.69 ($SD = 1.44$) at post-test. One-tailed Wilcoxon signed-rank tests indicated that the median post-test ranks were significantly higher than median pre-test ranks for overall level of communication ($Z = .000$, $p > .05$, $r = 0.00$). Additionally, the pre-test average for obtaining 4.92 ($SD = 1.19$) increased to 5.46 ($SD = 1.81$) at post-test with eight students demonstrating progress toward conventional symbolic communication; and the pre-test average for social communication, 3.54 ($SD = 1.39$), increased to 3.69 ($SD = .89$), with four students demonstrating progress toward more conventional communication. While the gains in these two areas are meaningful, one-tailed Wilcoxon signed-rank tests indicated that the median post-test ranks were not significantly higher than median pre-test ranks for individual purposes of communication of obtaining ($Z = 0.412$, $p > .05$, $r = 0.110$) or social ($Z = .106$, $p > .05$; $r = .028$) communication. Furthermore, the average pre-test level for refusing ($M = 3.92$, $SD = 1.75$) did not increase at post-test ($M = 3.33$, $SD = .98$). On the information scale, students must be communicating conventionally to receive a score; therefore, no pre-test–post-test comparison can be made with this group of students.

Summary

The preschool students in this study made overall gains in their level of communication complexity. At the same time, the educators who worked with them demonstrated increasing use of attributing meaning and aided language input. While the educators did not apply all of the practices they were taught in PD sessions, and they missed many opportunities to support communication development for the students, the

practices they did implement appear to have supported improved communication for some students across some purposes.

Discussion

The current investigation was designed to explore the transactional communication that resulted when teachers learned to combine attributing meaning, aided language input, and a core vocabulary approach with their preschool-aged students with ASD. The eight-month, mixed-methods investigation highlights the importance of the transaction among educators, children, experiences, beliefs, skills, and the environment in supporting early symbolic communication.

Consistent with theoretical descriptions of transactional communication (Alcorn, 2016), learning in the classrooms in this study was influenced by the students, participatory expectations and requirements, educator communication style, educator epistemology and pedagogy, and access to aided AAC supports. In the current study, educators' symbolic communication instructional style and actions appeared to be influenced by their prior training with PECS as well as by their observations of and interactions with the students and by participation in the PD that was part of the larger project. For example, the teachers' prior training in PECS understandably led them to focus on using AAC to teach students how to obtain desired items using a structured approach to modeling and requiring students to imitate responses. When the students did not comply, verbal or physical (hand-over-hand) prompting was used. Over time, two of the teachers shifted their practice as a result of the PD and started focusing on teaching students to communicate their own intentions through increased availability of the aided language board and decreased prompting. Each educator integrated the practices in different ways, but each was influenced in some way by the triadic elements of transactional communication.

The students did not always use clear conventional communication, which made it challenging for adults to attribute meaning (Colgan et al., 2007; Cress, Grabast, & Burgers Jerke, 2013). The educators were less likely than SLPs to attribute communicative meaning to students' non-symbolic behaviour, most likely as a result of differences in pre-service training (Carter & Iacono, 2012). Repeated exposures during PD sessions to the cycle of attributing communicative meaning (Warren & Yoder, 1997) and mapping that meaning to symbolic language (Warren et al., 1993) during aided language input as a means of increasing intentional communicative behaviours (Warren et al., 1993) while improving expressive and receptive language (Yoder, McCathren, Warren, & Watson, 2001), was insufficient to shift teacher behaviours. However, when the practice of attributing meaning was called out as a separate practice in Session 7, it became more prevalent across the classrooms.

Although there were some increases in the practice of attributing meaning to student's communication attempts, there were many missed opportunities throughout the year. The students in this study used vocalizations (e.g., whining, crying), emotional affect (e.g., smile), body movements, and whole-body reactions (e.g., run away, scream and drop to the floor) in ways that could have been viewed as efforts to communicate refusals or protests; unfortunately, many of these behaviours were viewed as

maladaptive, and efforts focused on eliminating them rather than on teaching more conventional alternatives. These externalizing behaviours are difficult for many children with ASD to inhibit and often serve a communication purpose (Nugai et al., 2017). Teaching students with ASD to request can reduce some of these externalizing behaviours (Bondy & Frost, 1994); however, increased requesting leads to increased opportunity for denial, which can trigger more externalizing problems (Nugai et al., 2017). In the current study, this cycle likely contributed to the externalizing behaviours that educators viewed as maladaptive.

The long-term aim of AAC instruction is to help individuals express whatever they want, to whomever they want, whenever they want (Erickson & Koppenhaver, 2018). Aided language input is an instructional method that can help students move toward this goal (O'Neil et al., 2018); however, it requires access to symbols that represent words that are meaningful across contexts. In the current study, core vocabulary presented with graphic symbols filled this need and allowed educators to provide aided language input across instructional contexts. Increased access to AAC beyond mealtime, and the evolution of the type of AAC systems students used in the current study seemed to follow student success in learning to use core vocabulary to communicate. By participating in PD sessions, the educators learned the role of core vocabulary within language and communication instruction and ways to incorporate it beyond requesting in the classroom. Eventually, educators began mounting aided language boards onto tables and in play centres around the classroom. They also added aided language boards to the inside front cover of students' PECS books. These changes in access to core vocabulary in the environment was associated with increased variety of student use of symbolic communication.

Limitations and Future Directions

This study is an important first step toward understanding how educators in preschool classrooms can use aided language input, attribute meaning, and use core vocabulary to support the early symbolic communication of young children with ASD; however, it is important to note several limitations. First, the study involved a single group of students who were young enough that there is reason to believe they would make progress in communication as a result of maturation. Future research should more systematically control for maturation.

This study is also limited by the fact that it was a secondary analysis of data collected as part of the larger investigation. Nonetheless, the field notes provided a rich description of the communication context and educator-child interactions and offered insight into the transactional communication development that occurred when re-analyzed for the current study. Future efforts might involve more systematic observations.

A final limitation is that students' classification of ASD was determined by the school team not the research team. All students received special education services under the eligibility category of autism, but the source of this determination was not available to the researchers. Furthermore, information regarding the severity of ASD and cognitive and linguistic skills was unavailable. The Communication Matrix (Rowland, 2013) did provide

important information regarding each students' level of communication complexity across four purposes for communication, but future research should consider additional measures of receptive and expressive communication, cognition, and severity of ASD.

Conclusion

This study suggests that preschool students with ASD can learn to use core vocabulary to communicate for at least some purposes when educators attribute meaning to their behaviours and demonstrate the use of graphic symbols representing core vocabulary through aided language input. This study also demonstrates that it is challenging for at least some educators to adopt these new approaches when their previous training has emphasized teaching targeted communication behaviours using systematic prompting and symbols with concrete referents.

This mixed-methods investigation revealed specific interaction patterns between educators and students that appeared to impact the frequency and success of child communication efforts. Through the triadic, transactional relationship between educators, students, the classroom environments, and the availability of a variety of aided AAC supports, this group of preschool children with ASD learned to use abstract graphic symbols representing core vocabulary to request and demonstrated increased use of conventional non-symbolic communication for social engagement and information sharing.

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