

Communicative interaction between a non-speaking child with cerebral palsy and her mother using an iPad™

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Abstract

There is a rapidly increasing range of augmentative and alternative communication (AAC) systems available for children who cannot communicate orally. Finding the best system for any one user is a challenge for the professionals and carers involved. As yet the use of portable, tablet forms of communication aid has been little researched, despite the rapid growth in their popularity. This article seeks to establish how a tablet form of AAC is exploited in day-to-day domestic interactions between a parent and a child where the child has a severe physical disability and complex communication needs. The study utilises conversation analysis (CA) as the methodology and looks in detail at sequential components of the interaction and the salience of certain interactional moves to both adult and child participants. The mother chose when and where the iPad or other forms of AAC were utilised within the day. Extracts were selected from the available data to exemplify the types of typical exchange that occurred and some key features of the iPad enhanced interaction. The analysis describes how turns are designed incorporating the iPad and discusses what is added to the communication toolkit. Asymmetries in this mother–child interaction are observed and discussed. The child typically remains a respondent to initiations by the caregiver, who in this scenario necessarily remains in control of the iPad symbol display. However, the child uses eye-gaze strategies to indicate interests that lie both within and external to those on offer on the iPad. The article reflects on the child's agency in initiating a possible novel topic in this way.

Keywords

Augmentative and alternative communication, cerebral palsy, conversation analysis, iPad™

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I Introduction

Since the 1980s, researchers have sought to describe features of aided interactions and to develop the design of augmentative and alternative communication (AAC) systems to better suit the needs of the users. Within that time the range of AAC aids available has grown in diversity and AAC aids are used more widely across individuals with a range of abilities. Studies describing interactions between speaking partners and aided speakers suggest that the use of aided communication has a significant impact on communication dynamics compared to non-aided communication (Clarke and Wilkinson, 2007; Pilesjö and Rasmussen, 2011). Research has begun to focus on the ways in which conversations using AAC systems are organised by participants to achieve intersubjective understanding.

The choice of AAC systems is dependent upon the individual characteristics of the child, including communication skills, cognitive level and motor abilities; as well as external factors, such as family attitudes, professionals' knowledge and the availability of support and funding. Different goals can be set: varying from acquiring AAC symbols to improving functional communication, to enhancing participation in social interactions or to improving life quality. However, AAC users and speech and language therapists have together faced challenges with social acceptability and device abandonment, as devices remained underutilised at home or school for reasons such as lack of training, operational challenges and portability (Waller et al., 2005).

The relatively simple, tablet forms of AAC are a recent addition to the range. The iPad has become popular due to its ease of use and multifunction, and it has been considered to increase communicative opportunity and development (Alliano et al., 2012). Because of the increasing ubiquitous popularity of tablets, children who use an iPad for communication purposes may feel more accepted. Alliano et al. (2012) describe the features of 21 applications (apps) that use symbols only or symbols and text-to-speech, which children with complex communication needs (CCN) can use for a variety of receptive and expressive communication. However, it has yet to be evaluated how interactions with the iPad are optimally constructed when compared to other forms of AAC (or indeed non-aided interaction).

Shared competence is believed to be the most important pre-requisite for the successful use of AAC systems (von Tetzchner et al., 2005) and the most efficacious route for conversation development (Solomon-Rice and Soto, 2011). AAC training for both conversation partners can promote a balanced communicative style. When caregivers are trained, they typically learn to position themselves so as to facilitate interaction, to interpret and assist responses and not to anticipate the needs of the augmented speaker. Pennington and McConachie (1999) further suggest that interaction can become 'fossilised', experiencing little change throughout childhood. They suggest that training in optimal AAC use should be regularly updated and reviewed, taking into account recent research findings as well as changes within the technology available. Therefore research into interactions is essential if AAC is to be well designed and optimally utilised. This study will examine the patterns of communication between a young non-speaking physically disabled child and the caregiver as the literature suggests that children typically acquire communication skills in the context of an ongoing primary relationship with a significant adult, traditionally a parent.

I Communicative interactions between the augmented speaker and the speaking partner

The child who requires an AAC device may routinely make simple requests for basic needs and seldom initiate communication. This can be the result of the physical effort needed to communicate, but it can be aggravated by the manner in which the child has been trained to use his or her

AAC system (Goossens et al., 1995). The communication of augmented speakers can also be affected by the speaking partner who may use closed questions and similar moves that limit responses. Speaking partners may also anticipate a contribution before an AAC message can be generated. In so doing they may make false interpretations or state their own views as those of the AAC user (Pilesjö and Rasmussen, 2011).

Ferm et al. (2005) compared conversation between a non-disabled child and their mother with that of a child with CCN and their carer at mealtime. The child with CCN who had no opportunity to use AAC systems was restricted to a limited range of topics related to the 'here and now', while the non-disabled child experienced a wider variety. Clarke and Kirton (2003) found similar patterns of asymmetry in interaction between a child using AAC and a typical peer. Clarke and Wilkinson (2007) however consider that asymmetry between the interactants may be advantageous for the aided speaker as it creates a context in which the unimpaired speaker can appear to understand the AAC speaker. With the iPad the speaking partner can construct through extensive use of probes and guesses, relevant messages for the other.

AAC systems are frequently used to support or replace speech for children with CCN but are most effective when used with other components such as gestures, facial expressions, eye gaze, body movements as well as formal symbol systems and voice-output devices (Beukelman and Mirenda, 1992), and research into AAC use must also take this total communication into account. The use of available aided AAC systems is habitually less than one might expect. An iPad set up with a simple symbol display as in 'Tap to Talk' (Bookman and Greenberg, 2013) provides a form of communication board, and historically such boards have been found to be used minimally within an interaction. Light et al. (1985) found that 81.8% of all communicative turns were conveyed by non-board modes such as head nods, facial expressions and vocalizations. Just 18.2% of all communicative turns demonstrated by the children were conveyed through the AAC itself and the augmented speakers were often cued or obligated to use their boards in the interactions.

As technology develops in speed and flexibility of use, this ratio of AAC use to bodily communication may change, but this will be dependent on many factors. As in the case of the child in the present study, the physical abilities of children with athetoid cerebral palsy are described as at best 'consistently inconsistent' (Higginbotham et al., 2007) and raise challenges of communicative interpretation and adaptation for the speaking partner as well as for the children themselves.

2 *Conversational analysis applied to AAC conversation*

The CA approach has its origin in ethno-methodological tradition. It was the methodology chosen for this study as it has been widely used to analyse interactions using AAC devices, looking at all forms of bodily communication. It is a qualitative research tool whose purpose is to discover how participants organise and manage interaction as a dynamic and collaborative process (Pilesjö and Rasmussen, 2011). Consideration of sequence, how one turn follows on from the previous one, is an essential feature of CA and analysis of the next turn displays what meaning the hearer has derived from the speaker's prior turn. Thus the sequence of turns makes explicit how the participants make sense of each other. Repair is a designation used specifically within CA literature to describe a set of features used to tackle troubles in conversation and seek mutual understanding. If either recipient finds it difficult to understand the previous turn, they will usually display this when it is their turn to talk again, for example by initiating a repair such as a request for clarification (Bloch and Wilkinson, 2004).

CA research has been key to understanding the range of skills that contribute to interactional competence in AAC interactions, determining for instance the sequence of eye gaze, vocalizations and body movements of a non-speaking participant that occur over a series of turns. These

elements are intrinsic to establishing rapport between an AAC user and the speaking partner. For instance, non-verbal strategies can help establish a participant's desire to talk or to hold their turn while using AAC, in ways that are inevitably slower than typical talk (Clarke and Wilkinson, 2010). These authors describe how a delayed response in typical interaction has to be explicitly accounted for within the turn. However, they also describe how delayed turns in talk with an AAC partner are oriented to as relevant to the design of the turns, taking into account meaningful extended eye gaze and body posture. Clarke and Wilkinson (2007) have described how turns are designed to enable smooth transition in the talk and to contribute ingredients such as humour to the interaction.

3 Study aims

This study aims to contribute to broader questions about how usual conversations shape the use of AAC systems and conversely how use of AAC systems shape conversations. Given the importance of the family and the home environment to the non-speaking child, this study is concerned with investigating the following research questions:

- How are communicative turns constructed around the use of AAC systems, specifically the iPad, between a child with athetoid cerebral palsy and her mother in the home environment?
- How does the child with CCN participate in iPad aided conversation?

II Methodology

1 Participants

The child with CCN is Amy, a 8-year-old female child diagnosed with quadriplegic athetoid cerebral palsy and seizure disorder. (The participant is identified by pseudonym.) Amy shows strabismus and nystagmus. According to the mother her cognitive level is unknown due to inconclusive cognitive testing. She attends the second grade at a state school for elementary students with physical disabilities. Her conversation partner is her mother, an early childhood educator who works with children with special needs and has an Advanced Studies in Special Needs Certificate.

The dyad has an agreed set of communication signals. Amy is able to use vocalization to indicate confirmation and turns her head to the right side for rejection. Her mother reports that smiling is not a pre-determined and acceptable answer associated with confirmation. Amy makes choices using eye gaze or live voice auditory scanning and uses eye pointing and gestural 'yes-no' more frequently than she uses vocalizations, bodily gestures or facial expressions, according to the mother. Apart from the iPad Amy has a low tech colour-coded communication folder system; this is a pragmatic organisation dynamic display, which she accesses with verbal scanning. However, the mother reports that this equipment is used less often for communication than the methods described above.

2 Procedures

This study was approved by the Department of Human Communication Sciences Research Ethics Panel within The University of Sheffield, Faculty of Medicine, Dentistry and Health.

Several video recordings of conversation between the child and her mother were made in the participants' home. The participants were not provided with instructions as to how they would spend their time. Recording was managed by the mother, who also decided on the placement of the

video camera. There were no time restrictions and the mother could record what she regarded as a whole activity. She could use whichever communication system was typical for the activity being recorded, so the recordings include the use of different types of AAC including switch devices as well as the iPad.

The extract of conversation analysed in this article comes from one of these recordings. The session takes place in the kitchen, where Amy and her mother have been baking a cake. The mother has designed a personal album to make choices of activity in 'Tap to Talk' (a web-based app). 'Tap to Talk' has both symbol and text-to-speech capabilities that allow for the production of built-in or customisable phrases (here called synthetic speech, or SS). The video camera was placed on a table on the right side of the mother who stood holding the iPad opposite Amy, who is in her wheelchair. Amy cannot touch the iPad to make choices as she does not have good enough motor control and it is not set up for her use in close proximity, so the mother selects the items. The mother offers every choice individually and Amy will confirm or deny the choice presented. The sequence is built around picture choices presented on the screen and aurally through SS.

3 Transcription and data analysis

The transcriptions that are presented in this study were transcribed and coded according to the principles from CA and combined the AAC convention proposed by Jefferson (2004) (Appendix 1). The sequential alignment of non-verbal behaviours such as eye gaze, gestures (e.g. head shake, head nod, pointing), actions (e.g. selecting, touching) as well as vocalization, natural speech and communication board output (e.g. the iPad) are transcribed so as to identify contingent relationships across Amy's and her mother's behaviours.

The analysis in this study focuses particularly on the nature of turn design for both participants and how difficulties establishing a firm choice from the 'Tap to Talk' six picture display arise. The whole choice event, which is represented here in the four extracts, takes two minutes and thirty five seconds to complete.

III Results

Transcription 1

Just prior to the first extract the mother stood in the kitchen and turned on the iPad with an open question 'So what do you want to do?'. She then turned the iPad towards Amy, leant forward towards her and started to use the symbol interface. This first question appears initially to invite Amy to make an open choice before the display is turned to her. But as this happens rapidly the question then is interpretable as introducing the choosing activity and goal with the iPad is showing the activities that Amy should actually choose from.

The mother shows the iPad, which has six symbols (two lines with three symbols on each line (Figure 1). The symbols are: (1) watch TV; (2) iPad; (3) play on the computer; (4) watch a DVD; (5) go swimming; and (6) do something else. Amy does not have any switch or any other form to access the iPad. The iPad speaks the choice when it is touched by the mother in the phrase 'I want...' and is accompanied by sustained eye gaze from mother to child. Thus the interaction is already unusual in that the 'choice' is spoken as if it was Amy with 'I', but since it is not under her control to initiate the voice, she is placed in a meta role of apparently suggesting a choice.

1. Mother: [((clicks at iPad)) SS:I want to wat[^hch [TV _____]
2. Mother: | ((looks at iPad)) Lx _____ |
3. Amy: L ((looks at iPad)) Lx ____((smiles))J



Figure 1. Tap To Talk™ symbol display on iPad™.

Source. By kind permission of Tap to Talk™.

4. (2.0)
5. Mother: [((looks at iPad))]
6. Amy: L((looks at video camera and keeps smiling))J
7. Mother: [is that what you want?.]
8. Mother: | ((looks at iPad)) |
9. Amy: L((continues looking at video camera))J
10. (3.0)
11. Amy: [((head movement to left with eyes up left and further left and
12. Amy: glances at video camera))]
13. Mother: L ((looks at iPad and looks at Amy)) J
14. Amy: [((looks at iPad with mouth movements))]
15. Mother: L((looks at iPad, glances at Amy, looks and clicks iPad)) SS: I
16. Mother: want the iPad J

After the mother clicks on the iPad in the option ‘I want to watch TV’, looking at the selection herself, Amy also looks at the iPad (line 3), smiles but then turns her gaze to the video camera (line 6). There is a pause and, on line 7, the mother requests clarification ‘is that what you want?’. The clarification suggests that she had expected a response but considers Amy’s smile, timed with the SS, as only a partial, unclear response. She does not appear to follow or address Amy’s gaze to the camera through lines 6 and 9.

The mother gives Amy three seconds to reply but Amy looks at the video camera and moves her head to the left. Her mother does not follow her eye gaze but also does not pursue the offered choice further, despite the lack of clear rejection. The SS choice ‘I want the iPad’ is then opportunistically introduced as Amy looks at the iPad (line 14). The mother appears to accept this eye gaze to

the iPad, as opposed to the camera, as engagement. Thus, at this point Amy's movements are interpreted as responses when they are sequentially placed after a suggested choice and directed towards the iPad display. The iPad is speaking as if it is voicing Amy's choice and is an unprompted initiation by her mother, there having been no definitive closing after the first offer or checking question.

The interaction so far appears to be strategically constructed by the mother to allow opportunity for Amy to respond and with an expectation that she will do so. There are quite lengthy pauses after each initiation. The unusual circumstance of the iPad SS stating a choice with 'I want' would require Amy to agree or disagree with this apparently positive statement rather than answer as if a direct question had been posed. This would seem a relatively sophisticated turn design and when no immediate response is initiated the mother prompts with a more predictable closed question. Amy's attention does not stay entirely on the iPad screen and she does not respond with yes or no in a recognised form.

The mother clicks on the other four choices that Amy can possibly choose from, with accompanying SS, but no longer pausing for a response. This, therefore, appears to lay out the options as a list and they are then returned to one by one in transcription 2.

Transcription 2

After presenting all the activities that Amy could do her mother comments that they cannot do anything unless Amy helps her choose. She restarts by requesting that Amy 'tell' her what she wants, then indicates the first (top left) icon with a point while articulating the choice herself. Therefore, in this sequence the child is not given a meta role as 'initiator' with the iPad speaking her putative choice, 'I want...', but is placed in a more typical responder role within the interaction. Amy's responses are non-verbal and clear at the outset in this part of the interaction.

17. Mother: [((shows whole iPad screen))]
 18. Mother: | ((looks at iPad)) [_____] ((looks at iPad)) |
 19. Mother: | so tell me [what you] want |
 20. Amy: [((head falls forward and left and looks at iPad))]
 21. (1.0)
 22. Mother: [((points at first item))]
 23. Mother: | ((looks at iPad)) [_____] |
 24. Mother: | _____ ↑ t [v =] |
 25. Amy: [((head falls forward and left and looks at iPad))]
 26. Mother: [=↑yes or no↓]
 27. Mother: [_____] |
 28. Amy: [((head goes up to right))]
 29. (1.4)
 30. Amy: [((head up to right))]
 31. Mother: [no]

The mother requests information by asking an open question. When she asks Amy 'so tell me what you want' (line 19), this question may aim to prepare her for what is about to happen, the 'so' making some reference to what has gone before as relevant to her next action. Immediately after that Amy's head falls forward as she looks at the proffered screen (line 20). With no pause the mother offers a brief recap questioning '↑ tv' (line 24) while Amy's head is for the second time

falling forward. This is followed rapidly by a turn designed to clearly scaffold the required answer, ‘↑yes or no↓’ (line 26). The mother consistently points at the icon and maintains eye gaze at Amy (line 27). She does not activate the SS here. Two movements occur with Amy’s head falling forward and left before the choice ‘yes or no’ is responded to with a clear right head movement, Amy’s agreed response for ‘no’. Her mother accepts the head move with a confirming ‘no’ with a falling tone and they successfully repeat this sequence one more time to reject another choice.

In this extract it can be seen the adult taking control and narrowing the type of question and expected response more closely. The participants fall into a rhythmic question answer routine in line with their agreed signal system and the pace is briefly brisker. The routine continues in the next transcription, with the iPad role reduced to that of a traditional communication board.

Transcription 3

In the continuing interaction, after two clear rejections Amy is offered another choice, ‘computer’.

32. Mother: [do you wanna play on a [computer?]]
 33. Mother: | ((looks at iPad)) lxx _____ |
 34. Mother: | ((pointing at third item)) |
 35. Amy: L ((head falls forward and left and looks at iPad)) J
 36. (4.0)
37. Amy: [((head goes up to the right, fast involuntary
 38. Amy: arms movements up and down and head falls left))]]
 39. Mother: | _____ |
 40. Mother: L ((pointing at third item)) J
 41. Mother: [_____]
 42. Mother: | ((continues pointing at third item)) |
 43. Mother: L ↑yes for no ↓ |
 44. Amy: L ((looks at video camera)) J
 45. (8.0)
46. Mother: [_____]
 47. Mother: | ((continues pointing at third item)) |
 48. Amy: L ((glances at iPad, glances right with fast involuntary left arm
 49. Amy: movement up and down, followed by fast involuntary right and
 50. Amy: left arm movements up and down, head turns left, glances
 51. Amy: at video camera, looks left with mouth movement, looks at
 52. Amy: video camera and glances up left))]]

As the mother has done in transcription 2, she gives Amy the choice of doing an activity, this time playing on the computer. However, when Amy appears to make a right head movement again, the head movement is not sustained before falling and is not accepted as a clear ‘no’. There are several extra body movements and the answer to ‘yes or no’ appears delayed. Whatever the intended outcome was at that point Amy then clearly looks again at the video camera. This controlled eye gaze could once again be considered initiation of a new topic that is a true choice but falls outside the remit of the iPad choices on offer. Whether her mother sees these moves and chooses to ignore them or does not realise the significance of the eye gaze as a desire to enquire about the novel object, is not interpretable from the data. However, it is possible that an opportunity to build on a

genuine child initiation is twice lost with the focus entirely on the adult's pre-defined choices on the iPad.

The mother does not interpret Amy's head movement as a meaningful response to her question, reformulating the question into a yes or no one (line 43). By doing that she orientates to production of meta-interactional turns, that is, how the conversation should develop, supplying the expected answers of the aided speaker's next turn and treating the prior turn as an inadequate response.

This example demonstrates Amy's motor control difficulty; although she appears to attempt to move her head to the right twice (lines 37 and 48) as it is seen on the video, in real time her movements are not accepted as answers by her communication partner. The mother does show her patient attention to Amy's contributions across voice and movement. However, she does not react to the body movements produced by Amy unless they are part of their agreed system or focus directly on the goals defined by the iPad choices.

Transcription 4

After scanning all the options, the mother presents the last one.

53. Mother: [((looks at iPad)) [_____]]
 54. Mother: L=do [you |want something else? |]
 55. Amy: L ((looks at iPad) |]
 56. Mother: L ((removes her right hand from iPad |]
 57. Mother: and touches Amy's left leg))]]
 58. (2.0)
 59. Mother: [((looks at iPad, glances at Amy, looks at iPad, touches puzzle
 item))]]
 60. Amy: L ((looks at iPad)]]
 61. Mother: [SS: I[want[to make a puzzle=]]
 62. Amy: L((looks at iPad) |((head orientation upward and downward)) |]
 63. Mother: L _____ |]
 64. Mother: L((removes her right hand from
 iPad and touches Amy's left leg))]]
 65. Mother:]]
 66. Mother: [=do you wanna make a puzzle?]]]
 67. Mother: |((keeps right hand on Amy's left leg) |]]
 68. Mother: | _____ |]]
 69. Amy: L _____]]
 70. (7.0)
 71. Mother: [_____]]]
 72. Mother: | ((keeps right hand on Amy's left leg) |]]]
 73. Amy: L((head orientation upward and downward still looking at mother,
 74. Amy: slight vocalization, glances at iPad, glances at mother, looks at iPad,
 75. Amy: mouth movements, left arm movement and looks at video camera))]]]
 76. Mother: [_____]]]
 77. Mother: | ((keeps right hand on Amy's left leg) |]]]
 78. Mother: |do you want to [make a puzzle?= |]]]
 79. Amy: L((continues looking at video camera L and looks left))]]]
 80. Mother: [_____]]]
 81. Mother: | =↑yes or no↓ |]]]
 82. Amy: L((head movement to centre and looks left))]]]

83. (7.0)
84. Mother: [_____]
85. Amy: L((slight vocalization, glances left, looks at video camera, glances
86. Amy: left, looks at video camera, vocalization and looks at iPad)) J
87. Mother: [↑that was verycle[ar]
88. Mother: | ((looks at iPad)) |
89. Amy: L((looks at iPad, L__ Llooks at iPad)) J

When the mother offers Amy to do something else (line 54) the question form leaves open that Amy's choice could be something completely different to what is on offer and a two second pause is left. The mother then clicks on another display with only a choice 'I want to make a puzzle'.

It can be observed that the mother always looks at the child while she asks the questions. By doing this she shows how intently aware she is of the significance of Amy's reactions and leaves long pauses for her to respond (lines 70 and 83). The mother at line 78 assumes there is a missing response and repeats her own previous turn. Then, the mother asks 'yes or no', to ask for a response from the child that fits her offer of a novel choice. She does not notice or treat as relevant the child's eye gaze to video camera during the pause. The yes or no question sequence both obliges Amy to respond and restricts the range of responses. By the time Amy has completed her message (line 86) her mother comments how clear this choice was at this point although she has previously had to repeat her question (lines 66 and 78) for confirmation of this same choice.

When Amy finishes her turn at line 86, the mother touches the selected item on the iPad. By doing so, Amy's vocalization is treated by her mother as an affirmative contribution to the on-going interaction.

Again, at the outset of this extract, Amy is apparently treated as being a competent conversational partner who could provide a novel answer to an open question. Her eye gaze at the video camera could be interpretable as an attempt to introduce an alternative, open choice but it is not treated as a relevant or meaningful action. This lack of response to a repeated eye gaze, whether inadvertent or deliberate, reinforces the impression of reduced opportunities to raise a new conversational topic for the child.

IV Discussion and conclusions

The analysis of these interactions between a child with CCN and her mother sought to describe how turns are organised around the use of the iPad as a communication aid. Consideration is given as to how turn design creates communicative opportunities that are taken up by the child. The analysis illustrates that interaction with an aid such as the iPad has to take into account the wider context in which the child is functioning and all forms of communication being used. The extracts illustrate the challenges and rewards of interacting with a child with a limited repertoire of consistently interpretable responses.

The mother has multiple roles: she controls the use of the electronic choice board, she is the interpreter of the non-speaking participant's turn and also, importantly, sums up her understanding of Amy's turn. There is clear sensitivity on the part of Amy's mother on a turn-by-turn basis in pursuing clearly interpretable moves that could establish the child's true choice. The adult speaker resources that shape Amy's contribution to the interaction include the use of extended pausing, as has been found in previous research into AAC interactions (Clarke and Wilkinson, 2010). However, there are also instances of negligible pausing after a question is posed. For example, at the outset the mother holds the iPad and the SS states the selected option, using the personal pronoun 'I' so the child is posed choices visibly and audibly in a way that suggests that the choice is self-initiated.

In addition the mother poses open questions that apparently suggest free choice of activity, such as 'What do you want?'. These questions appear to set the scene without expectation that the child would make a free choice in actuality as they are only occasionally followed by a pause. Pauses and extended pauses typically occur when the mother has posed a closed question which could achievable be answered with a yes/no response. Where agreed signals for yes/no are used there is a clear shift to efficiently timed interaction with Amy clearly dismissing options on the screen until extraneous movements blur her response.

The four sequenced transcripts display that there are three listings of the choices available while they attempt to establish a simple choice of next activity. The presentation of the list is quite similar in each cycle. The iPad is arguably quickly reduced in function to a symbol communication board as SS is not used after the initial round. Earlier in this scene, after the initial presentation of choices, the mother expresses her frustration to Amy that she is not 'helping' by answering in a way that could aid a decision. Von Tetzchner and Martinsen (2000) acknowledge that the child's motor control difficulty can lead to mutual frustration and misunderstandings. The child may also be resistant to the offers made available and can display this by resisting the expected response. Additionally in this data it is clear that some features of the interaction lead to difficulty in achieving a choice clearly and efficiently.

In examining the child's communicative opportunities it can be seen that Amy does not just give yes/no replies. She is persistent in turning her attention to the video camera, not a choice on the iPad but potentially a freely chosen one. At the first instance her mother turns her head to look where Amy is looking but makes no comment. After this Amy's repeated eye gaze turns are not reacted to in any overt way if they are noticed at all. If she had noticed the moves the mother could have accounted her reason for ignoring the gaze as attention to the video camera falls outside the preset iPad choices. Alternatively she could offer an explanation of the video camera as a novel item in their kitchen and allay the child's persistent curiosity.

The design of the turns moved quickly from 'open questions', which received minimal direct response, to using an agreed set of responses to closed questions. The mother takes responsibility for giving voice to her child's choices, controlling both form and content although it is Amy's wants that are being discussed.

Clarke and Wilkinson (2007) suggest that developers of AAC technology and professionals who assess children's existing competences and identify functional communication needs are challenged with optimising the usability of their systems. Despite the advantages of portability, the small size of the iPad screen is problematic for the child in this study who cannot easily respond with eye gaze or access it independently. However, when considering the whole range of possible communication, the child repeatedly shows communicative strategies, for example using eye gaze to indicate interests that lie outside those on offer on the screen. These behaviours are similar to what is often deemed immature distractible and inattentive in typically developing children.

Interventions that are focused on how AAC is used in daily interactions may be more ecologically valid, individually tailored and successful in improving daily communicative functioning. Whilst acknowledging the vital role of AAC and the need for learning opportunities, it has to be considered whether the use of the iPad (or how it was used) to establish Amy's opinion on yes/no choices was communicatively fruitful. Could her choice have been identified more rapidly with face-to-face communication or with adjustments to the communicative strategies used with the iPad itself? Is there some confusion of aims in that a simple choice activity is additionally being used as a staged 'learning' event? It may be that the choice of the iPad-based learning activities has to be more judiciously presented.

The 'Tap to Talk' display is used here simply as an electronic choice board, with visual and audio feedback. It is clear that Amy relies on all types of physical communication while the iPad is

in use. She still needs opportunities to develop a full range of comprehension and expression available through typical conversational opportunities and an accompanying system of gestures and eye gaze. It takes two minutes and thirty five seconds from the moment the mother asks Amy what she wants to do to the conclusion. The occurrence of such delays in children with CCN in daily conversations is notable and distinct from natural speakers' talk. According to Ferm et al. (2005), it is important for the unimpaired participant to consider whether it is more appropriate in a particular context to favour conversational symmetry or speed; the mother and Amy may agree that some conversations, such as choosing an activity, are more appropriately carried out more quickly and that less symmetric strategies such as a series of yes/no questions are acceptable, while other conversations such as sharing an experience should aim for balance of contribution from both conversational partners.

Many children with CCN use iPad apps for a variety of communication purposes and to target a variety of intervention goals but they may have more consistent physical control than Amy has. According to her mother, Amy uses the iPad apps in cause-effect activities with two switches. However, simple adjustments to use could make a difference to the interaction, e.g. in the time taken to arrive at a conclusion, if the choice is the main goal rather than the learning inherent in an activity. Amy accesses the iPad, indirectly, through verbal scanning. In the recorded activity her mother uses linear scanning, i.e. she moves from one item to the next. However, the mother could use row-line scanning, by asking in which line the option she wants to choose from is. Row-line scanning would reduce in half the time that she needs to answer each question, especially as the option apparently chosen by Amy is the last one presented. The adult could also make sure she definitely checks the world outside of the iPad through the final option 'something else' as well as the child's initiating moves.

The most important issue arising from this analysis is perhaps for the mother to be supported to consider communication and learning opportunities that occur between her and her child in different activities and with different communication aids. She can then fit the mode of communication to the activity as appropriate and practicable.

Future research could usefully be directed towards more clearly defining communicative competence of non-speaking children with differing AAC systems. The development of reliable and valid clinical assessment procedures to identify specific interaction strategies and interventions is crucial. The iPad has many socially acceptable attributes, but these must only ever be part of the decision: functionality for the child must be the prime. It should not be forgotten that the child also has access to the world around them and the communication aid may only play one part alongside natural communication systems.

Finally, if the goal for the aided speaker is to develop communicative competence and independence, then to be really effective, early intervention must target the interaction strategies of not only the child but also their family members.

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Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

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Appendix I

Conversation analysis (CA) transcription code

The transcription used in this research is based upon the standard CA notation developed by Jefferson (2004). Additional modifications have been made to incorporate augmentative and

alternative communication (AAC) transcription conventions. The verbal transcripts are written using Courier New (character size 12) and the non-verbal transcripts are written using Times New Roman (character size 12). The symbols used are described below.

┌	A left bracket bridging two lines links an ongoing utterance with an overlapping utterance or non-verbal action at the point where the overlap/simultaneous non-verbal action begins.
┐	A right bracket bridging two lines marks where overlapping utterances/simultaneous non-verbal actions stop overlapping.
=	The equals sign marks where there is no interval between adjacent utterances.
(0.3)	A number in single brackets indicate silence represented in tenths of a second.
.	A full stop indicates the end of a fall in tone. It does not necessarily indicate the end of a sentence.
,	A comma indicates continuing intonation, not necessarily between clauses of sentences.
?	A question mark indicates raising intonation, not necessarily a question.
word	Normal writing indicates naturally spoken elements.
↑↓	Marked rising and falling shifts in intonation are indicated by upward and downward pointing arrows immediately prior to the rise or fall.
(())	The researcher's own explanations are placed within double parentheses.
X _____	A line indicates that the party marked is gazing towards the other. The absence of a line indicates lack of eye gaze.
SS :	Synthetic speech. Symbol is placed in front of an utterance said by a voice output communication aid.
