

## Chapter XX

### *A tale of transitions:*

# *The challenges of integrating speech synthesis in aided communication*

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### **ABSTRACT**

Many aided communicators have used low-tech communication boards for extended periods of time when they receive a voice output device. Integrating sophisticated technology into conversational interactions draws on a range of skills for both the aided communicator and their speaking partners. The transition from low-tech to hi-tech communication aids is influenced by a range of individual and environmental factors. This chapter considers the impact of these factors on intervention and the developmental course of two individuals, Niall and Cara. The potential benefits of synthetic speech are clearly illustrated in the stories of Niall and Cara and by the literature. However, the scaffolding needed to support effective use of voice output must be carefully constructed, if these benefits are to be realized in ways that lead to meaningful, positive changes in the communication experiences and to genuine social inclusion of aided communicators.

## INTRODUCTION

The course of language development in people who lack the ability to speak and therefore have to express themselves with alternative means of communication, differs in significant ways from ordinary speech development (von Tetzchner & Grove, 2003), even in those who have good comprehension of spoken language (for a description of different groups of users, see von Tetzchner and Martinsen, (2000). Somewhat uniquely, these individuals may hear one form of language as input (speech), but produce a very different form of language for expressive output. The production process itself may be far less automatic, and require different and potentially greater cognitive resources than speech articulation. One important characteristic of *aided language development* (i.e., the development of expressive language with manual and electronic communication aids) is a discontinuity in production and form. Individuals who develop aided language typically change graphic systems, vocabulary organization structures and expressive communication modes, often several times across the lifespan (Williams, Krezman, & McNaughton, 2008) due to changes in intervention practice as well changes and innovations in technology (Arvidson & Lloyd, 1997; Hourcade, Pilotte, West, & Parette, 2004; von Tetzchner & Jensen, 1996). Many individuals who grow up with manual communication boards are introduced to electronic devices quite late in their language development careers.

This chapter describes the histories of two aided communicators that in quite different ways illustrate the diverse processes related to a shift from using a manual board to using an electronic device. The first history is about Cara, a young woman who transitioned from using a manual board with Blissymbols (Bliss, 1965) to an electronic communication aid with a communication system called “Language, Learning and Living” (LLL, (Jones, 1997)) and voice output at the age of seven. The second history is about Niall, a young man with cerebral palsy who was introduced to a voice output device after almost two decades of using manual boards with Blissymbols. Their histories highlight the importance of identifying the expectations of voice output use, and the role individual, environmental and cultural factors may have in facilitating and hindering the transition from manual boards to electronic aided communication. Cara’s history demonstrates the need for increased support and intervention during the transition to voice output technology, as well as the need for perseverance in order to integrate speech technology in everyday communication. In many respects, Niall’s history documents a failed transition, if increased use of synthetic speech output is the measure of success. Although Niall was successful in some activities over the course of a year of targeted intervention, his voice output device never became an integrated part of his communicative means. The chapter focuses on the ancillary factors that may be crucial in determining the extent to which a voice output device is integrated into the daily communication of an aided communicator.

The International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001) emphasizes participation in social and societal activities, and may be used as a general framework for evaluating the achievement of particular interventions, including interventions for individuals developing aided communication (Raghavendra, Bornman, Granlund, & Bjorck-Akesson, 2007). This chapter therefore also discusses the implications of being an aided communicator within the context of community and social inclusion and the challenges faced by aided communicators who may be perceived by others as being involved *in* their communities but who may yet be perceived as far from being part *of* these communities.

## **BACKGROUND**

### **Aided communication in a multi-modal context**

One of the most robust findings in relation to individuals with severe speech impairments is their reliance on multiple modes of communication, including both aided and non-aided means (Basil, 1992; Brekke & von Tetzchner, 2003; Collins, 1996; Falkman, Dahlgren Sandberg, & Hjelmquist, 2002; Iacono, Mirenda, & Beukelman, 1993; Kraat, 1987; Light, Collier, & Parnes, 1985b; Paul, 1998; von Tetzchner & Grove, 2003). However, within any total communication system, it is assumed that certain kinds of messages may be more effectively negotiated with some modes of communication. In particular, where there is little contextual support, referential communication with specific content may be reliant on access to a large and varied vocabulary. In communication aids, symbols (in various forms) may be represented in a number of different ways, not all of which rely on electronic technology.

### **Simple and complex electronic aided communication**

Communication devices vary significantly in their technological sophistication. Simple, “low-tech” or “no-tech” devices require no integrated circuitry (Wasson, Arvidson, & Lloyd, 1997). Communication boards displaying graphic symbols, words or letters and single message voice-output devices are examples of widely used low-tech devices. There are many advantages to such low-tech communication devices, including their reliability, low cost, durability and portability (Murphy, 2004; Smith & Connolly, 2008; Wasson et al., 1997). However, such systems often have a restricted vocabulary base, rely on partner co-construction of the message with associated risks of misinterpretation or over-interpretation, and may not be useful for distance communication. Devices with voice output technology can address some of the above limitations. Other advantages of speech output devices are presumed to lie in their potential for more independent communication (Dickerson, Stone, Panchura, & Usiak, 2002; Rackensperger, Krezman, McNaughton, Williams, & D'Silva, 2005), obviating or reducing the need for partner interpretation and formulation of messages. Access to voice output also allows for distance communication, for pre-storing of specific content to enhance speed in interactions and increased potential assertiveness (Clarke, McConachie, Price, & Wood, 2001).

The form of communication may also influence potential communication partners. Attitudes of naturally speaking peers have been found to be more positive towards individuals using voice output over manual and low-tech communication devices, and expectations of successful communication are also higher for sophisticated devices (Gorenflo & Gorenflo, 1991; Lilienfeld & Alant, 2001). The aesthetic appeal of a device may be critical for the willingness of communication partners to engage in dialogue and thus impact greatly on opportunities to participate in communication interactions (Bunning & Horton, 2007; Campbell, Gilmore & Cuskelly, 2003; Milner & Kelly, 2009).

However, there remain features that are common to both low-tech and hi-tech aided communication, including the unique role of communication partners in facilitating successful communication, the relatively slow rate of communication, even with sophisticated speech output devices, and the potential of naturally speaking communication partners to influence the direction, duration and success of communication interactions (Light, 1988; von Tetzchner & Martinsen, 1996).

### **Aided communication competence**

The communicative competence of aided communicators may be described in four related dimensions (Light, 1989; Light, Beukelman, & Reichle, 2003). *Operational competence* relates to skills in the technical production and operation of communication aids, including the motor and perceptual skills implicit in use of electronic communication systems. *Linguistic competence* refers to the ability to both understand and use the linguistic code of the community, as well as the linguistic code of the aided communication system in use. *Social competence* comprises the ability to determine the conventions or “rules” of interaction within specific contexts and with specific partners, and to apply those rules

effectively. This dimension includes pragmatic knowledge as well as judgment and skills related to relational and interpersonal aspects of communication. Finally, individuals who use communication aids must have *strategic competence*, that is, the ability to use aided communication strategies that allow them to minimize the impact of limitations in the linguistic, operational and/or social dimensions. In addition to these forms of knowledge, judgment and skills, motivation, confidence and attitude towards the use of aided communication may also contribute to their attainment of communicative competence (Light, 2003). These factors combine with the operational, linguistic, social and strategic knowledge to represent the resources brought by the individual using aided communication to the development and demonstration of communication competence.

Communication competence does not reside within the individual however. Language may be considered a cultural tool that children learn and internalize through interaction with more competent members of society (Lock, 1980; Tomasello, 1999; Vygotsky, 1962). Early language is co-constructed within dyads, and for children developing aided language it emerges from the interaction with naturally speaking partners, as communication between aided communicators is quite rare (cf., von Tetzchner and Grove, 2003). Johnson, Baumgart, Helmstetter, and Curry (1996) characterize this co-construction in a filter model, within which they contextualize the skills and abilities of aided communicators and their communication partners, and the extrinsic influence of social and cultural contexts of interactions (cf., also the ecological model of Bronfenbrenner (1979). Environmental factors are related to social and societal *communicative accessibility* and may include the demands and constraints of a given situation, including the cultural expectations to certain social roles, as well as the attitudes, knowledge and skills of possible communication partners and society at large (von Tetzchner & Martinsen, 2000). In this respect, the emergence of aided communicative competence may be vulnerable to environmental influences to a greater extent than spoken communication competence (Murray & Goldbart, 2009). The two histories presented in this chapter reflect this collaborative interdependence between individuals using aided communication and their speaking communication partners in the construction of aided communicative competence. They highlight the significant role that devices with speech synthesis can play in demonstrating the competence of the user, as well as the barriers that need to be considered if communicative competence is to be successfully constructed and used across a range of social and cultural contexts.

## **CARA**

The description of Cara combines evidence and information from a range of sources including parents, inter-professional interviews, intervention notes and discussions with Cara herself. From the age of 3 years Cara attended a school for children with physical disabilities. Immediately, she presented as a happy, energetic child who liked nothing better than playing and communicating with her peers and the adults around her. She did not develop speech but seemed to have good comprehension of spoken language. Cara lived at home with both parents who took a very active role in her personal, educational and communication development. From initial school assessment data, Cara was known to be bright and capable. She had a medical diagnosis of spastic cerebral palsy and a speech and language diagnosis of severe dysarthria. Cara was introduced to Blissymbols at 2 years of age and was still using Blissymbols when, some five years later, she was introduced to a communication device with speech output. Cara was able to move around using either a wheelchair or a rollator during her early school years. As she reached age seven, she primarily used her wheelchair – which by this time was a powered chair.

Blissymbols is a conceptually driven and stylized graphic system (see Figure 1). It has a finite number of elements that are combined to construct words and convey concepts (Bliss, 1965). It is a creative and flexible system that can support the generation of complex communication (McNaughton, 1993; McNaughton & Lindsay, 1995). Although it was one of the first symbol systems to be introduced to support children and adults with severe speech and physical impairments, in many countries it is no

longer used extensively. Throughout the UK and Ireland it has largely been replaced by more picture-based symbol systems in combination with voice output devices. Although Blissymbols were used in some early electronic devices with speech output (Hunnicut, 1984; Moffat & Jolleff, 1987), in the UK and Ireland this graphic system has almost without exception been used with manual communication boards. Cara's new voice-output device therefore came with a new graphic system (see below).

### INSERT FIGURE 1 ABOUT HERE

Having started very early with Blissymbols, by the age of seven Cara had already gained expertise in using a communication book with 500 Blissymbols, which were organized taxonomically. She was able to access the symbols directly by pointing using her right index finger. She could accurately point to squares that were 2cm x 2cm in size. She was also able to turn the pages of her book, although this was effortful, and could be somewhat inaccurate, so she preferred to access themes from the menu page and have her communication partner go to the section selected. The partner then went through each page in the section by asking Cara 'is it on this page' and so on until she could select the specific symbol. She presented herself as a confident, motivated and persistent communicator who was able to generate simple to complex communication messages as appropriate to the conversational context. Like many aided communicators, she needed active involvement from the communication partners to formulate her messages on the basis of her Blissymbol utterances and meaning negotiation. Changes in available communication aid technologies resulted in Cara being introduced to a device with voice output when she was seven years old. Cara and her family were particularly delighted by the prospect of using a voice output communication aid. The aid brought with it great excitement and anticipation that Cara would soon be a more independent communicator, entirely in charge of her own voice. Cara was the first child in the school to change to such a sophisticated system, and parents and professionals had great expectations and were eager to encourage her development. Although none of the people in her environment had previous knowledge of the technology, many of them viewed the new system as easier to use, primarily because the method of message transmission (voice output) was perceived as more normal and typical communication. No one was familiar with the differing demands of technology-mediated conversations. The staff anticipated that these non-optimal conditions might affect Cara's motivation to use the new communication aid, as well as other people's perception of her communication abilities, but there was an overwhelming sense in the environment that Cara's persistence and resilience would enable success.

### Changing language system

Cara's new communication device did not only imply the use of a new message form (speech rather than graphic symbols), but also a new graphic system, "Language, Learning and Living" (LLL; Jones, 1997). LLL is based on "semantic compaction" which is influenced by the multi-meaning Egyptian hieroglyphs (Baker, 1989). The meanings of the icons of the system are altered according to the icons associated with them, in any given sequence. In LLL, each icon or symbol on a display has multiple possible meanings. The specific meaning accessed depends on the choice of layer or "meaning frame" for interpretation of the icon. Each target selection requires specification of the semantic or syntactic class of the target, followed by specification of the specific exemplar within that class. For example, for the target utterance 'cat' the classifier is the first icon chosen ('animal' [zebra icon]) and the specifier is the second icon chosen, 'cat' [tiger icon], yielding a two-icon sequence, [zebra + tiger]. Similarly for the target utterance 'meat', the classifier icon is 'food' [apple icon] and the specifier icon is 'meat' [zebra icon]. The user has to learn the categories associated with each icon and then learn to sequence icons to generate particular words and phrases. Cara moved from using approximately 500 Blissymbols, which she had learned over many years and could combine to construct many more words, to a system with 128 icons with multiple layers of meaning. With LLL, a word was typically produced by sequencing two icons and Cara's device had a potential vocabulary of 10,000 words. Cara's conceptual, semantic and grammatical construction of

messages was thus affected by both the change in language representation system (from Blissymbols to LLL) and the mode of message transmission in the communication device. The LLL system implied new demands on Cara's cognitive skills, specifically visual and auditory attention and memory (cf., Carlesimo, Vicari, Albertoni, Turriziani, & Caltagirone, 2000).

Once the new communication aid arrived there was a period of transition from Blissymbols to LLL. Cara continued to use Blissymbols in most of her communications whilst being taught the locations of the different symbols in the device and the words that could be expressed with the new symbol system. Because artificial speech was thought to be easy for Cara to express, within two months the teachers had physically replaced the Blissymbols with LLL, even if Cara had not yet learned the equivalent vocabulary items on her new system and was not entirely familiar with key operational components of the technology. This rapid introduction brought some tension into the relationship between the parents, professionals and Cara, who had varying expectations of how quickly and smoothly the transition could and should occur.

### Learning to operate the electronic device

When Cara used her manual board, the Blissymbols were "read" and interpreted by the communication partners. It was thus the partners who formulated Cara's utterances. One important reason for choosing an electronic communication system was that Cara should gain independent control of the device by direct access to both the language system and the programming features. In addition, the mounting and positioning of the device were important in terms of the potential impact on her use of her powered wheelchair controls. The communication device she was introduced to, a Deltatalker, offered Cara a range of features in addition to voice output, including infrared environmental controls, computer keyboard emulation, and separate programming features. Cara used all 128 locations on the Deltatalker keyboard, but this challenged her independent mobility because it interfered with access to the wheelchair controls. Cara had difficulty maintaining an upright posture at the same time as making effective movements with her arms and hands. She accessed her powered chair joystick that was positioned on her right arm-rest, but to additionally re-position her trunk to access the 128 locations on her communication aid reduced the accuracy and speed of her independent communication efforts. These dual demands had implications for her conversations, as communication partners needed to become aware that Cara sometimes needed additional time to get into an effective communication position.

The new communication aid came with one wheelchair mounting system but Cara typically used a manual and powered chair during the school day and a different easy-chair at home. In two of these three chairs she had no means of placing her communication aid in an accessible position. It was the knowledge, enthusiasm and persistence of Cara's parents that resulted in her getting an additional mounting system that could be attached to her manual chair. This increased her communication opportunities even if it did not entirely solve the problem of not being able to communicate in every context.

Cara soon learned how to control basic operational features, e.g., switch on/off, speech on/off, volume control, and to select a spelling mode or a symbol communication mode on the device. What remained challenging for her was remembering all the symbol sequences and combinations that were needed to support effective communication. This resulted in frequent 'false starts' during symbol sequences and accidental word productions, which were perceived by people in the environment as Cara 'messing' and holding people up in conversations, or that she was not as linguistically able as they had originally thought. In fact, these early hiccups reflected Cara's efforts in learning to use the new system effectively. However, because the system was perceived by people in environment as easy to learn, as noted recurrently in team meetings, their attitudes and perceptions of Cara's communication and cognition changed and this negative interpretation proved to be difficult to counteract.

## Changes in perceptions and interaction patterns

When Cara got her electronic communication aid, she was perceived as a skilled communicator, using facial expression, vocalization, gesture and body posture to support conversational turns. Aided communication without speech output tends to be unobtrusive because the aided communicator typically must obtain the attention of the communication partner before starting to formulate messages. Many aided communicators depend on others for initiating communication and have limited experience with both initiating and terminating conversations (Kraat, 1987; Light, Arnold & Clarke, 2003). It was not easy for Cara to “take the floor”, and she had difficulties knowing how and when to join in a conversation. As she got older it became more apparent that her awareness of the rules of beginning and ending, or of breaking into an on-going conversation, was unclear. She was beginning to be perceived as rather egocentric and insensitive in her interactions. The introduction of voice output did not seem to change her pattern of social engagement. In fact, the new technology brought additional challenges. Accessing LLL in the communication aid was slower than with her Blissymbol communication system; Cara had to look longer at the device whilst constructing her message, thereby reducing her access to non-verbal cues. Moreover, interaction with Blissymbols maintained the attention of the partner, while the new system did not require the partner to co-construct. In fact, partners had to wait longer and often moved the conversation on while Cara was still constructing a message.

The operation of the new system implied a very different message construction process. Cara now had sole responsibility for message generation but it took time to change her long-established construction patterns. For example, although she knew the symbol sequences of simple sentences like *‘my turn now’*, she found it difficult to produce these three words without verbal acknowledgement from her communication partner following every word. She would often stop and look up at the partner after each word. The staff interpreted this use of an old strategy as an indication that she was not as able as previously thought. They expressed concern that she was unable to construct typical spoken utterances and may not have a grasp of English word order, rather than noting the fact that message construction naturally would reflect language experience. In effect, Cara was continuing to use the message co-construction pattern that she had used so effectively with Blissymbols.

The introduction of the electronic device with speech output meant that Cara was perceived and reacted to differently by her communication partners. Whilst using Blissymbols, she was perceived as an able communicator. The conflation between the linguistic and operational competences required for the two differing communication systems took some time for those working with Cara to recognize, and this delay had negative consequences for Cara. She recognized the staff’s frustration with her, but did not understand the source of their frustration, as she was only using strategies that had previously worked. Cara became more socially isolated and frustrated as messages were no longer timely and were perceived by others as slowing up the conversation. The communication partners became focused on her use of the device, as the synthesized speech output was the most salient of her expressive modes. In the beginning her use of the communication device was certainly not always the most effective or efficient means of communication, so, there was significant differences between the partners’ expectations of her communication with synthesized voice and her actual competence in using the device effectively. However, Cara may have been more communicatively strategic at this time than she was often given credit for by people in her environment. She continued to use her full repertoire of communication modes (e.g., vocalizations and gestures) and seemed to choose the mode that was most effective for her in specific situations. For example, when she knew that she had not learned, or did not know where to find a vocabulary item on her device, she would turn the machine off and rather effectively maneuver her conversational partner into a routine with yes/no questions. As her Blissboard had been taken away from her, this strategy was a rather successful alternative for her. However, this particular strategy caused a degree of consternation amongst staff who were concerned that the device had cost a considerable amount of money and that Cara seemed to be indicating that she did not want to use it. Both Cara and her parents

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reported that they found the pressure to perform and to succeed with the new device quite stressful. It also negatively influenced Cara's interest in others and her eagerness to communicate.

### **Intervention needs**

Any change of graphic system and communication device represents a huge effort for the user and hence should naturally be accompanied with major intervention measures. Cara received one intervention session per week to support her in aided communication. This allocation of time was typical of service provision at this time. However, a review of the possible influences on Cara's communication development effected a dramatic change in intervention. Cara said that she found the change from Blissymbols to voice output personally challenging. She moved from someone who communicated competently using a system that instantly established close interaction between her and her conversational partner, to someone who had sole control of her voice output system. She found the increased pressure on her to communicate with a less familiar language system socially isolating.

Due to a timely collaboration with a local university, the school was able to provide Cara with more dedicated intervention sessions. Two days every week a speech and language therapist with competence in aided communication offered her sessions related to vocabulary learning, conversations, and system operation. The therapist also gave her some classroom support and guided the staff and the parents in aided conversation strategies. Changes and developments were mapped and recorded in an accessible way, resulting in clearer understanding of the transition process. It soon became clear to everyone that both Cara and the staff needed time and instruction support. There was a positive change in attitudes and expectations, both in Cara and the staff. Cara became more enthusiastic about communication again and staff had realistic expectations of her interactions. She was once again in a position to make her own choice of communication strategies and priorities. She achieved the original goal of becoming a more independent communicator, able to produce sophisticated utterances. Speed of conversational turn was good for an electronic communication aid user but it remained slow and difficult for some of her communication partners to accept.

### **Further development**

Three years after initial introduction of the device, Cara and her parents were asked to consider a transfer to mainstream education. Cara was the first communication aid user in this education authority to be offered this option. She moved into a mainstream primary school over the following year, moving to full time attendance during the spring term. This was soon followed by a successful transition to a secondary high school. The inclusion team, based in the special school, continued to support the teaching staff in the new schools, including help with Cara's communication device. When Cara completed her high school examinations, she used her device as a keyboard emulator. At the time that this is written, Cara has commenced her second year of college. The speech output device, even if slow, is important for her study activities and social interaction with other students. She continues to find it physically and cognitively demanding to use the electronic device and therefore prefers multi-modal communication. She uses her communication device, a Liberator 14 with LLL, at college and mostly vocalization and gesture at home. The choices Cara has made regarding when and how she uses her different communication modes suggest she views them as equally important.

### **NIALL**

Niall was severely motor disabled from birth but showed good cognitive abilities and comprehension of spoken language. He did not produce speech himself and his first experiences with aided communication were when he was provided with a board with Blissymbols at the age of five. He quickly progressed from a small array of symbols to using a standard chart initially with 100 symbols and then by the age of eight to a chart of 250 symbols, which he accessed using finger pointing. By the time he was a teenager, he used a 400-symbol chart to communicate and was recognized by all communication partners as being



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an unusually persistent aided communicator and he demonstrated many meta-communicative insights. He was independently mobile in a powered wheelchair operated with joystick controls and accessed a computer using an expanded keyboard with keyguard for his school-work. Similar to many aided communicators, Niall's academic progress was constrained by his very slow progress in developing reading and spelling skills, and as he progressed across adolescence he became increasingly frustrated with the limitations this placed on him. Although he acquired a small sight vocabulary and developed some initial sound recognition skills, he rarely successfully incorporated these skills to support communication. Within the school context, he was considered to present with specific learning difficulties, and there was a general sense that he did not realize his potential academically. He did not complete any State examinations, although he acquired functional numeracy skills and became independent in many aspects of daily living. Niall's adolescence in the late 1980s coincided with a very significant global shift in technological developments across all domains, but particularly in computer technology and speech synthesis, and by association, electronic communication devices. Across his teenage years, he had several trial periods with electronic devices with speech output, but none of them was found to enhance his communication. As other aided communicators within his school setting acquired voice output devices, the pressure on him to achieve in this domain increased. Culturally, the importance of being an effective user of technology increased and so, although Niall's manual communication board had served him well for many years, its status gradually diminished relative to the emerging high-technology devices. Furthermore, there was a general sense among teachers and professionals that the power of technology was such that if it were not possible to find a device that could be used by a particular individual, somehow that represented a failure on the part of the individual rather than the technology. Thus, his failure to find a useful electronic communication aid increased the impact of his academic problems in school.

After leaving school as a young adult, Niall entered a residential setting for adults with physical disabilities. A new speech and language therapist joined the organization when Niall had lived there several years and she turned her attention to investigating the communication options that technology might have for Niall. He was not employed at that time and although there were some structured recreational activity options available to him, he expressed a desire to engage in more meaningful and rewarding activities. He was independently mobile, using a very old powered chair still with a joystick control and had a keen interest in getting out and about to immerse in the social world around him. He also had a manual chair with a seating insert as a back-up seating option, but he rarely used this chair, as it removed his independence in navigating his environment. At around the same time, Niall started to develop a keen interest in music composition and formed a close working relationship with a musician interested in computer applications for music. He accessed his computer using two switches, accessed with both hands. This newfound interest in technology reinvigorated his desire to gain voice output. A team assessment led to a recommendation and acquisition of a Tellus, an electronic device using MindExpress software, which enabled him to continue using Blissymbols to produce synthetic speech output. However, very little support in learning how to use the device was made available to him. Approximately three years after this device had been purchased, Niall had only minimal experience using it in very structured context-dependent situations, and so he was referred to a university speech and language therapy clinic to get additional support for 'introduction' of his device. Over the course of the following year, Niall attended the university clinic one hour a week to gain skills in using his device. He also participated in a number of interviews about his attitudes to and experiences of aided communication. Excerpts from some of these interviews are interspersed in the discussion below. Around the same time as he started to attend the university clinic, he was seen for a review of his seating at a specialist centre. A new powered chair, still with joystick controls was recommended. One of the advantages of the new powered chair was that it had the potential for mounting his voice output device directly, a factor that was seen to be of crucial importance.

## Niall's use of manual and electronic communication aids

When first seen in the university clinic, Niall impressed as a very competent Blissymbol communicator. He was still using the same 400-symbol board that he had left school with, even though many of the symbols were difficult to identify, due to the many years' of use. He pointed with his fingers to the 2cm x 2cm symbols, accessing the full display of 400 symbols. Niall could express a wide range of communicative functions and was a very active contributor in conversations, belying the frequent descriptions of conversational passivity of aided communicators (e.g., Basil, 1992; Harris, 1982; Hjelmquist & Dahlgren Sandberg, 1996; Iacono, 2003). He monitored communication partners' comprehension of his symbol use, and readily recognized and repaired communication breakdown. However, he found it difficult to communicate specific information, such as his address, destination or personal names, talking about these tasks as *HARD, TOO MUCH DIFFICULT*<sup>1</sup>. Although his vocalizations were limited to vowel-like utterances, with no intelligible words, he was extremely effective at using these vocalizations and sweeping gestures of his arms to gain attention from potential communication partners. Once attention was established, he formulated his message on the communication board, often embellishing these utterances with facial expression and vocalization to modulate the emotional tone of the utterance. He drew heavily on the strategies intrinsic to his graphic system, for example expanding his available vocabulary by using Blissymbols such as *SIMILAR-MEANING*, *OPPOSITE-MEANING* and *COMBINE-MEANING* though rarely using letter cues.

Niall had a strong knowledge of the Blissymbol system and his understanding of spoken language was adequate to support all types of conversations. He produced quite long symbol utterances to express himself, with a word order that usually reflected aided production processes and hence differed from the word order of the spoken language. The following history, produced as a sequence of symbols without partner interruption, is typical of his utterances:

*ONE DAY I HE I WAS GO DOWN TRAIN PLACE  
PERSON NOT KNOW WHAT I GO ON WHAT TRY TO SAY  
I WAS LUCKY NUMBER TELEPHONE TO STICK ON PAGE ON  
WHEELCHAIR  
THEY DID MAKE BIG THING  
THEY NOT KNOW WHAT NUMBER TELEPHONE  
MOTHER WAS ANGRY ME.*

The story is about a time he had gone to the train station to get a train home and had been unable to communicate his desired destination to the ticket master. Fortunately, his home telephone number was on the arm of his wheelchair and so the ticket master phoned to check what station he needed. Because of his skills in producing narratives such as this example, Niall was regarded as a sophisticated and competent aided communicator, and his language competence was seen as one of his key assets. This competence had strongly influenced the choice of electronic device, as it was seen as essential to maintain the same symbol system in order to minimize the new learning needed, thus focusing new skill development in the domain of operational competence.

Aided communication places challenges not only on the aided communicator, but also requires different skills of the conversational partners than natural speech communication. In the interviews, Niall demonstrated an insight into the situation of his partners. He empathized with the challenges aided communication posed for them, saying *IF I HAVE NOT WORD IT PAIN FOR THEM ME FEEL SORRY FOR THEM*. He especially mentioned the strain of the slow rate of communication, saying *DIFFICULT*

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<sup>1</sup> In line with current notation, graphic utterances are written in capital italicized letters (see von Tetzchner & Martinsen, 2000).

*FOR THEM I FEEL THEY PUT OUT.* Niall appeared to be acutely aware of the image he projected of himself when using the communication board. During conversations, he often mentioned the limitations of graphic symbols without voice output. For example, when explaining the difficulties of using his board, Niall acknowledged its value by saying: *I NEED GET TELL THINGS*, but added *CAN BE DIFFICULT TIMES*. He commented that in shopping centers in particular, staff did not have time for him at the till: *THEY CAN NOT STOP. ME COME UP DESK. THEY QUICK. I NEED QUICK.*

Niall frequently referenced his need to have access to speech, for example communicating *I NEED MAKE "speech"* (gestures to mouth). When asked why he wanted voice output, Niall responded *QUICK, SAY QUICK*, indicating a belief that voice output would reduce the time pressure that was typical of his aided interactions. He also recognized the potential of voice output for distance communication and for interacting with those who could not read his symbols: *IF PERSON CAN NOT COME UP FOR READ*. On the other hand, he could identify many activities and interactions where his board was effective, including familiar, communicative predictable situations such as going to a tea-shop where he was known, chatting with friends, and communicating with his mother.

Being able to convey competence to people, particularly people who did not know him, appeared to be very important to him. In his view, using a communication aid with voice output would help people to see that he was a competent individual *BECAUSE THEY CAN SEE PERSON IN BODY*. He expected that having voice output would reveal an image of him as someone who could contribute: *MACHINE MAKE MORE PEOPLE LEARN FROM ME YES BUT NOT THINK THINK ABOUT WHEELCHAIR*. He was anxious to have an opportunity to enter conversations from a position of equality and even authority, and not always as someone who needed help, or who was intimidating. He said his communication board made him less approachable to unfamiliar people *BECAUSE THEY AFRAID TO WHEELCHAIR*.

Thus, what Niall really wanted was conversation in all possible forms. However, he had few conversational opportunities and so tended to make the most of any opportunities that came his way. In common with many individuals who use aided communication, his social networks were small, his opportunities for meaningful and satisfying interactions limited, and his opportunities to develop relationships were constrained. In conversations, he tended to dominate, focusing on topics driven by his own interests and needs, tending to show little interest in what others wanted to say. His strong motivation to express himself was reflected in the demands he placed on students and staff working with him in the university clinic. For a period he had a weekly appointment of one hour working with students and a supervisor, but he frequently arrived up to 90 minutes early for sessions, telling the students that he wanted to start work. The questions of time-keeping and the commitments of all involved in the intervention were discussed extensively by the supervisor and the students with Niall, and he was provided with different types of schedule reminders, alarms and time prompts to help him plan his time-keeping more effectively, but with only limited success. Clearly, his motivation to participate in the intervention outweighed the inconvenience of waiting for long periods of time on a weekly basis. Niall also resisted terminating discussions, so that sessions often over-ran by up to an hour as the students and the supervisor tried to gently guide him towards the exit. While they recognized his need for support, they also had to make him aware of the need to keep time and respect partner signals in relation to conversation termination. At times, the only effective solution seemed to them to be to close his communication board or turn off the device, a strategy that was clearly not acceptable.

However, the result of Niall's communicative motivation and persistence was not more conversation time, but rather that many potential communication partners avoided interacting with him, or limited their interactions to conversations 'on the fly'. Niall complained that the staff where he lived *HEAR WHAT I NEED SAY BUT THEY PLAY PLAY UP ON ME*. Their reactions frustrated him: *I GET ANGRY BECAUSE THEY NOT TALK*, although he also recognized: *THEY NOT STOP BECAUSE THEY HAVE NOT TIME*. His awareness of the time it took for him to say something and the strain this put on the conversational partners seemed to drive his conviction that access to a voice output device would resolve many of his difficulties in conversations. He struggled to understand the tensions his conversational style

created for speaking partners, and showed little insight into the fact that increasing his rate of communication would not alone be sufficient in resolving these difficulties. His understanding of time pressure also reflected his experiences and the attitudes, perceptions and understanding of staff in relation to Niall's communication needs.

### The challenges of the new device

Despite the retention of Blissymbols in Niall's new device, access to the symbols differed significantly from his communication board and the device was also more difficult to manage physically. Niall accessed his Blissboard using finger pointing. He could quickly locate symbols and give the listener his full attention during communication interactions. His pointing was often ambiguous, as he was not always able to isolate one finger, but he readily perceived and corrected the partners' misinterpretations. His old and rather battered Blissboard was stored either under the seat or at the side of his power chair, and he could extract it independently or indicate to the other person that he needed it. With the board placed on the arms of his chair, he could access the full board, although he relied on his communication partner to stabilize it as he selected symbols. Thus, he used his manual communication aid with great skill.

The use of the electronic communication aid required new skills and abilities. Niall was used to a board where all his 400 Blissymbols were visible and in well-known positions, while the screen of the electronic device could display a maximum of 64 symbols and the symbols therefore had to be distributed over several pages. Niall thus had to switch from a static board to a dynamic vocabulary organization. He had to learn page navigation techniques and to remember the locations of "hidden" Blissymbols. The cognitive efforts involved in symbol memory and search seemed to leave fewer cognitive resources for message formulation and dialogue monitoring and participation (cf., Oxley, 2003).

Physical access to the device was also more problematic and effortful. While his finger pointing was adequate when using the manual board, his difficulties in isolating one finger for key pressing meant that associated movements of the other fingers often led to non-target symbol selections or multiple repetitions of the target symbol on the device. A keyguard had been attached to the device display, but the guard did not fully match any of the grids available in the software and the alignment of spaces and symbols within the grid was not optimal. Even with timing adjustment and the keyguard, Niall found it very difficult to directly access only one symbol on the display. Moreover, when he used the communication board, the communication partner could see the Blissymbols and Niall's movements and filter out potential ambiguities arising from his failure to isolate a single finger, while partner support for 'disambiguation' was not as easy with the electronic device. Both Niall and the partners were frequently frustrated and distracted by the intrusion of non-target symbols. Niall's physical abilities had not changed, but the demands and requirements of the new technology highlighted his difficulties, drawing attention to difficulties that had been less apparent when he used the manual communication board, and making him appear more disabled. Some of the people who knew him well perceived him as less competent than before and became concerned his abilities might have been over-estimated. Given these physical access difficulties, the option of using switches instead of direct selection with the electronic device was considered. When first assessed for an electronic aid, Niall had rejected switch access and there had been no follow-up to explore whether or not access had improved.

Part of the team's delay in reviewing switch access as an option arose from their uncertainty about his seating. When Niall first came to the university clinic, his preferred wheelchair was an old powered chair with joystick controls, but his electronic communication aid could not be mounted onto this chair. It could only be mounted on his manual chair. Having the device mounted in an optimal position increased Niall's accuracy in symbol selection, effectively making it necessary for him to choose between relatively adequate direct access to voice output and independent mobility. Although he had had the device for almost three years when first seen in the university clinic, he had not yet been provided with a communication aid mount that was compatible with his old powered chair, or given a new chair.

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Decisions about whether or not switch access would be more effective were postponed until after he received his new powered chair, as the new chair offered greater postural control and hence improved his hand function. Partly as a consequence of delays in resolving the seating and access issues, the voice output device had not become an integrated part of his communication. Niall used it mainly during intervention sessions in the university clinic or when the staff working with him brought it to him for a specific purpose. Thus, Niall's high level of aided communication competence when using his manual board contrasted sharply with the many difficulties he faced with the voice output device.

### Situational variation

One way for Niall to make the best of his different communication aids would have been to determine the most effective mode of aided communication for specific situations. In discussions about where he might use either his manual communication board or his electronic device, Niall did not identify any situation where his board might be more effective, despite his very limited experience of successful use of his voice output device compared with his many successful interactions using his board. His expectations were clearly that success in learning to use the electronic device would overcome the limitations he experienced in communication using his manual board. While his motivation and persistence were key factors in his success as an aided communicator, they also appeared to represent vulnerability. His motivation to succeed in using voice output was partly based on unrealistic expectations that having access to speech would solve the communicative challenges he faced with the manual board, despite the fact that in three years he had achieved very little success with the speech technology. His expectation was still that the voice output device would *HELP BIG FUTURE*, suggesting a remarkable persistence in his belief in technology, but also a limited insight into the nature of challenges to be overcome.

### Awareness of grammatical construction

When Niall used his manual board, he constructed Blissymbol utterances that his partner then interpreted in dialogue with him. Having voice output created a very different conversational structure and made him more aware of the difference between his own productions and natural speech. This contrast became apparent when he prepared a presentation for a meeting of the Irish Chapter of the International Society for Augmentative and Alternative Communication. For this event, he was determined to use his voice output, to speak for himself and have his own voice heard. In this respect, the electronic device provided a new dimension to his communication – an audible voice to tell his story. For the purpose of this presentation, he stored phrases and sentences under single symbols. Niall used his Blissboard to compose the speech, which was then programmed into the device by a helper. During these interactions, Niall selected sequences of symbols whose glosses were written down and entered into the device by the helper. However, when Niall heard the stored utterance that replicated his symbol output, he frequently indicated dissatisfaction with it and requested that it be changed to a more conventional spoken word order and grammar. The structure of his own collaborative language production only seemed to become apparent to him when he started using his voice output device. Being able to review and edit his utterances opened new opportunities for Niall to explicitly evaluate how his communication style and choice of language might impact on others' perceptions of his competence. While utterances with a different grammatical structure were natural in interactions where he used a manual board and the communication partner glossed his message, the opportunity to present his story in (synthetic) spoken utterances without any co-construction turns seemed to raise his awareness of aspects of form that were inconsequential in less formal situations.

### Support and intervention

One of the challenges for adults in Ireland who live in residential settings is the lack of access to services and supports. Many decisions about Niall's device access, mounting, transport and opportunities to

practice using the electronic communication aid were reliant on the voluntary support of others. The lack of structured services resulted in significant delays in many aspects of his development and significantly constrained Niall's progress in integrating voice output into his everyday communication. There was no key worker consistently available to advocate for him, and he had to address multiple service agencies to get attention to his different communication and mobility needs. There was little coordination across service agencies and often Niall had to coordinate the work across the agencies. These were barriers over which Niall had no effective control, despite the many resources he brought to the task. Another significant influence on Niall's development was his limited communicative access in his environment. There were few communication partners available to support his development of conversational skills. In interviews, Niall spoke of the significant time pressures on staff and others in his social world: *THEY NOT STOP BECAUSE THEY HAVE NOT TIME*. Even his close friends could not always take the time needed to talk with him: *TOO MUCH DO WORK*. His need simply to chat even took up most of the available intervention time, leaving little time for focusing on skills that might make him able to make greater use of the device.

Finally, major decisions about moving to more independent living accommodation came onto the agenda. Niall got the opportunity to move to a small house, several miles from his present residential setting. This move offered him far greater independence and autonomy, but also removed him further from even the limited structural communication supports available to him, including the university clinic. At the time of writing, Niall continues to use his manual board and has not yet integrated the electronic device and speech output into his communication. He has moved into independent living, the speech and language therapist working in the residential setting has left the service and has not been replaced, and Niall is no longer able to access the university clinic because of transport distance and costs. Not surprisingly, his motivation to persist in the face of such adversity appears to be waning, although he has recently expressed interest in attending the university clinic again, because he has received his new powered chair and it might be possible to mount the device directly onto this chair.

## **FUTURE DIRECTIONS**

It seems to be a basic premise implied in much of the literature on aided communication that electronic devices are more flexible, easier to operate and give the user more communicative autonomy and power than manual boards which depend more on active collaboration from the conversational partner. The histories of Cara and Niall presented here illustrate the complexity of the processes involved in transitions from manual communication boards to electronic devices with speech output. Both individuals were extremely motivated to use synthetic speech and both showed significant difficulties in acquiring the skills and strategies required by the electronic devices. For Cara the success of voice output was obvious and direct, although neither immediate nor pervasive. She slowly came to utilize the power of electronic navigation and synthetic speech, but still tended to use them only in more "formal" everyday situations, continuing to use the manual board with people she knew well. Niall used the voice output device to present a pre-prepared talk at a conference, but he never integrated the use of synthetic speech in his everyday communication.

It generally takes longer to produce an aided than a spoken utterance, sometimes several minutes to produce a single aided utterance (Kraat, 1987), contrasting with rates of articulated speech exceeding 100 words per minute (Kent, 1997). A manual board requires sustained attention and collaboration from the communication partner when the user is constructing messages. It is a characteristic of visual communication (such as graphic symbol use) that the conversational situation or joint engagement has to be established before communication is functional. Electronic devices may imply more assertive power for the user, new (synthetic) vocal means for taking the floor and more independence in constructing messages.

However, the partners had a more passive role when Cara and Niall were using electronic devices, and this shift seemed to make them more distant and less involved. Having less active engagement in the interaction also appeared to make them more aware of the slowness of aided communication. This change affected the closeness of the interaction, as experienced by both Cara and Niall. Access to speech synthesis thus brought with it new pressures for them both. People's expectations of what they should be able to achieve and what kinds of support they might need shifted. They were regarded as very competent communicators and therefore not in need of any language or social learning when they got the electronic device, only some initial help with the operational skills. While Blissymbols usually are regarded as 'difficult' and needing to be taught and scaffolded, learning to use a device with speech output is typically perceived as 'easy' by natural speakers (Smith, 2008). Significant people in Cara's environment expected her to immediately communicate more quickly and effectively with the electronic device than with her manual board, even though she was less familiar with all aspects of her new system. Her pioneering status in relation to voice output technology in her setting seemingly made people in the environment place a heavy burden of expectation on her, showing little awareness of the complexity of the task she was undertaking. The changes in interaction style arising from her access to a voice challenged the expectations of her communication partners often with uncomfortable results, while at the same time new expectations of how she should interact were not explicitly explored. For Niall, the struggle to become an effective device user led to a less favourable impression of his abilities for people who knew him well. He never reached a sufficient stage of competence with the electronic device to challenge these perceptions of his interaction style. It was clear that his own expectations of the voice output device also were very high, and likely unrealistic. However, these high expectations no doubt contributed to his motivation and persistence over a prolonged period of time, in the face of considerable barriers to success.

It is a common finding that the provision of new electronic devices does not always come with the understanding that is necessary for successful implementation and realization of the power of the technology. As pointed out by another aided speaker: "Technology is awesome, but it doesn't solve everything" (Lund, 2001, p. 108). The experiences of Cara and Niall disclose a very real reason for concern that failure of technology to solve all the problems of an aided communicator and make his or her communication more normal may be attributed to the user instead of the technological development and implementation – both by parents and professionals, and by the users themselves.

Electronic devices sometimes have to be bulky and heavy in order to function properly, often impacting on the user's access both to the communication device and to other devices. Both Niall and Cara faced challenges in marrying mobility and communication access. Cara was fortunate in facing these challenges in a context where she received help with seating, mounting and access. For Niall, the challenges were far greater because support became limited once he left pediatric services. Niall's experiences are not unique and several studies have reported similar findings (Forster & Iacono, 2007; Hamm & Mirenda, 2006; Murphy, Marková, Collins, & Moodie, 1996; Smith & Connolly, 2008). These reports highlight the need for services that span the lifetime of individuals who use aided communication. Even for Cara, however, the challenges were significant. People who use a number of different wheelchairs are often faced with difficult choices about mounting systems and limited resources and funding agency constraints may force users to make decisions that essentially revolve about where communication is most likely to be a priority over independent mobility, choices that are never a source of concern for natural speakers.

The field of aided communication has to a large extent been driven by technological optimism and an idolization of what technology can achieve in overcoming physical and cognitive impairments (Vanderheiden, 2002). Although communication boards and manual signs had been used with people with impairments of speech, language and cognition for many years, research in aided communication only emerged in the middle of the 1980s when personal computers and electronic communication devices became commercially available (Kiernan, Reid, & Jones, 1982; von Tetzchner & Jensen, 1996). Given the technological advances in the last 20 years, it should seem that it has never been easier for individuals

with severe speech impairments to become equal partners in their community. Technology is seen as enabling community participation fitting a general increasing emphasis on the inclusion of people with disability in everyday experiences. However, the histories of Cara and Niall show that communication partners may have unrealistic expectations about how technology may provide participation possibilities, seemingly reflecting a naïve location-focused view of participation and a confounding of physical access with communicative access. Greater physical independence in utterance construction will not always alter the quality of the contribution of people using aided communication within their communities.

For both Cara and Niall, access to voice output brought new opportunities to assert and develop independence. The transition towards greater independence involved a complex evolutionary process for Cara, from a familiar interdependent style of interaction where she was both comfortable and confident, towards a more autonomous but also more unfamiliar role. Initial assumptions were that her speech synthesis would allow her to progress from interdependence to independence in her interactions, whereas in reality, what she needed initially at least was a different type of inter-dependence, one that scaffolded her communication attempts with the same level of supports as were available to her when she used her manual board. The initial delay by professionals in initiating these scaffolds had the effect of increasing her isolation, rather than fostering independence.

Niall expressed independence in all aspects of daily life as a key personal goal. Although he did not achieve this independence directly through significant success in using voice output, engaging in the process of attempting to become more competent using his device still seemed to promote a perception of him as an independent adult. He appeared keenly aware of his isolation and lack of opportunities for communication, including everyday small talk. In reality he changed his focus from trying to achieve more communicative access to trying to increase his autonomy, so that he could independently tackle that isolation. The role of his speech synthesis in that process was largely indirect, but powerful nonetheless. The extent to which Niall's newfound independence will yield genuine participation rather than a new form of isolation within a new community remains to be seen. In the interviews, he often mentioned his desire to be seen as an active agent and a contributing and valuable member of society, rather than as an object of help. Niall clearly viewed the ability to express himself with own voice as central to presenting his independence in such a way as to allow him to assume a role of contributor rather than recipient of support. Attitudes and expectations can thus act as both facilitators and barriers to effective integration of electronic devices into an individual's everyday communication.

In studies, many aided communicators have reported a sense of being an outsider, looking in on their community, while aspiring to authentic roles within and of the communities in which they resided. In interviews they have spoken of their experiences of physical access and presence, but not always communicative access and inclusion; it was not *where*, but *how* they participated that mattered (e.g., Milner & Kelly, 2009). Only through rewarding social interactions between disabled and non-disabled individuals can there be a genuine change in acceptance and involvement in a community (Bunning & Horton, 2007).

The ultimate feeling of *belonging* to a community is complex and for people using communication aids this authentic inclusion may require much professional time and support, over a more extended period of time than has been generally acknowledged. A significant difference between disabled and non-disabled people seems to lie in the different possibilities they are given for developing new skills in response to technological development at an adult age. For most adults without physical disabilities, technological innovations within the workplace that imply new skills automatically lead to new training opportunities, help and support at work, and/or the provision of publicly accessible skill development courses. For many people with disabilities, new technological developments may in fact be decisive for their everyday life. However, the new technologies are expected to give people with disabilities immediate benefits, while as demonstrated by Cara and Niall, keeping up with technology may be a life-span struggle.



Finally, the histories outlined highlight the importance of the resources individuals who use aided communication bring to the challenge of incorporating voice output systems into their communication repertoire. Cara and Niall's own resilience, motivation, persistence and willingness to take risks were extremely important in fostering communicative success. By themselves however, these resources are insufficient, if there are significant barriers to be overcome. One of the core differences between Niall's and Cara's situation was the lack of a key communication support partner for Niall, to support his development towards competence using a voice output device.

## CONCLUSIONS

The histories of Cara and Niall demonstrate that transitioning to competent use of a voice output device may be a bumpy road to an uncertain destination. The journey is often lonely in spite of the fact that users are likely to traverse unknown territory and engage in new forms of communicative interaction. Sometimes the journey and what the user and significant people in the environment learn along the way is more important than arriving somewhere. However, it is also clear that if an aided communicator undertakes the journey alone, with few supports and little understanding of key communication partners of the journey, then the aided communicator is likely to arrive at the same place he or she started, possibly facing both the old and new challenges and barriers. For both Cara and Niall, the theme of time emerged as a core concern – time to simply chat, to fulfill all the common goals of communication.

In both of their stories, people in the environment placed great emphasis and expectation upon equipment, and for both Cara and Niall this emphasis resulted in an unhelpful and superficial focus. They wanted to be valuable and valued members of their talking, listening and acting communities, but their technology was initially a barrier to that fundamental urge towards social identity and belonging. There is a real danger that until professionals utilize what is best about technology by recognizing that it can create as well as break down barriers to participation, they will become surprised again and again when competent aided communicators using manual boards become disempowered by their technology and the expectations of the community. Real community inclusion requires far more than more or less advanced technological solutions. Speech synthesis technology cannot, of itself, generate a new social identity or ensure reciprocity in communication and relationships for people who develop aided communication. Nonetheless, it is important to recognize the positive role that technology can play in allowing individuals to take advantage of new opportunities to participate, to develop their social identity and to experience being valued in a community. In spite of the fact that participation in conversations is the explicit goal of the provision of electronic communication aids to people with speech and language impairments, there is still a great need for research that can provide practitioners with the knowledge they need for scaffolding the development of aided communication with electronic means.

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Figure 1. Examples of Blissymbols.

mouth	drink	(to) laugh
		
(to) say	happy	sad
		
clothing	trousers	upset
