Murray, Janice, Sandberg, AD, Smith, MM, Deliberato, D, Stadskleiv, K and von Tetzchner, S (2018) Communicating the unknown: descriptions of pictured scenes and events presented on video by children and adolescents using aided communication and their peers using natural speech. Augmentative and Alternative Communication, 34 (1). pp. 30-39. ISSN 0743-4618

Publisher: Taylor & Francis

DOI: https://doi.org/10.1080/07434618.2017.1420690

Communicating the unknown: descriptions of drawings and video events by children using aided communication and natural speech.

Janice Murray[1], Annika Dahlgren Sandberg[2], Martine, M, Smith[3], Débora Deliberato[4], Kristine Stadskleiv[5], Stephen von Tetzchner[6]

[1]Manchester Metropolitan University, UK, [2]Gothenburg University, Sweden, [3]University of Dublin, Trinity College, Ireland, [4]State University of S. Paulo, Julio de Mesquita Filho, Marilia Campus, Brazil, [5]Oslo University Hospital, [6]University of Oslo, Norway

Abstract

The facility to describe scenes and events is important in everyday communication, but little is known about the description skills and strategies of young people using aided communication. This article explores how 81 children and adolescents using aided communication and 56 peers using natural speech, aged 5–15 years, described pictured scenes and events presented on video to a partner who had no prior knowledge of the content. The group who used aided communication took longer and included fewer elements in their descriptions than the reference group; however, the groups did not differ in their use of irrelevant or incorrect elements, suggesting that both groups stayed on topic. Measures related to aided message efficiency correlated significantly with measures of spoken language comprehension. There was no significant difference between groups for their descriptions of pictured scenes and video events. Analyses showed both unpredicted group similarities and predictable differences, suggesting key components for future research consideration.

Key words: Aided language; Peers; Pictured scenes; Video events; Co-construction

Communicating the Unknown: Descriptions of Pictured Scenes and Events Presented on Video by Children and Adolescents Using Aided Communication and their Peers Using Natural Speech

Effective interactions between speaker and listener enable a co-constructed understanding of the context or situations being considered (Grice, 1975). Descriptions are important elements in everyday interactions and often involve conveying information that is unknown to a communication partner. Research evidence to support our understanding of the impact of aided communication use in conveying something unknown to a conversational partner remains limited (e.g., Lund & Light, 2007; Smith, 2015). Children using aided communication have more experiences where their partner already knows what is about to be communicated and have access to a more limited range of communication partners (Clarke & Kirton, 2003; Soto & Starowicz, 2016). Often parents and other adults establish communication routines with known or highly predictable communicative content to ensure communicative success and avoid communication breakdowns (e.g., Binger & Light, 2007; Smith, 2006).

Where research exists, techniques used to explore what children and young people do when presented with novel information have included the use of picture material and video sequences. For example, video sequences without dialogue have been used to evaluate the narrative components generated by children aged between 6 and 11 years (Eaton, Collis, & Lewis, 1999). The younger children tended to label elements or actions from the video event while the older group narrated an evaluative summary of the event depicted. DeLoache and Burns (1994) explored the representational function of picture material and how very young children inferred meaning from these pictures to complete a hiding game. They demonstrated that children as young as 27 months could use picture material to understand and map to real world referents. While we could find extensive examples of the use of picture-based material used in barrier and narrative tasks within the AAC research literature (Smith, 2015; Stephenson, 2009), we found many fewer examples of the use of video material (e.g., Soloman-Rice, Soto, & Heidenreich, 2017) and none where these two forms of visual representation were compared. Also of note when reviewing this literature were the types of events depicted. For the most part, but not exclusively, pictured scenes or video events were familiar and therefore highly predictable in terms of the amount of aided language output that would be required for a conversational partner to understand the intended message (Nelson, 2007). Identifying and relaying the relevant elements of pictured scenes and video events may be demanding for all children but research suggests that reduced variation within communication routines may make this more challenging for young people using communication aids (Bornman, Alant, & Du Preez, 2009; Brekke & von Tetzchner, 2003; Murray & Goldbart, 2009; Smith, 2003). Furthermore, the focus of recent research explores output from the child in terms of vocabulary and grammatical structures produced, with less consideration of the type and complexity of the stimulus materials used to elicit responses (Sutton, 2016). Sutton suggests that revisiting the influence of the stimulus materials may help us to consider converging evidence on the impact of task demands if the same child completes more than one type of task. In particular, research that explores processes involved in deconstructing the complexity of images, in terms of their gestalt or their component parts and colour and visual orientation, could offer insights into the impact on participants' understanding of the task and related outputs (Dada, Huguet, & Bornman, 2013).

The motivation for the current study was to explore the impact of task demands on the descriptions young people produced. These demands included conveying unknown and unpredictable content to a communication partner for pictured scenes and video events. The inclusion of two types of task, pictures and videos, enabled consideration of static and temporal influences on the elements prioritized and included by the young people. Both tasks draw on a number of interrelated cognitive and linguistic skills (Benigno & McCarthy, 2012; Murray & Goldbart, 2011; Stadskleiv et al., 2014). These may include pragmatic demands (Norbury, 2014), the impact of life experiences and opportunities (Soto & Hartmann, 2006), aided language construction demands (Binger & Light, 2008), and access demands, including executive function demands and physical effort involved (Norbury, 2014; Stadskleiv et al., 2014; Thistle & Wilkinson, 2013). The decisions that children have to make in choosing what to offer as key components to describe a pictured event or video scene may be influenced by their language skills, world knowledge and communicative competence (Light & McNaughton, 2014). Investigation of interactions where aided communicators need to relay specific visual information that is unknown to the conversation partner may contribute to our understanding of the production characteristics associated with real-time description activities (Dada et al., 2013; Smith, 2015).

The present study details the performance of children and adolescents who use aided communication and peers using natural speech in describing pictured scenes and short events presented on video to a communication partner. The following research questions were investigated:

1. How does the performance of children and adolescents who use aided communication contrast with that of a reference group of peers using natural speech when their task is to relay to a partner the content of pictured scenes and events shown on video?
2. What individual characteristics are associated with the performance of the participants using aided communication?

3. How does the material presented (pictured scene versus video event) influence the performance of the aided group and the reference group?

Method

The present study is part of the international project "Becoming an Aided Communicator (BAC): Aided Language Skills in Children and Adolescents aged 5–15 years: A Multi-site and Cross-Cultural Investigation," which involves participants from 16 countries and different languages. The project includes 14 tasks designed to explore the participants' understanding of aided language and their use of aided language in communication with a partner in activities resembling everyday activities. The project received ethical approval in each participating country according to national procedures in each country.

Participants

There were two groups of participants: (a) children and adolescents who used communication aids (aided communicators), and (b) children and adolescents who used natural speech (reference group) and their communication partners. Participants who used aided communication were recruited with the help of professionals in the specialized health care and special education systems in each of the countries and regions. A search was made for individuals who met the following criteria: (a) were aged between 5 and 15, (b) had speech production that was absent or very difficult to understand, (c) had speech comprehension considered adequate or near adequate for age, (d) had used communication aid(s) for a minimum of one year, (e) had normal hearing and vision (with corrective technology), (f) were not considered to be intellectually impaired by their teachers, and (g) did not have a diagnosis on the autism spectrum.

The function of the reference group was to obtain information about how a group of children of the same age, who did not need to use AAC, would do the 14 tasks. The aim was to provide a contextualizing background and reference point. The children and adolescents in the reference group were recruited from the class of the aided communicator, or from a class in the closest school in the same type of neighborhood (e.g., rural or urban) if the aided communicator went to a special school. The reference participant had the same gender and was the student in the class who was closest in date of birth to the aided communicator. All the participants in the reference group were naturally speaking, had vision and hearing within the normal range (or with corrective technology), had no known learning disabilities, and attended mainstream preschools or schools.

Communication partners in the study were parents, peers, and teachers of the aided group, and teachers and peers of the reference group. The peers were friends whom the aided communicators knew well, and they had experience in communicating together. A few of the children in the aided group were unable to suggest a friend, and instead a sibling near in age functioned as communication partner.

There were 81 participants in the aided group (44 female, 37 male) and 56 participants in the reference group (34 female, 22 male), aged between 60 and 191 months (Table 1).

Insert Table 1 about here.

There were 13 countries represented in the data set, with Dutch, English, Finnish, German, Portuguese (including Brasilian), Mandarin, Norwegian, Spanish and Swedish languages represented. To assess comprehension of single spoken words, either the British Picture Vocabulary Scale, second edition (BPVS-II; Dunn, Dunn, Whetton, & Burley, 1997) or the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2007), third or fourth edition, was used, depending on which of these tests offered relevant national norms. The Test for the Reception of Grammar, second edition (TROG-2; Bishop, 2003) was used to assess comprehension of spoken grammar, applying relevant language-specific norms. Non-verbal reasoning skills were assessed with Raven's Matrices, either the colored version (Raven, 2008) or the standard matrices (Raven, Raven, & Court, 2000), or with matrices from the Kaufman Brief Intelligence Test (KBIT; Kaufman & Kaufman, 2004). All results are reported as *z*-scores. Table 1 shows that the participants in each sample varied in age, gender, language comprehension and cognitive function. There was no statistical difference in age between the two groups, $F\ (1, 135) = 0.071$. There were more girls than boys in both groups, and no statistically significant difference in gender distribution between the groups, $\chi 2\ (1, N = 137) = .552, p = .458$. The groups differed, however, on scores on non-verbal reasoning (Raven's matrices/KBIT), $F\ (1, 69) = 29.07, p < .001$, on receptive vocabulary (PPVT/BPVS), $F\ (1, 73) = 19.46, p < .001$, and on receptive grammar (TROG), $F\ (1, 53) = 6.73, p = .012$, with reference peers outperforming participants who used aided communication.

Prior to commencement of the data collection tasks, the aim was to describe participants using a number of classification tools (Table 2). These measurement sources all take an ordinal scaling approach to classification, and include data from four published rating scales. One unpublished rating scale was developed by members of the project. The participants' gross motor skills were classified using the Gross Motor Functional Classification System (GMFCS), a five-level system for children with cerebral palsy (Palisano et al., 2007). Their ability to handle objects during everyday activities was classified with the Manual Ability Classification System (MACS), a five-level classification for children with cerebral palsy (Eliasson et al., 2006). In all, 81% of the aided communicators had GMFCS Levels IV or V, and 71% had MACS Levels IV or

V indicating that most used a wheelchair for mobility and had severely limited ability to handle objects.

Insert Table 2 about here

The quality of the participants' speech production was classified with the Viking Speech Scale (VSS; Pennington et al., 2013), a four-level classification system, where Level IV indicates no understandable speech. All the aided communicators had VSS Level III or IV, reflecting that they had no or very little functional speech. A five-level Communication Functioning Classification System (CFCS) for children with cerebral palsy was used to classify the participants' everyday communication on the basis of their performance as senders and receivers, and pace of communication with familiar and unfamiliar partners (Hidecker et al., 2011). On CFCS, scores in the aided group were relatively equally distributed across Levels II and III, with 77.5% of the aided communicators being effective senders and receivers of information with familiar conversational partners, of whom almost half (42.3%) were also effective communicators with unfamiliar partners. However, 19.7% of the aided group were inconsistent senders and receivers of information with familiar conversational partners (Level IV on CFCS) . On the Smith-Dahlgren Sandberg Spelling Scale (SDSS)[1], 32% of the aided communicators were text reliant, 26% were rated as emerging spellers, 8% were rated as reluctant spellers, and 34% did not spell.

Of the participants who used aided communication, 51 (63%) used graphic communication, 19 (23.5%) used orthographic communication, and 11 (13.6%) used a combination of graphic and orthographic communication. Four types of graphic systems were in use: PCS, Pictograms, Blissymbolics and Minspeak™. These were displayed on communication boards, books, eye-transfer frames, and electronic devices. These systems offered participants access to a different range of vocabulary. In terms of operational access, two-thirds (*n* = 55, 67.9%) of the participants were able to directly access their communication aid, 13 (16.0%) used high-tech scanning and 13 (16%) used scanning assisted by a partner.

Materials

The BAC research team developed 14 project-specific comprehension and expression tasks. Although no piloting of materials occurred, tasks were developed with the needs of a cross-linguistic and culturally variant participant group in mind. Research team members led the sourcing or creation of BAC specific task materials (see XXX this issue). Two BAC tasks are reported here: Pictured Scene and Video Event.

Pictured Scene. The first task, Pictured Scene, consisted of eleven items, including three training items. The task required participants to describe a scene in a picture to a communication partner (who could not see the picture) in such a way that the partner would be able to understand its content and provide a description of the image. The items included a combination of believable and unlikely scenes. Believable items included a girl looking out from behind a tree; unlikely examples included a horse balancing on an elephant with a bird standing on the horse. The picture material, all hand drawn and coloured by a member of the research team, varied in visual and cognitive complexity. All picture materials included an actor and an action or location, and some required a narrative evaluation (e.g., a man in front of a mirror, a man looking away from the mirror, and the mirror showing the face of the man.

Video Event. This task consisted of three training items and 15 test items. The participant described a short video event to a partner who had not seen the video. Similar to the Pictured Scene task, the videos included a combination of believable and unlikely events (e.g., a girl using a wheelchair driving along a road; and a man walking a pineapple on a lead, as if he might walk a dog). A member of the research team filmed the video material. All videos were silent to make them accessible regardless of the linguistic context of each participating country. The video material varied in length and narrative complexity. All video events included actor/s and actions, that in some instances required narrative evaluation (e.g., a girl eating a cake, a boy steals the cake, the girl shows clearly that she is angry).

Procedure

Research partners in all participating countries followed the same procedures to introduce the materials. Two verbal instructions were provided and the research room was organized in a specific way in relation to the stimulus materials used. Both the aided group and the reference group participants were provided with the following verbal instruction:

> Have a look at all the things in this picture. Now tell your parent/teacher/friend all about what is happening in the picture. You could talk about who is in the picture, what things are in the picture, where the people and things are, and what is happening.

The picture was positioned so that the participant describing it had a constant view of the picture, while the partner was always unable to see the picture.

In Video Event, the conversational partner was out of the room while the participants from both groups viewed the video. The verbal instruction accompanying the viewing was

> Now you are going to look at some videos. They are very short videos that show something happening. You will see each video two or more times, but your parent/teacher/friend is not allowed to see the video. Instead, you will tell your parent/teacher/friend what happened in the video.

The participants could watch the video up to five times before the partner was brought back in to the room, and could request to view the video again after they had commenced the description, but the partner had to leave the room during the viewing.

The scenes and events were presented in a prescribed order. Although they varied in complexity they were not presented in order of perceived complexity. When the participant finished describing the pictured scene or the video event, the communication partner was asked to re-cast what they understood the scene or event to be, based on what the participant had expressed. The partner was instructed to let the description start without prompts or leading questions. During the training items, the participants were made aware that they would see some strange or funny things and that they could mention what was going on, who was taking part, what objects were involved or where the action was taking place. No help or suggestions were given on the other items, only non-directive encouragement was offered if needed. Each item was complete when the partner described the scene or event correctly or if the participant or partner agreed it was time to stop.

Reliability

The BAC project research team devised two coding frameworks that were used to define the participants' expressive output. The frameworks were developed through a process of consensus (Langdridge & Hagger-Johnson, 2013), which was achieved through dialogue and debate, using expressive language examples to define the type of information to be coded. First, the first framework (Table 3) was used to code the amount of information expressed by the participant, defined as the number of elements described and their relevance.

Insert Table 3 about here

The unit of coding was at word level for all relevant or irrelevant information conveyed. Second, a classifying category score of the participants' responses was assigned, defined by the capacity to express the main idea, or not, using a scale ranging from 1 to 10, detailed in Table 4. The first seven classifications indicated relevant information and the remaining two classifications indicated non-relevant responses. Ideas expressed were coded at a unit level, which included clause- and phrase-level utterances or word level utterances. For example, in classification Level 5, the child labelled certain elements of the picture or video, with some inaccurate components and was not able to convey the main idea (e.g., if the picture of a girl looking out from behind a tree was described by a participant as *BOY TREE*). This same measure was used to code the responses of the conversational partner in relation to his or her level of understanding demonstrated via the recasting of the information provided.

Insert Table 4 about here

Prior to any data coding, all picture and video interactions were transcribed orthographically using AAC conventions for multimodal communication (von Tetzchner & Basil, 2011) and then translated into English. Each of the participating countries followed the same procedures for rater-reliability checks: (a) the primary researcher coded all data using the agreed frameworks, (b) a second researcher independently coded 10% of the same data, (c) the primary and second researcher agreed a process for obtaining consensus for the 10% of the data that both had coded, and (d) the lead researcher did a final coding-consistency check for the entire data set.

Statistical Analysis

SPSS, Statistical Package for Social Sciences 24.0, was used for all statistical analysis. Analysis of variance (ANOVA) was used to analyse differences between groups. To examine the impact of chronological age, scores on language tasks and a measure of non-verbal logical reasoning on the results, analysis of covariance (ANCOVA), was performed. Two-way ANOVAs were used to examine interaction effects of groups and conditions on measures. Correlations were computed, using the Pearson coefficient, between measures of the participants' expressions and the partners' recasting of the participants' descriptions. In cases where the correlations between the task measures and the predictors were approaching 0.30 or higher, stepwise regression analyses were performed. This was to explore if measures of nonverbal reasoning scores (Raven's Matrices/KBIT) and indicators of communication and language ability (CFCS and TROG) could predict time required to solve the tasks, the level of relevant information provided, based on category level score described in Table 4, and the average number of relevant elements expressed. A similar analysis was made for corresponding scores for partners' recasting. The analyses were made separately for performance on the two BAC tasks. Significance value was set at $p < .05$.

Results

The results reported here include data from 81 children and young people who use aided communication; and compare these to a reference group of 56 young people without aided communication needs. The first research question considered how the performance of children and adolescents who use aided communication contrasted with that of a reference group of peers using natural speech when their task is to relay to a partner the content of pictured scenes and events shown on video. Tables 5 and 6 show that the aided group and the reference group differed significantly on several measures on the Pictured Scene and Video Event tasks. Not surprisingly, the aided group took significantly longer to complete the tasks. There was a main effect for group where the reference group provided significantly more information on each item and their communication partners understood significantly more from the description than did the partners in the aided group. However, there were no significant differences on measures of irrelevant or incorrect elements expressed (Tables 5 and 6), suggesting similarity of performance in terms of capacity to stay on topic throughout the dialogue. According to the ANCOVAs with scores on Raven's matrices, PPVS/BPVS, TROG and chronological age as covariates, the results remained the same, indicating that the results were robust. Comparing the best communicators in the aided group according to the results on CFCS (i.e., the participants who scored I or II on the CFCS) with the participants in the reference group did not change this result.

Insert Tables 5 and 6 about here

Stepwise regression analyses explored the second research question, which aimed to identify the individual characteristics associated with the performance of the participants using aided communication. Analysis of scores on the Pictured Scene task showed that scores on TROG were significantly associated with all four indicators of success, explaining 13% to 29% of the variance in the dependent variables (Table 7). TROG scores were also significantly associated with performance on the Video Event task, explaining 17% to 20% of the variance (Table 8).

Insert Tables 7 and 8 about here

The third research question considered how the material presented (pictured scene versus video event) influenced the performance of the aided group and the reference group.

As indicated in Tables 5 and 6, the two-way ANOVA showed a significant main effect of group on average category expressed, average category recast by partner, average number of relevant elements expressed, and average number of relevant elements recast by the partner.

A main effect of material presented was found for the number of relevant elements expressed by the child ($M_{picture}$= 7.00, M_{video} = 7.47), F (1, 264) = 9.17, p = .003 and elements recast by the partner, ($M_{picture} = 6.35$, $M_{video} = 8.12$), $F\ (1, 249) = 9.42$, $p = .002$, respectively. No significant interaction effects were found. In both groups, there were moderate and high correlations between measures related to the participants' descriptions on the Pictured Scene and Video Event tasks, as well as the partners' recasting of the descriptions, with (*r)* varying between .26 and .94 in the aided group, and between .39 and .85 in the reference group.

Discussion

Analyses of aided communicators' and their peers' descriptions of pictured scenes and events presented on video demonstrated differences and similarities between the groups. There were group differences in amount of information provided and that was recast by their partners. Differences in elements expressed, main ideas expressed and time usage confirm differences previously described by others (Smith, 2006; Soto & Hartmann, 2006; Thomas, Nye, & Robinson, 1994). There were similarities between groups in their use of irrelevant or incorrect message elements. Measures of language comprehension were strongly associated with aided group performance on both Pictured Scene and Video Event. There was no significant effect for either group in terms of the type of stimulus material presented.

The current study reinforces previously documented findings (Bornman et al, 2009; Sevcik, Romski, & Wilkinson, 1991). It is not surprising that the children and adolescents who used communication aids were functioning at a statistically different level from their peers using natural speech in their capacity to produce language-specific descriptions of pictured scenes and video events in real time. It is worth remembering that the participants in the study described here may not be typical of all children and adolescents who use AAC. The inclusion criteria were specifically intended to include those best able to cope with the cognitive and linguistic task demands, and the procedural components of each task enabled each child to have as much time as he or she needed to complete every task as fully as possible. Even so, statistically significant differences between young people who used aided communication and the reference group remain with regard to the extent of the descriptions produced.

The present findings are in line with those of Soto and Hartmann (2006), who found that the elicited narratives of four aided communicators aged 5- to 11-years-old contained good attempts at labelling and describing using a limited number of graphic symbols that were available, while there was a lack of explicitness in terms of elaboration at the grammatical level. The current findings suggest that further linguistic and narrative analysis of individual descriptions produced would be of value to determine in what way the output was influenced by availability of graphic vocabulary items on each participating child's aided system. In addition, whether output was weighted towards labelling rather than evaluating the pictured scenes and video events described. Such future research could clarify if these results are due to limitations of their aided language system, rather than a lack of message construction skill (Brekke & von Tetzchner, 2003).

There were some similarities across groups. The number of message components that were irrelevant or incorrect were comparable. This finding, taken together with the amount of information conveyed successfully, suggests that the children and adolescents who used aided communication did not have more incorrect communication attempts or irrelevant message components compared to their peers, as might sometimes be assumed. They stayed on topic as effectively as their peers with natural speech did but as a group had a reduced range of effective message generation options available to them, particularly in relation to linguistic specificity. Given the cognitive demands and time-related challenges of aided communication, the aided participants' capacity for appropriate topic maintenance during interactions shows linguistic and social competence (Light & McNaughton, 2014). The clinical implications of this finding warrant further follow-up in terms of recognising children and young people's strengths in topic maintenance and their ability to access the most relevant vocabulary items from their available graphic language system.

Individual characteristics of the aided communicators were considered using a range of measures. Spoken language comprehension measures, specifically TROG, were the best predictors of message success. This suggests that comprehension abilities are related to the selection of relevant information to support listener understanding (Kent-Walsh, Murza, Malani, & Binger, 2015; Smith, 2015, Soto & Hartmann, 2006; von Tetzchner & Stadskleiv, 2016). Given that the pictured scenes and video events showed that they varied from predictable (and guessable for the conversational partner) to unlikely and unfamiliar, future considerations could include quantification of the language comprehension demands of the tasks presented.

The demands for the Pictured Scene and Video Events were complex and included effective use of processing and retelling skills. The tasks drew on visual attention, memory, world knowledge, and event memory, and knowledge of participants' aided communication system. Effective message transmission relies on a child's capacity to search within his or her aided system and select the graphic symbols needed to construct the intended message (Bornman et al, 2009). The visual relationship between concept and representation is not a constant phenomenon; instead, it operates along a continuum from transparent to translucent to arbitrary. The identification of appropriate graphic vocabulary and how it is displayed introduces variance in operational and production characteristics (Murray, Bell, & Goldbart, 2016; Nelson, 1998; Thistle & Wilkinson, 2013; Trudeau, Sutton, & Morford, 2014). Moreover, the pictorial representation in the symbol is a metonym and may be iconic for some intended meanings and not for others (von Tetzchner, 2015). These production characteristics may place differing demands on mental representations and representational thinking skills (Stadskleiv et al., 2014, Thistle & Wilkinson, 2013), and may potentially influence the ease with which individuals can retrieve and use message productions in real-time activities with their communication partners (Dada et al, 2013; Smith, 2015). The impact of differing aided language systems and the influence of processing and mental representational skills warrants further follow-up because it is possible that these cognitive skills may have had significant impact on the linguistic output of the participants in the current study who used aided communication (Stadskleiv et al., 2014).

At the outset, it was hypothesized that there might be a level of variability in response to the task demands of Pictured Scenes and Video Events. The partners in the aided group had an average expressive score of 3.27 for Pictured Scene and 3.62 for Video Event, while the reference group's scores were 1.79 for Pictured Scene and 1.42 for Video Event. The hypothesis was not confirmed in the statistical analysis; however, such similarity between groups may merit further research consideration. The impact of using contrasting modes of presentation of materials has received little attention in the intervention literature (e.g., Sutton, 2016) but may offer a window into different learning styles and output characteristics. The video presentations may have offered a natural re-telling sequence, which may have supported the effective re-telling of the event, while the pictured scene offered the child a visual from which to make a judgement about the order in which to present elements to describe the scene effectively. Future research could consider how video events tap working memory and executive functioning, as well as the language demands of verbs used across a temporal sequence of events. Similarly, future research could consider if pictured scenes place less demand on working memory and more demands on long-term memory requiring the capacity to infer meaning from the image while generating an effective description of the image (Murray & Goldbart, 2011; Stadskleiv et al, 2014, Thistle & Wilkinson, 2013).

As suggested by von Tetzchner (2015), young children who use aided communication typically hear and then produce different language forms, partly as a consequence of the range of available linguistic constructs in their graphic communication systems. These often limited graphic vocabularies may force aided communicators to produce meaning in unusual and untaught ways, a blend of the spoken language that they hear and the graphic representations of the system they use. This study adds impetus to ongoing exploration of children and adolescents' creative use of graphic communication systems to convey meaningful information to a conversational partner. Finally, it offers comment on the impact of differing task demands on the output characteristics of children and adolescents using aided communication and their peers using natural speech.

Limitations and Future Directions

While this study offers some insights into the similarities and differences between aided communicators and their peers who use natural speech, it is acknowledged that the influence of partner characteristics was not investigated in any detail. It was assumed that the aided communicators had skilled conversational partners; however, the partners varied and included peers, parents, and familiar and less familiar adults (although all adults were familiar with aided communication). Future analysis of partner characteristics during these kinds of interactions could include consideration of their skills in eliciting more enriched descriptions from children and adolescents who used aided communication.

There were differences in culture, language and available vocabulary within each participants' aided system. Although tasks were developed with these differences in mind, the focus of the analysis was on what was produced, rather than what might influence what was produced. Although these components were not explicitly addressed, detailed consideration of their potential impact may offer greater understanding of the production processes involved.

In this study, the output from the communication aid was regarded as the most important tool for message generation, but most individuals who used aided communication also used gesture, deictic and symbolic pointing, facial expression, body posture, and vocalization. Including these forms of communication in the present analysis was beyond the scope of the study but future studies may investigate how the creative use of such non-linguistic expressions may influence communication partners' understanding of descriptions produced by aided communicators. Furthermore, although we have descriptors of the types of graphic representation systems used by the aided communicators, we do not know what type of symbolic representation or mode of communication each individual used per element per task. This may have influenced the finding of differences in linguistic specificity.

Every effort was made to ensure reliability and validity of the data collected, through many BAC face-to-face research team meetings to agree on protocols. The data used is a combined data set from 13 out of a possible 16 countries, making it impossible to ensure consistency at all times in terms of data collection style, transcription from the original language into English, and data coding procedures. Where possible, local teams worked through a process of consensus coding, and the lead researcher appraised consistency across each country's data set. It must be acknowledged that data are missing from some elements. For example, formal test data was not available for the reference group, in part because of variations in ethics approval processes (e.g., in some countries, unnecessary testing of participants was deemed inappropriate).

This study offers a cross-sectional glimpse of development at a specific point in time and should be supplemented with longitudinal studies of emerging aided communicators. Although not the key focus of the study, the findings do offer some direction for methods of intervention. Setting up unpredictable and unfamiliar conversational experiences for aided communicators and their partners may support greater aided communication practice and skill development.

Conclusion

In this study, both groups performed similarly in terms of response to differing stimulus material (picture and video). However, the participants who used aided communication provided significantly less information than the reference group and took significantly longer to complete the tasks. The aided communicators stayed on-task as effectively as their naturally speaking peers, but their descriptions were less specific and less elaborated. Future research and intervention could focus on the success of staying on-topic by children and young people who use aided communication, and how different conversational partners recognise that achievement. Further research and intervention considerations exploring the influence of stimulus material would be welcome. Based on the data presented, formal language assessment scores predicted success in message transmission better than measures of intelligence. This suggests that describing scenes or events require language skills more than any other skill. The lack of association with motor skills evidenced in this study may be due to limited variation, as a large majority in the aided group scored IV or V on GMFCS and MACS. In sum, this study has demonstrated both unpredicted group similarities and some predictable differences in the production processes of describing pictured scenes and video events. The aided communicators in this study conveyed relevant information to their conversational partners when faced with materials that depicted believable and unbelievable events. The use of believable and unbelievable types of material, and their modes of presentation (picture and video), warrants further exploration.

References

Benigno, J. P., & McCarthy, J. W. (2012). Aided symbol-infused joint engagement. *Child Development Perspectives, 6*, 181–186. doi:10.1111/j.1750-8606.2012.00237.x

Binger, C., & Light, J. (2007). The effect of aided AAC modeling on the expression of multi-symbol messages by preschoolers who use AAC. *Augmentative and Alternative Communication*, *23*, 30–43. doi:10.1080/07434610600807470

Binger, C., & Light, J. (2008). The morphology and syntax of individuals who use AAC: Research review and implications for effective practice. *Augmentative and Alternative Communication*, *24*, 123–138. doi:10.1080/07434610701830587

Bishop, D. (2003). *Test for Reception of Grammar* (2nd ed.). London: Pearson.

Bornman, J., Alant, E., & Du Preez, A. (2009). Translucency and learnability of Blissymbols in Setswana-speaking children: an exploration. *Augmentative and Alternative Communication, 25,* 287–298. doi:10.3109/07434610903392456

Brekke, K. M., & von Tetzchner, S. (2003). Co-construction in graphic language development. In S. von Tetzchner, & N. Grove (Eds.), *Augmentative and alternative communication: Developmental issues* (pp. 176 – 210). London, UK: Whurr/Wiley.

Clarke, M., & Kirton, A. (2003). Patterns of interaction between children with physical disabilities using augmentative and alternative communication systems and their peers. *Child Language Teaching and Therapy,* 19, 135-151. doi:10.1191/0265659003ct248oa

Dada, S., Huguet, A., & Bornman, J. (2013). The iconicity of Picture Communication Symbols for children with English additional language and mild intellectual disability. *Augmentative and Alternative Communication, 29*, 360–373. doi:10.3109/07434618.2013.849753

DeLoache, S., & Burns, N. M. (1994). Early understanding of the representational function of pictures. *Cognition,* 52, 83-110. doi:10.1016/0010-0277(94)90063-9

Dunn, L. M., & Dunn, D. M. (2007). *The Peabody Picture Vocabulary Test* (4th ed.). San Antonio, TX: Pearson.

Dunn, L. M., Dunn, L. M., Whetton, C., & Burley, J. (1997). *The British Picture Vocabulary Scale* (2nd ed.). UK, London: NFER Nelson.

Eaton, J. H., Collis, G.M., & Lewis, V.A. (1999). Evaluative explanations in children's narratives of a video sequence without dialogue. *Journal of Child Language, 26*, 699-720. doi: 10.1017/S0305000999003967

Eliasson, A. C., Krumlinde-Sundholm, L., Rosblad, B., Beckung, E., Arner, M., Ohrvall, A. M., & Rosenbaum, P. (2006). The Manual Ability Classification System (MACS) for children with cerebral palsy: Scale development and evidence of validity and reliability. *Developmental Medicine and Child Neurology, 48,* 549–554. doi:10.1111/j.1469-8749.2006.tb01313.x

Grice, H.P. (1975). Logic and conversation. In: P. Cole & J. Morgan (Eds.). *Syntax and semantics 3: Speech acts* (pp. 41–58). New York: Academic Press.

Hidecker, M.J.C., Paneth, N., Rosenbaum, P.L., Kent, R.D., Lillie, J., Eulenberg, J.B., … Taylor, K. (2011). Developing and validating the Communication Function Classification System (CFCS) for individuals with cerebral palsy, *Developmental Medicine and Child Neurology, 53*, 704–710. doi:10.1111/j.1469-8749.2011.03996.x, PMC3130799.

Kaufman, A.S., & Kaufman, N. (2004). *Kaufman Brief Intelligence Test* (2nd ed.). Bloomington, MN: Pearson. doi:10.1002/9781118660584.ese1325

Kent-Walsh, J., Murza, K.A., Malani, M.D., & Binger, C. (2015). Effects of communication partner instruction on the communication of individuals using AAC: A meta-analysis. *Augmentative and Alternative Communication*, *31*, 271–284. doi:10.3109/07434618.2015.1052153

Langdridge, D., & Hagger-Johnson, G. (2013). *Introduction to research methods and data analysis in psychology* (3rd ed.). Harlow, UK: Pearson.

Light, J., & McNaughton, D. (2014). Communicative competence for individuals who require Augmentative and alternative communication: A new definition for a new era of communication? *Augmentative and Alternative Communication*. *30,* 1–18. doi: 10.3109/07434618.2014.885080

Lund, S. K., & Light, J. (2007). Long-term outcomes for individuals who use AAC: Part III−Factors contributing to outcomes. *Augmentative and Alternative Communication, 23*, 323–335. doi: 10.1080/02656730701189123

Murray, J., Bell, H., & Goldbart, J. (2016). Operational demands and representational forms. In M. M. Smith & J. Murray (Eds.), *The silent partner? Language, interaction and aided communication* (pp. 35–64). Guildford, UK, Surrey: J&R Press.

Murray, J., & Goldbart, J. (2009). Cognitive and language acquisition in typical and aided language learning: A review of recent evidence from an aided communication perspective. *Child language Teaching and Therapy, 25,* 31–58. doi:10.1177/0265659008098660

Murray, J., & Goldbart, J. (2011). Emergence of working memory in children using aided communication. *Journal of Assistive Technologies, 5,* 213–232. doi:10.1108/17549451111190623

Nelson, K. (2007). *Young minds in social worlds: Experience meaning, and memory*. Cambridge, MA: Harvard University Press.

Nelson, N. W. (1998). *Childhood language disorders in context: Infancy through adolescence* (2nd ed.). London: Allyn and Bacon.

Norbury, C. F. (2014). Practitioner review: Social (pragmatic) communication disorder conceptualization, evidence and clinical implications *United Journal of Child Psychology and Psychiatry, 55,* 204–216. doi:1 0.1111/jcpp.12154

Palisano, R., Rosenbaum, P., Bartlett, D., & Livingston, M. (2007). *GMFCS – E & R, Gross Motor Function Classification System Expanded and Revised*. Toronto, Canada: CanChild Centre for Childhood Disability Research, McMaster University.

Pennington, L., Virella, D., Mjøen,T., da Graça Andrada, M., Murray, J., Colver, A., … de la Cruz, J. (2013). Development of the Viking Speech Scale to classify the speech of children with cerebral palsy. *Research in Developmental Disabilities, 34,* 3202–3210. doi:10.1016/j.ridd.2013.06.035

Raven, J. (2008). *Raven's Coloured Progressive Matrices.* San Antonio, TX: Pearson

Raven, J., Raven, J. C., & Court, J. H. (2000). *Standard Progressive Matrices. Including the Parallel and Plus Versions.* Oxford: Oxford Psychologists Press.

Sevcik, R. A., Romski, M. A., & Wilkinson, K. M. (1991). Roles of graphic symbols in the language acquisition process for persons with severe cognitive disabilities. *Augmentative and Alternative Communication, 7,* 161–170. doi:10.1080/07434619112331275873

Smith, M. M. (2003). Environmental influences on aided language development: The role of partner adaptation. In S. von Tetzchner & N. Grove (Eds.), *Augmentative and alternative communication: Developmental issues* (pp. 155–175). London: Whurr/Wiley.

Smith, M. M. (2006). Speech, language and aided communication: Connections and questions in a developmental context. *Disability and Rehabilitation*, *28*, 151–157. doi:10.1080/09638280500077747

Smith, M. M. (2015). Language development of individuals who require aided communication: Reflections on state of the science and future research directions. *Augmentative and Alternative Communication*, *31*, 215–233. doi:10.3109/07434618.2015.1062553

Solomon-Rice, P.L., Soto, G., & Heidenreich, W. (2017). The impact of presupposition on the syntax and morphology of a child who uses AAC. *Perspectives of the ASHA Special Interest Groups*, 12, 2, 13-22.

Soto, G., & Hartmann, E. (2006). Analysis of narratives produced by four children who use augmentative and alternative communication. *Journal of Communication Disorders*, *39*, 456–480. doi:10.1016/j.jcomdis.2006.04.005

Soto, G., & Starowicz, R. (2016). Narrative development and aided communication. In M. M. Smith, & J. Murray (Eds.), *The silent partner? Language, interaction and aided communication* (pp. 141–158). Guildford, Surrey, UK: J&R Press.

Stadskleiv, K., von Tetzchner, S., Batorowicz, B., van Balkom, H., Dahlgren Sandberg, A., & Renner, G. (2014). Investigating executive functions in children with severe speech and movement disorders using structured tasks. *Frontiers in Psychology, 5*, 1–14. doi:10.3389/fpsyg.2014.00992

Stephenson, J. (2009). Iconicity in the development of picture skills: Typical development and implications for individuals with severe intellectual impairment. *Augmentative and Alternative Communication, 25,* 187-201. doi: 10.1080/07434610903031133

Sutton, A. (2016). Symbolic representation and graphic symbol use: insights from typical development. In M. M. Smith, & J. Murray (Eds.), *The silent partner? Language, interaction and aided communication* (pp.64–118). Guildford, UK: J&R Press.

Thistle, J., & Wilkinson, K. (2013). Working memory demands of aided augmentative and alternative communication for individuals with developmental disabilities. *Augmentative and Alternative Communication*, *29*, 235–245. doi:10.3109/07434618.2013.815800

Thomas, G., Nye, R., & Robinson, E. (1994). How children view pictures: Children's responses to pictures as things in themselves and as representations of something else. *Cognitive Development*, *9*, 141–164. doi: 10.1016/0885-2014(94)90001-9

Trudeau, N., Sutton, A., & Morford, J. P. (2014). An investigation of developmental changes in interpretation and construction of graphic AAC symbol sequences through systematic combination of input and output modalities. *Augmentative and Alternative Communication*, *30*, 187−199. doi: 10.3109/07434618.2014.940465

von Tetzchner, S. (2015). The semiotics of aided language development. *Cognitive Development, 36*, 180–190. doi:10.1016/j.cogdev.2015.09.009

von Tetzchner, S., & Basil, C. (2011). Terminology and notation in written representations of conversations with augmentative and alternative communication. *Augmentative and Alternative Communication, 27*, 141-149. doi: 10.3109/07434618.2011.610356

von Tetzchner, S., & Stadskleiv, K. (2016). Constructing a language in alternative forms. In M. M. Smith, & J. Murray (Eds.), *The silent partner? Language, interaction and aided communication* (pp.17–34). Guildford, UK: J&R Press.

End Notes

[1]The Smith-Dahlgren Sandberg Spelling Scale (2010) was developed for use in the BAC project. It comprises a 4-point scale for the description of spelling abilities: (a) text reliant, competent speller; may use word prediction effectively; errors can occasionally be self-corrected; there may be occasional confusions; (b) word/symbol reliant but emerging speller who initiates spelling that is sometimes helpful in bridging vocabulary gaps; there may be frequent misunderstandings; (c) reluctant speller, responds only if prompted to spell; and (d) does not use spelling.

Appendix

Table 1
Participants' Characteristics

Characteristic	Aided group (*n* = 81)			Comparison group (*n* = 56)			
	M	*SD*	*R*	*M*	*SD*	*R*	*p* -value
Gender M/F	37/44			22/34			.458[a]
Chronological age (in months)	132.7	34.4	60 – 191	131.1	34.5	62 – 190	.791[b]
Raven[c]/KBIT*[d]	-1.60 (*n* = 60)	1.31	-3.65 – 2.05	0.60 (*n* = 11)	0.74	0.00 – 2.25	.001[b]
PPVT[e]/BPVS*[f]	-1.40 (*n* = 56)	1.36	-4.00 – 2.00	0.15 (*n* = 19)	1.18	-2.58 – 2.25	.001 [b]
TROG*[g]	-1.30 (*n* = 41)	1.33	-3.00 – 1.33	-0.30 (*n* = 14)	0.99	-2.47 – 1.07	.012 [b]

Note: [a]Pearson Chi-square, [b]One-way ANOVA, [c]Raven's Matrices, [d]Kaufman Brief Intelligence Test, [e]Peabody Picture Vocabulary Test, [f]British Picture Vocabulary Scale, [g]Test for Reception of Grammar.
*z-scores

Table 2

Aided Group: Classification of Motor Ability, Communication, Speech and Literacy, Number in each Category (Percentages in Parenthesis)

Level	GMFCS[a] (n = 80)	MACS[b] (n = 79)	VSS[c] (n = 77)	CFCS[d] (n = 71)	S-DSS[e] (n = 50)
1	8 (10)	6 (7.6)	0	1 (1.4)	16 (32)
2	5 (6.3)	7 (8.9)	0	30 (42.3)	13 (26)
3	2 (2.5)	10 (12.7)	15 (19.5)	25 (35.2)	4 (8)
4	18 (22.5)	21 (26.6)	62 (80.5)	14 (19.7)	17 (34)
5	47 (58.8)	35 (44.3)	N/A	1 (1.4)	N/A

Note: [a]Gross Motor Functional Classification System, [b]Manual Ability Classification System, [c]Viking Speech Scale, [d]Communication Functioning Classification System, [e]Smith-Dahlgren Sandberg Spelling Scale.

Table 3

Type of Information Expressed and Examples

Element types	Element examples
Things	This includes toys and objects, like toy animals and body parts. If same noun is repeated differentiate between types and tokens
Actions	Score main events happening (e.g., open = one action); auxiliary verbs, (e.g., is opening = one action) Count auxiliary verb if change content of utterance (e.g., couldn't open = two actions) Score "is" as an action if used as main verb (e.g., dog is black, but not if used as auxiliary (e.g., *is* reading, or narrative device) When same verb is repeated differentiate between types and tokens
Persons/animals	Living creatures Do not score as multiple if number added (e.g., three women ladies is one element (woman) on Persons and one element (three) on Properties
Time	For example seasons, days, expressions (e.g., then-so, first-last).
Place	All types of placements (e.g., in front of mirror, on the road, outside. Includes positions, prepositions and places)
Properties	Descriptions of objects and persons, but also verbs like afraid of and irritated
Idiosyncratic	Expressions with only personal reference and use of symbols in a personal and unconventional manner
Irrelevant	Expressions with only personal reference
Incorrect	Elements included in the expressed/understood solution that are not correct
Other	Elements that do not fit into any of the other categories of elements

Table 4

Classification of Ideas Expressed and Recast

Classification	Description of classification categories expressed and recast
1	Main idea, all important information included
2	Main idea, most important information included
3	Central elements understood, but lacking main idea
4	Some elements in picture expressed/understood
5	Some elements expressed/understood + some inaccurate added
6	Some elements are approximated, but incompletely expressed/understood
7	Tangential message, a detail but clearly related to picture
8	Wrong general idea
9	Don't know
10	No reply

Table 5

Measures of Child Description and Partner Recasting of the Content of Picture Scenes

BAC scene variables	Aided group (n = 81)		Comparison group (n = 56)		Significance
	M	*SD*	M	*SD*	*p*-value
Time (in seconds)	309.7 (n = 53)	258.3	57.49 (n = 42)	34.59	$p < .001$*** $F(1, 93) = 34.419$
Average category expressed by child (1 to 10 scale)	3.27 (n = 81)	1.26	1.79 (n = 54)	0.58	$p < .001$*** $F(1, 133) = 65.371$
Average category recast by partner (1 to 10 scale)	3.37 (n = 80)	1.27	2.13 (n = 48)	0.85	$p < .001$*** $F(1, 126) = 36.509$
Average number of relevant elements expressed by child	5.20 (n = 80)	3.70	9.66 (n = 54)	4.78	$p < .001$*** $F(1, 126) = 36.893$
Average number of relevant elements recast by partner	5.38 (n = 80)	4.46	7.97 (n = 48)	3.58	$p = .001$** $F(1, 126) = 11.671$
Average number of idiosyncratic elements expressed by child	0.03 (n = 81)	0.12	0.00 (n = 54)	0.02	$p = .046$* $F(1, 133) = 4.052$
Average number of idiosyncratic elements recast by partner	0.03 (n = 80)	0.12	0.02 (n = 48)	0.08	$p = .643$ $F(1, 126) = 0.216$,
Average number of irrelevant elements expressed by child	.047 (n = 81)	0.16	0.02 (n = 54)	0.06	$p = .287$ $F(1, 133) = 1.142$
Average number of irrelevant elements recast by partner	0.11 (n = 80)	0.38	0.02 (n = 48)	.09	$p = .113$ $F(1, 126) = 2.544$
Average number of incorrect elements expressed by child	0.12 (n = 81)	.55	0.01 (n = 54)	.07	$p = .142$ $F(1, 133) = 2.181$
Average number of incorrect elements recast by partner	0.18 (n = 80)	.62	0.01 (n = 48)	.05	$p = .059$ $F(1, 126) = 3.617$

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 6

Measures of Child Description and Partner Recasting of the Content of Events Presented on Video

BAC event variables	Aided group (n = 81)		Comparison group (n = 56)		Significance
	M	*SD*	*M*	*SD*	*p*-value
Time (in seconds)	292.1 (n = 53)	206.2	70.2 (n = 39)	59.7	$p < .001$*** $F(1, 90) = 42.488$
Average category expressed by child (1 to 10 scale)	3.62 (n = 80)	1.63	1.42 (n = 54)	0.39	$p < .001$*** $F(1, 131) = 94.322$
Average category recast by partner (1 to 10 scale)	3.71 (n = 80)	1.69	1.92 (n = 45)	1.06	$p < .001$*** $F(1, 123) = 41.344$
Average number of relevant elements expressed by child	4.97 (n = 80)	1.75	11.17 (n = 54)	4.84	$p < .001$*** $F(1, 132) = 110.605$
Average number of relevant elements recast by partner	6.10 (n = 80)	4.93	11.74 (n = 45)	6.76	$p < .001$*** $F(1, 123) = 28.603$
Average number of idiosyncratic elements expressed by child	0.03 (n = 80)	0.08	0.00 (n = 54)	0.02	$p = .015$* $F(1, 132) = 6.070$
Average number of idiosyncratic elements recast by partner	0.01 (n = 80)	0.04	0.00 (n = 45)	0.01	$p = .089$ $F(1, 123) = 2.938$
Average number of irrelevant elements expressed by child	0.06 (n = 80)	0.18	0.05 (n = 54)	0.16	$p = .785$ $F(1, 132) = 0.075$
Average number of irrelevant elements recast by partner	0.11 (n = 80)	0.50	0.06 (n = 45)	0.23	$p = .490$ $F(1, 132) = 0.479$
Average number of incorrect elements expressed by child	0.13 (n = 80)	0.52	0.01 (n = 54)	0.06	$p = .086$ $F(1, 132) = 2.944$
Average number of incorrect elements recast by partner	0.13 (n = 80)	0.40	0.00 (n = 45)	0.00	$p = .033$* $F(1, 123) = 4.657$

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 7

Stepwise Regression Analysis for Pictured Scene

	Time		Average category expressed		Average category recast		Average elements expressed		Average elements recast	
Predictor	Adj R^2	β	Adj R^2	β	Adj R^2	β	Adj R^2	β	Adj R^2	β
TROG[a]			.261**	-.534	.234**	-.509	.143*	.431	.699*	.365

Note: Time to solve the tasks, average category expressed, average number of relevant elements expressed, average category recast by partner, and average number of relevant elements recast by partner.

$*p < .05$ $**p < .01$

[a]Test for Reception of Grammar

Table 8

Stepwise Regression Models for Video Event

	Time		Average category expressed		Average category recast		Average elements expressed		Average elements recast	
Predictor	Adj R^2	β	Adj R^2	β	Adj R^2	β	Adj R^2	β	*Adj R^2*	*β*
Raven[a]/ KBIT[b]	.181*	-.466								
TROG[c]			.142*	-.412	.169*	-.443				

Note: Time to solve the tasks, average category expressed, average category recast by partner, average number of relevant elements expressed and average number of relevant elements recast by partner.
*$p < .05$
[a]Raven's Matrices
[b]Kaufman Brief Intelligence Test
[c]Test for Reception of Grammar